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OR, A

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# ENCYCLOPÆDIA BRITANNICA.

ELECTRICITY, Medical. See Materia Medica.

ELECTRIDES, anciently islands in the Adriatic sea, which received their name from the quantity of amber (*electrum*) which they produced. They were at the mouth of the Po, according to Apollonius of Rhodes; but some historians doubt of their existence.

ELECTROMETER. In various parts of the article Electricity, we have described a great variety of instruments for ascertaining the presence of electricity, and measuring its quantity or proportion.

But there are several instruments of this kind that have not been described in that article; and as they are well deserving a place in this work, either from the ingenuity of their construction, the reputation of their inventors, or the intrinsic value of the instruments themselves, we shall give an account of them here.

Plate CC. Fig. 1.

Fig. 1. Plate CC. is a geometrical representation of Mr Cavallo's improved atmospherical electrometer, of half its real size. The principal part of this instrument is a glass tube CDMN, cemented at the bottom into the wooden piece AB, by which part the instrument is to be held when used for the atmosphere; and it also serves to screw the instrument into its wooden case ABO, fig. 2. when it is not to be used. The upper part of the tube CDMN, is shaped tapering to a smaller extremity, which is entirely covered with sealing-wax, melted by heat, and not dissolved in spirits. Into this tapering part a small tube is cemented, the lower extremity G of which being also covered with sealing-wax, projects a short way within the tube CDMN. Into this smaller tube a wire is cemented, which with its lower extremity touches the flat piece of ivory H, fastened to the tube by means of cork; the upper extremity of the wire projects about a quarter of an inch above the tube, and screws into the brass cap EF, which is open at the bottom, and serves to defend the waxed part of the instrument from the rain, &c. In fig. 3. a section of this brass cap is represented, in order to show its internal shape, and the manner in which it is screwed to the wire, projecting above the tube L. The small tube L, and the upper extremity of the large tube CDMN, appear like one continued piece, on account of the sealing-wax, which covers them both. The conical corks P of this electrometer, which by their repulsion show the electricity, &c. are as small as can conveniently be made, and they are suspended by exceeding fine silver wires. These wires are shaped in a ring at the top, by which they hang very loosely on the flat piece of ivory H, which has two holes for that purpose. By this method of suspension, which is applicable to every sort of electrometer, the friction is lessened almost to nothing, and thence the instrument is sensible of a very small degree of electricity. IM, and KN, are two narrow slips of tin-foil, stuck to the inside of the glass CDMN, and communicating with the wooden bottom AB; they serve to convey off that electricity, which, when the corks touch the glass, is communicated to it, and being accumulated, might disturb the free motion of the corks.

Fig. 2.

Fig. 3.

In regard to its use, this instrument may serve to observe the artificial, as well as the atmospherical electricity. When it is to be used for artificial electricity, this electrometer is set upon a table or other convenient support; then it is electrified by touching the brass cap EF with an electrified body, which electricity will sometimes be preserved for more than an hour. Mr Cavallo had one of these electrometers which would remain electrical for more than twelve hours, though in a room without a fire. If in an electrified state, any electrified substance be brought near the cap EF, the corks of the electrometer, by their converging, or by increasing their divergency, will shew the species of that body's electricity.

It is necessary to remark, that to communicate any electricity to this electrometer, by means of an excited electric, e. g. a piece of sealing-wax, (which we suppose is always negatively electrified), is not very readily done in the usual manner, on account of the cap EF being well rounded, and free from points or sharp edges. By the approach of the wax, the electrometer will be caused to diverge; but as soon as the wax is removed, the wires immediately collapse. The best method to electrify it, is to bring the excited wax so near the cap, that one or both the corks may touch the side of the bottle CDM; after which, they will soon collapse and appear unelectrified: if now the wax be moved, they will again diverge, and remain electrified positively.

When this instrument is to be used to try the electricity of the fogs, the air, the clouds, &c. the observer is to do nothing more than to unscrew it from its case, and, holding it by the bottom AB, to present it to the open

open air, a little above his head, so that he may conveniently see the corks P, which will immediately diverge if there be any sufficient quantity of electricity; whose nature, i. e. whether positive or negative, may be ascertained by bringing an excited piece of sealing-wax, or other electric, towards the brass cap EF.

It is perhaps unnecessary to remark, that this observation must be made in an open place, as the roads out of town, the fields, the top of a house, &c.

The principal advantages of this electrometer, as stated by Mr Cavallo, are as follows.

1. The smallness of its size. Mr Cavallo made one so small, that its case, which was of brass, measured only three inches and a half in length, and nine-tenths of an inch in diameter, and yet it acted perfectly well.

2. Its being always ready for experiments, without fear of entangling the threads, or having an equivocal result by the sluggishness of its motion.

3. Its not being disturbed by wind or rain.

4. Its great sensibility; and,

5. Its keeping the communicated electricity longer than any other electrometer.

Fig. 4.

II. *Saussure's* ELECTROMETER. M. de Saussure's electrometer, with which he made the observations on atmospherical electricity that have been related in the second chapter of Part V. of the article ELECTRICITY, and represented at fig. 4. is much the same with that of Mr Cavallo above described. The following are the most material circumstances in which they differ: First, the fine wires, by which the balls are suspended, should not be long enough to reach the tinfoil which is pasted on the inside of the glass, because the electricity, when strong, will cause them to touch this tin-foil twice consecutively, and thus deprive them in a moment of their electricity. To prevent this defect, and yet give them a sufficient degree of motion, it is necessary to use larger glasses than those that are generally applied to Mr Cavallo's electrometer; two or three inches in diameter will be found to answer the purpose very well. But as it is necessary to carry off the electricity which may be communicated to the inside of the glass, and thus be confounded with that which belongs to those substances that are under examination; four pieces of tin-foil should be pasted on the inside of the glass; the balls should not be more than one-twentieth of an inch diameter, suspended by silver wires, moving freely in holes nicely rounded. The bottom of the electrometer should be of metal; for this renders it more easy to deprive it of any acquired electricity, by touching the bottom and top at the same time.

Fig. 4. & 5.

In order to collect a great quantity of electricity from the air, the electrometer is furnished with a pointed wire, 15 inches or two feet long, which unscrews in three or four pieces, to render the instrument more portable; see fig. 4. When it rains or snows, the small parapluie, fig. 5. is to be screwed on the top of the instrument, as by this its insulation is preserved, notwithstanding the rain.

This instrument indicates not only the electricity of fogs, but that also of serene weather, and enables us to discover the kind of electricity which reigns in the atmosphere; and to a certain degree to form an estimate of its quantity, and that under two different points of view, the degree of intensity, and the distance from the earth at which it first begins to be sensible.

A conductor raised for the purpose of making observation on atmospherical electricity will be found to exhibit signs of electricity, only when the electric fluid is more or less condensed in the air, than in the earth. Though the air resists the passage of the electric fluid, it is not absolutely impermeable to it; it suffers it to pass gradually, and generally with more ease in proportion as its mass or thickness is less. It is therefore interesting to discover at what height it is necessary to be elevated, in order to find a sensible difference between the electricity of the earth, and that of the air. A very sensible difference may be generally discovered by this instrument, at the distance of four or five feet from the ground; sometimes it may be seen if the instrument is placed even on the ground; while at others, it must be raised seven or more feet before the balls will open; sometimes, though seldom, this height is not sufficient. This distance is generally greatest when the electricity is strongest, though necessarily modified by a variety of circumstances, some of which are known, as the degree of dryness or humidity of the air, and others are unknown.

The degree of intensity, at a given height, may be discovered thus; raise the electrometer, and judge by the divisions which are placed on the edge of it, the degree of their divergence. To find the relation between this degree of divergence, and the force of the electricity, M. de Saussure took the following method: As he could not with certainty double or triple a given quantity of electricity; yet as a given force may be reduced one half, a fourth or eighth, &c. by dividing between two equal and similar bodies, the electricity contained in one; he took two of his unarmed electrometers, which were as similar as possible, and electrified one of them, so that the balls separated precisely six lines; he then touched the top thereof by the top of that which was not electrified; in an instant the electricity was equally divided between them, as was evident by the divergence of the balls, which was four lines in each; consequently a diminution of half the density had only lessened the divergence one-third. One of these electrometers was then deprived of its electricity, and was afterwards brought in contact with the other as before; the remaining electricity divided itself again between them, and the balls fell from four to twenty-eight lines, nearly in the same proportion as before; in the third operation they fell to nineteen; in the fourth to one, where he was obliged to stop, as there was not now sufficient force in the fluid to pass from one electrometer to the other, and distribute itself uniformly between them. The same experiment, repeated several times, gave very nearly the same results. Negative electricity decreased also in the same proportion as the positive. The following table may therefore be considered as giving a general, though not exact idea of the increase in force, which corresponds to different degrees of divergence in the balls; it is only calculated to every fourth of a line; the force of electricity is always expressed by whole numbers, as it would be ridiculous to put a greater degree of exactness in the numbers than is to be found in the experiments which form the bases of the calculation.

Distance

Electrometer.

| Distance of the balls in fourths of a line. | Corresponding forces of electricity. |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| 4 | 4 |
| 5 | 5 |
| 6 | 6 |
| 7 | 8 |
| 8 | 10 |
| 9 | 12 |
| 10 | 14 |
| 11 | 17 |
| 12 | 20 |
| 13 | 23 |
| 14 | 26 |
| 15 | 29 |
| 16 | 32 |
| 17 | 36 |
| 18 | 40 |
| 19 | 44 |
| 20 | 48 |
| 21 | 52 |
| 22 | 56 |
| 23 | 60 |
| 24 | 64 |

Those who are desirous to carry this measure of the electric force farther, may do it by having similar electrometers constructed, but made upon a larger scale, and with heavier balls, which would only separate one line, with the degree of electricity that makes the smaller ones diverge six lines; these would consequently measure a force 1024 times greater than that which forms the unity of the preceding table; and thus by degrees we may be enabled to discover the ratio of the strongest discharge of a great battery, or perhaps even of thunder itself, to that of a piece of amber, which only attracts a bit of straw or any other light substance.

In order to observe the electricity of the atmosphere with this instrument, we must first bring the electric fluid contained in the electrometer to the same degree of density with that at the surface of the earth; this is easily done by letting the bottom and top touch the ground at the same time; then raise the point, keeping the bottom still in contact with the ground, from whence it may be lifted up in a vertical position till the balls are level with the eye.

The second circumstance is to render the divergence of the balls, which is occasioned by the electricity of the air, permanent. This is effected by touching the top of the electrometer with the finger; but here the acquired electricity becomes contrary to that of the body by which they are electrified. Let us suppose, for example, that the electrometer is at five feet from the ground, and the balls diverging; touch the top of the electrometer with the finger, and the balls will close; but they will again open, if the electrometer is withdrawn from the influence of the electricity of the air, by being brought nearer the ground, or into the house. M. Saussure only employed this method when the electricity was so weak that he could not perceive any until the electrometer was raised considerably above his eye: as in this case he could not perceive the divergence of the balls, he always endeavoured to obtain a permanent electricity in the foregoing manner.

Electrometer.

The following example will render the use of the foregoing observations more familiar. Choose an open situation free from trees and houses, screw the conductor on the top of the electrometer, lay hold of it by its base, and place it so that the base and conductor may touch the ground at the same time; then elevate it to the height of the eye, and observe the quantity of lines, or fourths of a line, that the balls have diverged; now lower it till the balls almost touch each other, and observe at what distance the top of the conductor is from the ground; and this is the height from the ground at which the electricity of the air begins to be sensible. If the electricity of the air is sufficiently strong to make the balls diverge when it stands upon the ground, one of the lengths of the electrometer must be unscrewed from it. If the balls, however, still diverge, the other parts of the conductor should also be unscrewed, and you may mark down, that the electricity is sensible at zero, or on the surface of the earth. If, on the contrary, the electricity is so weak, as not to cause the balls to diverge when they are even with the eye, and consequently when the conductor is two feet higher, or seven feet from the ground, you should then raise it a foot higher; while it is thus elevated, touch the top with the other hand; when this hand is taken away, lower the electrometer, and if it is electrified, you may say the electricity is sensible at eight feet; if it is not, raise it as high as the arm can reach, and repeat the same operation; if any electricity is found, write down electricity sensible at nine feet; if not, mark 0, or, no electricity relative to this instrument, and this mode of employing it; for signs of electricity may still be obtained, by throwing a metallic ball 50 or 60 feet into the air, which is at the same time connected with the electrometer by a metallic thread.

One advantage of this instrument is, that it will often exhibit signs of electricity when none can be obtained from a conductor of 100 feet in height, because it can more easily be preserved from humidity, &c. which will destroy the insulation of the large conductors.

This electrometer may be used instead of the condenser of M. Volta, by only placing it on a piece of oiled silk, somewhat larger than the base of the instrument; but in this case, it is the base, and not the top of the instrument, which must be brought into contact with the substance whose electricity is to be explored.

It is easy to discover also by this instrument, the electricity of any substance, as of cloths, hair of different animals, &c. For this purpose, it must be held by the base, and the substance rubbed briskly (only once) by the ball of the electrometer; the kind of electricity may be ascertained in the usual manner. It is proper, however, to observe here, that as the top of the electrometer acts in this case as an insulated rubber, the electricity it acquires is always contrary to that of the rubbed body.

III. *Cadet's* **ELECTROMETER**, is thus described by the author, as translated in Nicholson's Journal.

Fig. 6.

Fig. 6. In a glass tube A, 18 or 20 inches long, is inclosed another shorter tube X, sealed at both ends. This tube contains a graduated scale: one of the ends of these two tubes is cemented in a handle of turned wood,

wood, C, by which it is held in the hand; the other end is closed by a brass cap, D; the distance between the extremities of the small tube and that of the large one is filled with red wax, B, B; on the cap D is screwed at pleasure, either a ring E, or a brass hook F. The ring is used for applying the instrument to the ball of a conductor, and the hook when it is hung to a ring: on the cap D is a brass stem G, terminating by a knob. This stem is bended, and the extremity of its knob must be directly beneath the line with which the graduated scale of the small tube commences.

Round the large tube is a brass ring H, half of which extends to the length of twelve or fifteen lines in the form of a half tube P, applied against the sides of the tube. This gutter serves to mark the degrees, by sliding along the graduated scale by means of a button beneath I. On the ring H is fixed one of the small electrometers invented by Saussure, K, K, which is surmounted by a stem V, on which stem is fixed at pleasure either a point L, or a ball M, of the same size as that which terminates the stem G, opposite which it is placed. The extremity of this point or ball must be placed immediately over the extremity of the half tube or scale P, and horizontally to the centre of the ball, which terminates the stem G.

At the top of Saussure's electrometer is a small ring N, which serves to connect it with the chain Z when required.

To explain the use of this instrument by a single experiment, charge a Leyden jar, till the spontaneous overflowing announces it to be saturated. Then place the ring E on the knob of this bottle, and cause the electrometer of Saussure, armed with its point, to slide towards it. Observe the degree at which the divergence of the thread stream commences, and at that instant suppress the point, and adapt in its place the ball M. Continue to advance the electrometer of Saussure till the electric pressure of the atmosphere in the jar causes the threads to diverge; again observe the degrees, replace the point L, and close the shutters of the room; then continue to advance the electrometer till the luminous point appears, which again affords new degrees. Lastly, replace the ball M, and fix the chain Z to the small ring N: cause it to communicate with the exterior coating of the jar, and advance the electrometer till the explosion takes place. Then comparing the different degrees, we may ascertain the comparative difference between the respective methods.

As soon as these relative proportions have been once accurately ascertained by attentive observations, one of those methods alone will be sufficient for measuring the intensity of electricity; and, in fact, if the body intended to be submitted to examination be little charged with the electric fluid, the diverging of the threads, by means of the point, will fix the limits of the electric atmosphere: if it be more, the pressure of the atmosphere on the ball M, which is substituted for the point, will indicate this quantity. In short, if the body be loaded with a considerable mass of electric matter, it will be shown by the luminous point. If a Leyden jar, instead of being positively, is negatively electrified, the point indicates it at the same time that it measures the electric atmosphere, for instead of a luminous point, a star will be observed upon the ball of the jar, and another at the end of the point.

Let us now apply this electrometer to useful observations.

In order to connect the idea of a determinate quantity of fluid to each degree of the electrometer, it is necessary to compare these degrees with the known quantities. Suppose for instance we have a jar, the coating of which is six inches square; electrify it till a spontaneous discharge takes place, and remark, by means of Henley's electrometer, at what degree this discharge is effected. Again, electrify the jar, till it is nearly saturated, and measuring with this electrometer, observe, that the luminous point appears for instance at two degrees; then say, that when the electrometer, applied to an electrified body, marks two degrees, the body contains six inches square of electricity. Repeat this experiment with a plate of glass, the coating of which is seven, eight, ten, or twelve square inches, and we may form a scale of proportion, which is of the greatest utility in accurate experiments.

" In endeavouring to ascertain some of these propositions, (says M. Cadet), I have made an observation which has convinced me of the utility of my electrometer in discovering the capacity of electric apparatus. Having taken a jar from an electric battery, I electrified it, and measured it with a point which I passed along a string of silk; on observing the distance at which the luminous point appeared, I joined this jar to another of the same size, and imagined that by doubling the quantity of matter, the measure I had taken would also be doubled; on the contrary, however, the latter measure was not more than about one-third of the former: I then added a third bottle; and still obtained nearly the same result; whence the following proposition appears to be established; namely, that the extent of the electric atmosphere is in an inverse ratio to the quantity of fluid accumulated. Another observation which I have several times made, on measuring the electric atmosphere of a conductor, is, that the limits of this atmosphere form an elliptic figure around the body, nearly similar to that represented at fig. 7. Fig. 7.

" This doubtless arises from the electrified body suspended in a chamber, being nearer to the earth than the ceiling; but it would be a curious experiment to measure it at an equal distance from every attracting body, in order to observe whether the fluid has not really a tendency to descend towards the earth, rather than in any other direction. It is my intention to repeat this experiment, as I consider it of great importance to ascertain whether electricity gravitates towards the globe.

" From these first attempts, I conceive my electrometer would be well adapted for measuring the absolute capacity of Leyden jars, and also their capacity with regard to their size, or to the quality of the glass of which they are constructed; for the latter, by its greater or less density, absorbs a greater or less quantity of fluid."

IV. *Lawson's* ELECTROMETER. This is a simplified improvement on Brooke's steelyard electrometer, and should have been described when that instrument was mentioned, instead of Mr Adams's: but it did not occur to us till after that sheet was printed.

The following account is given of this electrometer, in a letter from Mr Lawson to the editor of the Philosophical Magazine.

"Some time ago it struck me that some additions to Brooke's electrometer might be made, so as to fit it for a good discharging electrometer to measure the repulsion between two balls (of a certain size) in grains, and also effect the discharge of a battery at the same time. The instrument known by the name of Cuthbertson's discharging electrometer, (See ELECTRICITY, N° 203.) was at that time the best, and indeed the only instrument for discharging batteries or jars by its own action, then made; but I think this will be found, in the essentials, and in the theory and use, a more perfect instrument.

Fig. 8. "On the basis (fig. 8.) is fixed the glass pillar G, supporting the hollow brass ball B. I is a light graduated brass tube, divided (from the weight W towards the ball B) into 30 parts, representing grains. W is a sliding weight. L, a light brass ball screwed to the end of the tube I. On the other end of which tube adjusts the heavy counterbalance ball C, the tube I and its two balls being suspended at their common centre of gravity by a silk line in the centre of the ball B, the mechanism of which is shewn in fig. 9. The brass ball F is stationary, and of the same size as the ball L; and is fixed by, and adjusts close to, the ball L, or at any lower station between that and the ring *r*. The brass tube to which the ball A is fixed is divided into inches, halves, and quarters: (a more minute division is unnecessary and improper.) The divisions begin, or the line o is marked on the said tube at the ring *r*, when the three balls A, L, F, are close together. The ring *r* serves as an index, as the divisions pass in succession into the glass tube P on lowering the ball A. The hook H is screwed into the base of P. The quadrant, or Henley's electrometer, Q, is supported in a long brass stem, to keep it out of the atmosphere of the lower part
Fig. 9. of the instrument. Fig. 9. shows the internal construction of the ball B, fig. 8. In the first place the ball screws in half, horizontally. The light tube I passes through the ball, and is suspended nearly in the centre of it by some silk twist, *s*, which small silk twist is fixed into the eye of the adjusting wire, *a*, part of which wire is filed square and goes through the square hole *h*. The nut *n* screws on *a*, and serves to adjust the light tube I vertically. The light plates PP are of copper, and move freely on the wire *w w* somewhat like a hinge, and rest on the copper wires CC, serving to make the direct communication between the inside and out of the battery or jar. NN are notches serving to let the tube I descend when the discharge is made. Into the tube Z the glass pillar is ground. Note, that at the bottom of the notch N is a piece of brass filled with a Y, and so placed as to keep the centres of the balls L and F, fig. 8. under each other when they come close together.

"When the instrument is adjusted, which is done by placing the weight W, fig. 8. at o on the line of grains, and then screwing or unscrewing the counterbalance ball C, till the tube I rises slowly into its horizontal position; then set the ball A at the distance from the ball L that you choose, and the weight W placed at the division or number of grains that you wish the repulsive power of the electricity to arrive at before the discharge is made: this being done, connect the battery or jar with the ball B, by means of the wire *y*, the end of which goes into B at the hole X, and should stand at right angles to B, the ball of *y* resting on the battery: then connect the outside of the battery or jar with the hook H. As the battery charges, the electrometer Q continues to rise; and when it is so highly charged that the repulsive power between the balls L and F is equal to the number of grains at which the weight W was placed, the ball L will descend, and deliver the charge of the battery to the ball A. The substance or thing through which the shock is intended to be passed, must form part of the communication between the hook H and the outside of the battery or jar.

V. *Hauch's* ELECTROMETER. Fig. 10. contains a representation of this electrometer, and the different parts of which it consists. Fig. 10. OP is a board of dry mahogany, twelve inches in length and four in breadth, which serves as a stand for the instrument. In this board are fastened two massy glass pillars, M and N, which support the two brass caps or rings GG, with the two forks of tempered steel KK screwed into them. The two rings GG are well covered with varnish.

In the ring is fastened a brass rod, which terminates in a ball E of the same metal, and an inch in diameter. The length of the rod and ball together is four inches and a half.

A very delicate beam AB, the arms of which are of unequal length, moves on a short triangular axis (a knife edge) of well tempered steel, on the fork K of the pillar M. It is seventeen inches in length, and so constructed that the short arm forms a third, and the long one two-thirds of the whole beam. The short arm of brass furnished with the ball B, exactly of the same size as the ball E, is divided into forty-five parts equivalent to grains. The long arm A is of glass covered with copal varnish, and ends in an ivory ball A, into which is fitted an ivory hook R, destined to support the ivory scale H. In order to render the insulation more complete, this scale is suspended by three hairs.

A very delicate beam CD, eleven inches in length, moves on an axis like the former, on the pillar N, though not here shewn. This beam is proportioned in the same manner, one arm being a third and the other two-thirds of the whole length. The long arm of brass is furnished at the end with a ball D, and divided into thirty parts corresponding to grains. The short arm of glass terminates in a long roundish plate C, covered with copal varnish. The steel forks are shewn by the sections of the two brass caps FF, as are also the two knife edges L, L. By these caps the escape of the electric matter is partly prevented.

A brass ring Q, capable of being moved along the short arm of the upper beam AB, shews by means of marks determined by trial and cut out on the beam, the number of grains which must be placed in the small scale to restore the equilibrium of the beam, at each distance of the ring Q from the point of suspension.

On the long arm CD of the lower beam there is also a moveable ring S, which, like the ring Q, shews in grains, by its distance from the point of suspension, the power requisite to overcome the preponderance of LD in regard to LC.

The power necessary for this purpose will be found, if

Electrometer.

the shell H, which weighs exactly fourteen grains, be suffered to sink down on the glass plate C, and the ring *s* be pushed forwards till both the arms of the beam are in equilibrium. The part of the beam on which the ring *s* has moved, is divided into fourteen parts, so that 0 marks the place where the ring *s* must stand when the beam, in its free state, is in equilibrium; and 14 stands at the place where the ring *s* again restores a perfect equilibrium when the shell H is laid on the glass plate C. Each of these parts, which are divided into quarters, indicates a grain. The lower divisions of the scale will be found with more accuracy, if quarters of a grain be put in succession, into the shell H (after it has been laid on the plate C), and the ring *s* be moved between each quarter of a grain until the perfect equilibrium be restored. This place on the beam is then to be marked, and you may continue in this manner until the 30th part of a grain be given. Both scales, for the sake of distinctness, are only divided so low as quarters of a grain; though the instrument is so delicate, and must absolutely be so, that 1-20th of a grain is sufficient to destroy the equilibrium.

The two glass pillars M and N, together with the steel forks affixed to them, are so fitted into the stand, that both the beams lie parallel to each other as well as to the rod GE. In this position of the beams AB, the balls B and E are just in contact. The smallest glass pillar N is of such a height that the ball of the beam CD stands at the distance of exactly four lines from the ring G, and cannot move without touching the latter. The small shell H is suspended in such a manner that there is a distance of exactly two lines between it and the shell C. In each of the brass rings GG is a small hole, that the instrument may be connected with the two sides of an electric jar. I is a brass wire, with a hollow bit of ivory, *o*, destined to support the beam CD, which is necessarily preponderate at D, in order to prevent oscillation between the discharges to be examined by the instrument.

It may be readily comprehended that, when the beam AB has moved, A must pass over twice the space that B does; and that in the beam CD, the case is the same in regard to C and D. If AB be therefore connected with the external, and CD with the internal side of a battery, but in such a manner that the instrument is at a sufficient distance beyond the electric atmosphere; and if the battery be charged, the repulsive effect of the electric power will oblige the ball B to separate from the ball E; the shell H must therefore naturally sink down with double velocity, so that when the ball B rises a line, the shell H must sink two: when it reaches this depth it will touch the shell C, and the latter, by the power excited in it, will be obliged to sink, by which D must naturally again ascend in a double proportion to the sinking of C; so that when C has fallen two lines, D must have ascended four, and D that moment touches the ring by which the two sides of the battery are connected with each other, and discharges the battery.

But as the attractive electric power between unlike atmospheres, under like circumstances, is at least as strong as its repulsive power between like atmospheres, it would thence follow, that the electric power, instead of repelling the ball B from the ball E, would rather attract D, and by its contact with G, promote the discharging; by which the instrument would fail of its object, and be subjected to the temperature of the atmosphere like all other electrometers; and, besides this, the electric power could no longer be determined by weight. To obviate this inconvenience, the instrument, in all electrical experiments, must be applied in such a manner that the power with which the ball D is attracted by AB may exceed in strength the power required to repel the ball B from the ball E. For this purpose the ring *s* must always be removed two divisions farther on CD, towards D, than the ring Q is shifted on AB towards B. If, for example, an electric force were required equal to eight grains, according to this electrometer, the ring Q must be removed to the place where 8 stands, and the ring *s* to the place marked 10. The repulsive power will then naturally repel the balls B and E before G is in a condition to attract the ball D, as a power of two grains would be necessary for this purpose, besides that of the eight already in action. The shell H with its weight of fourteen grains, will easily overcome the preponderance of LD over LC, as it amounts only to ten grains, and therefore nothing exists that can impede the discharging.

When the ring *s*, according to the required power, is removed so far towards D, that the shell H is not able by its weight to destroy the preponderance of LD in regard to LC, the active power of the shell H must be so far increased by the addition of weights, that it can act with a preponderance of four grains on the plate C. If, for example, an electric power of 14 grains be required, the ring *s* must be removed to 16, by which LD rests upon *o*, with a preponderance of 16 grains in regard to LC. Now, to make H act on the plate C with a preponderance of four grains, it must be increased to 20 grains, that is, six grains weight more must be added, as it weighs only 14; which six grains are again laid upon LB; and therefore the ring Q is shifted to 20, as the strength of the repulsive power is pointed out by 14 grains.

If an electric power of 25 grains be required, the ring *s* must be removed to 27, and the weight of 17 grains be put into the shell H, in order to produce a preponderance of four grains in regard to *s*. These 17 grains are added to the required power of 25 grains, and the ring Q is pushed to 42, &c. In this manner the repulsive power always acts before the attractive power can.

It may be readily perceived that the faults and inconveniences common to all the electrometers hitherto employed, and which have been already mentioned, cannot take place here; because the discharging is performed by immediate connection between the positive and negative electricity in the instrument itself, without any external means being employed.

One of the most essential advantages of this instrument is, the certainty with which the same result may be expected when the experiment is repeated. From the same degree of electric power, whatever be the temperature of the atmosphere, it will always be necessary to commence the separation of the two balls B and E from each other, the quantity of coated glass and the distance of the ring Q from the axis L being the same.

Another no less important advantage of this instrument is, that in an experiment where the same electric power,

power, often repeated, is necessary to ascertain the result with accuracy; such, for example, as the charging a battery through acids, water, &c.; the same degree of precaution is not necessary as is indispensably so in any other electrometer, as the person who puts the machine in motion has nothing to do but to count how often the electrometer discharges itself; and the instrument may be inclosed in a glass case, or prevented in any other manner from external contact, or any other circumstances which might render the experiment uncertain.

"I flatter myself (says M. Hauch), that the simplicity of the construction of this instrument, the facility with which it may be made at a very small expence, and the certainty that two instruments, prepared according to the same scale, with a like quantity of coated glass, must exactly correspond with each other; but above all, that the certainty and accuracy by which experiments may be made with it, and by these means be accurately described, are advantages which will not be found united in any of the electrometers hitherto invented." *

We shall close this account of electrometers with describing the construction and use of M. Coulomb's electrometer, or, as he calls it, *Electrical Balance*.

Fig. 11. Fig. 12. Fig. 13. ABDC (fig. 11.) represents a glass cylinder, twelve inches in diameter and the same in height, covered by a glass plate fitted to it by a projecting fillet on the under surface. This cover is pierced with two round holes one inch and three-fourths in diameter. One of them *f* is in the centre, and receives the lower end of the glass tube *f h*, of twenty-four inches height, which is fixed in the hole with a cement made of sealing-wax, or other electric substance. The top of this tube receives the brass collar H, (fig. 12. N° 3.) bored truly cylindrical with a small shoulder, which rests on the top of the tube. This collar is fastened with cement, and receives the hollow cylinder φ (fig. 12. N° 2.), to which is joined the circular plate *a b*, divided on the edge into 360 degrees. It is also pierced with a round hole G in the centre, which receives the cylindrical pin *i* (fig. 12. N° 1.) having a milled head *b*, and furnished with an index *i o*, whose point is bent down so as to mark the divisions on the circle *a b*. This pin turns stiffly in the hole G, and the cylinder φ moves steadily in the collar H. To the lower end of the centre pin is fastened a little pincer, *q*, formed like the end of a port-crayon, and tightened by the ring *q*, so as to hold fast the suspension wire, the lower end of which is grasped by a similar pincer, P *o* (fig. 13.) tightened by the ring φ. The lower end φ *o* is cylindrical, and is of such a weight, as to draw the wire perfectly straight, but without any risk of breaking it. It may be made equal to half of the weight that will just break it.

This pincer is enlarged at C, and pierced with a hole, which tightly receives the arm *g* C *q* of the electrometer. This arm is eight inches long; and consists of a dry silk thread, or a slender straw completely dried, and dipped in melted lac or fine sealing-wax, and held perpendicularly before a clear fire, till it become a slender cylinder of about one-tenth of an inch in diameter. This occupies six of the eight inches, from *g* to *q*: the remaining two inches consist of a fine thread of the lac or sealing-wax, as it drains off in forming the arm. At *a*, is a ball of pith or fine cork, one-fourth or one-half of an inch in diameter, made very smooth, and gilded. It is balanced by a vertical circle of paper *g*, of large dimensions, made stiff with varnish. The resistance of the air to this plane soon checks the oscillations of the arm.

The whole instrument is seen in its place in fig. 11. where the arm hangs horizontally about the middle of the height of the great cylinder. In its oscillations the ball *a* moves round in a circle, whose centre is in the axis of the whole instrument. Its situation is indicated by a graduated circle *z o q*, drawn on a slip of paper, and made to adhere to the glass by varnish. The electrified body whose action is to be observed, is another small ball of cork *t*, also gilt, or a brass ball well polished. This is carried by a stalk of lac *m* φ, inclosing a dry silk thread. This stalk is grasped by a clamp of cleft deal, or any similar contrivance, which is made to lie firm on the glass cover. When this ball is let down through the hole *m*, it stands so as to touch the ball *a* on the arm, when that ball is opposite to ο on the graduated circle.

Fig. 14. In order to electrify the ball *t*, we are to employ the insulating handle, fig. 14. which is a slender stick of sealing-wax or lac, holding a metal wire that carries a small polished metallic ball. This is to be touched with some electrified body, such as the prime conductor of a machine, the knob of a jar, &c. This electrified ball is to be introduced cautiously into the hole *m*, and the ball *t* is to be touched with it. The ball *a* is immediately repelled to a distance, twisting the suspension wire, till the force of twist exerted by the wire balances the mutual repulsion of the balls *t* and *a*.

Fig. 15. This is the process for examining the law of electric action. When it is desired to examine the action of different bodies in different states, another apparatus is wanted. This is represented by the piece *c* A *d* (fig. 15.) consisting of a plug of sealing-wax A, fitting tightly into the hole *m*, and pierced by the wire *c d*, hooked at *c*, to receive a wire to connect it occasionally with an electrified body, and having below a polished metal ball *d*.

The instrument is fitted for observation in the following manner: The milled button *b* is turned at top, till the twist index *i o* is at the mark ο of the twist circle. Then the whole is turned in the collar H, till the ball *a* stand opposite to the mark ο of the paper circle *z o* Q, and at the same time the ball *t* or *d* is touched. The observation is thus made. The ball *t* is first electrified as just described, and thus *a* is repelled, and retiring twists the wire, settling, after a few oscillations, at such a distance as is proportional to the repulsion. The twist-index is now turned so as to force *a* nearer to *t*. The repulsion thus produced is estimated by adding the motion of the index to the angle at which the ball first stopped. Giving the index another turn, we have another repulsion, which is estimated in a similar way, and thus we obtain as many measures as required.

It is not necessary to make this instrument of very large dimensions; one 14 inches high, and five in diameter, of which the arm *a g* should occupy two inches and a half, will be sufficiently large for most purposes. The diameter of the glass cylinder must always be double the length of the arm *a g*, that the position of this may not be disturbed by the action of the glass.

Dr Robison considered this electrometer as one of the

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* Phil. Magaz. vol. iv.

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the most valuable instruments that have been made, as it is not only extremely delicate, but gives absolute measures with the greatest accuracy. For all purposes in which only repulsions were to be measured, he preferred it to his own instrument described in ELECTRICITY, N° 206.

He, however, suggested several improvements in it, which are deserving of attention,

The bottom should be furnished with a round hole, admitting the lower end of the cylinder C *o* belonging to the lower pincer (when the wire is strained at both ends) to hang freely, by which means much tedious oscillation will be prevented. It is much more convenient to have the suspension wire strained at both ends; and it should extend as far below the arms as above it, and the lower extremity should be grasped by a pincer that turns by a milled head in a hole at the end of a slender spring. The instrument may then be speedily adjusted by placing the twist index at 0, and gently turning the lower button till the ball *a* point exactly at 0 on the paper circle.

The instrument will be greatly improved, if, in place of the apparatus with the ball *t*, we substitute the piece represented at fig. 15. making some little changes in its construction. Thus, instead of the wire *c d*, is used the smallest glass tube that will admit of being varnished on the inside, which is done by drawing through it a silk thread dipped in varnish, made of lac.

The outside of the tube must also be varnished, and a brass ball *d* fixed at its lower end, and a slender wire surmounted by a ball, is to be inserted into the tube, so as to touch the ball below. The position of the ball *d* will not be liable to alteration, when the hole *m* is once stopped with the plug. In making delicate experiments, the upper ball *c* must be touched with the charger, represented at fig. 14. by which means the ball *d* is electrified. Then drawing out C by means of the forceps, the ball *d* is left completely insulated. In examining the electricity of the atmosphere, to which purpose this instrument is well adapted, the wire must be allowed to remain in the tube.

It was by means of this incomparable instrument, that M. Coulomb made the valuable experiments, to which we alluded in the article ELECTRICITY, when treating of the law of action of the electric fluid. By means of this electrometer, he also made his experiments on the dissipation of electricity into the air, and along imperfect conductors. He ascertained the law of dissipation into the air from bodies in contact, and the relation which this bore to the original repulsion, by first observing the gradual approach of the ball *a* towards *t*, in proportion as the electricity dissipated from both, and then slackening the twist index till the ball *a* resumed its original situation.

The following was the general result of Mr Coulomb's experiments.

That the momentary dissipation of moderate degrees of electricity is proportional to the degree of electricity at the moment. He found that the dissipation is not sensibly affected by the state of the barometer or thermometer; nor is there any sensible difference of bodies of different sizes or different substances, or even different figures, provided that the electricity is very weak.

But he found that the dissipation was greatly affected by the different states of humidity of the air. In the scale of Saussure's hygrometer, the relation to the quantity of water which a cubic foot of air is capable of holding in solution is distinctly marked; the relation of this solution to the dissipation of electricity in Coulomb's experiments may hence be seen in the following table, the first column of which marks the degrees of Saussure's hygrometer, the second how many grains of water are dissolved in a cubic foot of air at each degree, and the third column column shews the corresponding dissipation per minute.

| | | |
|---|---|---|
| 69 | 6,197 | $\frac{1}{60}$ |
| 75 | 7,295 | $\frac{1}{41}$ |
| 80 | 8,045 | $\frac{1}{39}$ |
| 87 | 9,221 | $\frac{1}{24}$ |

Hence it follows, that the dissipation is very nearly in the triplicate ratio of the moisture of the air. Thus if we make $\frac{60}{41}=\left.\overline{\frac{7,197}{6,180}}\right|^{m}$; *m* will be $=$ 2,764. If we make $\frac{60}{39}=\left.\overline{\frac{8,045}{6,180}}\right|^{m}$; *m* will be $=$ 2,76; and if we make $\frac{60}{24}=\left.\overline{\frac{9,240}{6,180}}\right|^{m}$; *m* will be $=$ 3,61; or at a medium *m* will be $=$ 3,40.

The immediate object that M. Coulomb had in view in his experiments, was to ascertain the diminution of repulsion. He found that this, in a given state of the air, was a certain proportion of the whole repulsion taken at the moment of diminution, which is double the proportion of the density of the fluid; for the repulsions by which we judge of the dissipation are reciprocal, being exerted by every particle of fluid in the ball *t* of the electrometer, on every particle of fluid in the ball *a*. The diminution of repulsion is therefore proportional to the density of the electric fluid in each ball; and, as during the whole dissipation, the densities continue to have their original proportion, and as the diminution of repulsion is directly proportional to the diminution of the products of the densities, it is consequently directly proportional to the square of either. If we put *d* for the density, the mutual repulsion will be represented by $d^2$, and its momentary diminution by the fluxion of $d^2$, or $2\,d\,d=2\,d\times d$. But $2\,d\times d : d^2=2\,d : d$. The diminution of the repulsion observed by experiment will be to the whole repulsion, in double the proportion that the diminution of density, or the dissipation of fluid will have to the whole quantity of fluid at the moment of observation. Let us, for instance, suppose the observed diminution of repulsion to be $\frac{1}{40}$; we may conclude, that the quantity of fluid lost by dissipation is $\frac{1}{80}$. M. Coulomb did not examine the proportion of the dissipations from bodies of various sizes. But we know, that if two spheres communicate by a very long canal, their superficial densities, and the tendencies of fluid to escape from them, are inversely as the diameters of the spheres. Now, in a body that has twice the diameter of another body, the surface of the former is quadruple of that of the latter; and though the tendency of fluid to escape from the former is only the half of its tendency to escape from the latter, yet the greater surface of the former may so far make up for its smaller density, that the

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the dissipation of fluid from a large sphere may in fact be greater than that from a small one in the same given time.

We have remarked above, that these experiments were made in a particular state of the air; and the law of dissipation ascertained by them is of course adapted only to that given state. In a different state of the air, even if this should be impregnated with the same proportion of moisture, the law of dissipation may be different. The inference which M. Coulomb expected to draw from his experiments was, that the ratio of dissipation would prove to be less than the cube of the quantity of water held in solution, except when that quantity of water was what the air was capable of holding in solution at the given temperature.

This is agreeable to observation; for we know that air which is considered as dry, that is, when it is not nearly saturated with moisture, is the most favourable to electrical phenomena.

Such is the general result of Coulomb's experiments on the dissipation of electricity into the air.

The method in which M. Coulomb examined the dissipation along imperfect conductors, by means of this instrument, was, by completely insulating the ball *t*, and then after observing the loss sustained by a body in contact with it from the air, sliding a metallic rod down the insulating stalk, till the dissipation began to exceed what took place only by the air.

From his experiments respecting the dissipation along imperfect conductors, he found that this took place in a different manner from that in which electricity escaped by communication with the contiguous air. The electricity seems to be diffused chiefly along the surface of the insulator, and appears principally to be produced by the moisture that is more or less attached to it. M. Coulomb illustrates this in the following manner.

Water is found to adhere to the surface of all bodies from which it is prevented by adhesion from escaping when the bodies are electrified, and is thus rendered capable of receiving a greater degree of electric power. Let us suppose that the particles of moisture are disposed uniformly over the surface, with intervals between them; the electricity that is communicated to one particle, must acquire a certain degree of density, before it can fly from this particle to the next, across the intervening insulating space. When an imperfect conductor of this kind is electrified at one extremity, the communicated electricity, in passing to the other extremity, must be weakened every step in passing from particle to particle.

Suppose we have three adjacent particles, which we may call *a*, *b*, and *c*; we infer from N° 374. of the article ELECTRICITY, that the motion of *b* is sensibly effected, only by the difference of *a* and *c*: and therefore the passage of electric fluid from *b* to *c*, requires that this difference be superior, or at least equal to the force necessary for clearing this coercive interval. Let a particle pass over. The density of fluid of the particle *b* is diminished, while the density of the particle on the other side of *a* remains as before. Therefore some fluid will pass from *a* to *b*, and from the particle preceding *a* to *a*; and so on, till we come to the electrified end of this insulator. It is plain, from this consideration, that we must at last arrive at a particle beyond *c*, where the whole repulsion of the preceding particle is just sufficient to clear the coercive interval. Some fluid will come over; and the repulsion of this, acting now in the opposite direction, will prevent any fluid from coming to supply its place in the particle which it has just quitted; the transference of fluid will therefore stop here, and beyond this point the insulation will be complete. Hence we perceive that there is a mathematical relation between the insulating power, and the length of the canal; and this may be ascertained by the theory which we adopted in the article ELECTRICITY. We shall here give an instance of this investigation; and, for the sake of simplicity, we shall take a very probable case, viz. where the insulating interval, or, as we may more properly call it, the coercive interval, is equal in every part of the canal.

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Fig. 16.

Let R represent the coercive power of the insulator, or the degree of force required to clear the coercive interval between two particles. Suppose a ball C, fig. 16. suspended by a silken thread AB; and let us denote the quantity of a redundant fluid in the ball by C, and let the densities at the different points of the canal be denoted by AD, P*d*, &c. ordinates to some curve D*d*B, cutting the axis in B, the point where the thread AB begins to insulate completely. Let P*p* be an element of the axis; draw the ordinate *pf*, a tangent to the curve *df*F, the normal *d*E, and draw *fe* perpendicular to P*d*. Suppose $AC = r$, $AP = x$, and $Pd = y$. Then we shall have $Pp = \dot{x}$, and $de = -\dot{y}$. It was shewn in N° 374. of the article ELECTRICITY, that the only sensible action of the fluid on a particle at P is $-\frac{y\dot{y}}{x}$, when the action of the redundant fluid in the globe on the particle at P, having the density *y*, is denoted by $\frac{Cy}{(r+x)^2}$. Therefore $\frac{y\dot{y}}{x}$ is $= R$, the coercive power of the thread, which is supposed to be constant, $\frac{Pd \times de}{Pp}$ is therefore equal to some constant line R. But P*p* (or *fe*) : $de = Pd$ : PE. The subnormal, PE, is therefore a constant line. But as this is the property of a parabola, the curve of density D*d*B must be a parabola, of which $2PE = 2R$, is the parameter.

COR. I.—The densities at different points of an imperfect insulator are in the subduplicate ratio of their distances from the point of complete insulation: for $Pd^2 : AD^2 = BP : BA$.

COR. 2.—The lengths of canal requisite for insulating different densities of the electric fluid are in the duplicate ratio of their densities; for $AB = \frac{AD^2}{2PE}$, and PE is a constant quantity.

COR. 3.—The length of canal requisite for insulation is inversely as its coercive power, and may be represented by $\frac{D^2}{R}$. For $AB = \frac{DA^2}{2PE} = \frac{D^2}{2R}$.

If we reflect on this theory, we shall perceive, that our formulæ determine the distribution of fluid along the surface of an imperfect conductor, only in a certain manner, supposing that the ball C has received a certain determinate portion of fluid, for this portion diffusing itself, particle by particle, through the conducting matter, will extend to *b* in such a manner, as that the

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the repulsion shall be everywhere in equilibrio with the coercive power of the insulating interval, taken at a *maximum*. We must here remark that this resistance is not *active*, but only coercive, and may be compared to the resistance afforded by viscidity or friction. Any repulsion of electric fluid, which falls short of this, will not disturb the stability of the fluid that is spread along the canal, according to any law whatever. So that if AD represent the electric density of the globe, and remain constant, any curve or density will answer, provided that $\frac{d\dot{d}}{\dot{x}}$ be everywhere less than R. It is therefore an indeterminate problem, to assign in general the disposition of fluid in the canal. The density is as the ordinates of a parabola on this supposition only, that the maximum of R is everywhere the same. And, in this case, the distance AB is a minimum: for, in other cases of density we must have $\frac{d\dot{d}}{\dot{x}}$ less than R. If, therefore, we vary a single element of the curve D*d*B, in order, that the stability of the fluid may not be disturbed, having *d* constant, we must necessarily have *x* larger, that $\frac{d\dot{d}}{\dot{x}}$ may still be less than R; that is, we must lengthen the axis.

The reasonings which have thus been deduced from theory, were confirmed by M. Coulomb in a numerous set of experiments. These are chiefly valuable for having stated the relation that subsists between the electric density, and the length of support necessary for complete insulation. But as M. Coulomb has not given us the scale of his electrometer, according to which the absolute measures of the densities were determined, the experiments can be of but little use till this be known.

We hinted, at the end of the theoretical part of ELECTRICITY, that the theory of Volta's *condenser* might be more satisfactorily explained after we had considered the above experiments of Coulomb. The account which we gave of the condenser in Chap. xiii. of that article, (chiefly from Cavallo), was the only one we could properly give in that early part of our view of the science. We are now prepared for a more scientific account of the effects of that instrument. The following is nearly the manner in which Dr Robison considered the subject.

Let the cover of an electrophorus be furnished with a graduated electrometer, such as may indicate the proportional *degrees of electricity*; electrify it positively to any degree, we shall suppose six, while it is held in the hand, at a little distance, directly over a metallic plate lying on a wine glass, or such like insulating stand, but made to communicate with the ground by a wire. Now bring it gradually down towards the plate. Theory teaches, and we see it confirmed by experiment, that the electrometer will gradually subside, and will perhaps fall to 2°, before the electricity is communicated in a spark: but let us stop it before this happens; the attraction of the lying plate produces a compensation of four degrees of the mutual repulsion of the parts of the cover, by condensing the fluid on its inferior surface, and forming a deficient stratum above. This needs no farther explanation, after what we said under ELECTRICITY, on the charging of coated glass plates. Now we may suppose that the escape of the fluid from this body into the air, begins as soon as it is electrified to 6°, and that it will fly to the insulated plate with the degree 2, if it be brought nearer. But if we can prevent this communication to the insulated plate, by interposing an electric, we may electrify the cover again, while so near the metallic plate, to 6°, before it will pass off into the air. If now it be removed from the lying plate, the fluid would cause the electrometer to rise to 10°, if it did not immediately pass off; and an electric excitement of any kind which could raise this body only to 6° by its intensity, will, by means of this apparatus, raise it to the degree 10, if it be sufficiently copious in extent. If we do the same thing when the wire which connects the lying plate with the ground is taken away, we know that the same diminution of the electricity of the other plate cannot be produced by bringing it down near the lying insulated plate.

The theory of Volta's *condenser* now becomes very simple. M. Volta seems to have obscured his conceptions of it, by being intent on the electrophorus which he had lately invented, and was thus led into fruitless attempts to explain the advantages of the imperfect conductor above the perfect insulator. But the condensing apparatus is wholly different from an electrophorus; its operations are more analogous to those of a coated plate not charged, and insulated only on one side; and such a coated plate lying on a table will be a complete condenser, if the upper coating be of the same dimensions as the plate of the condenser. All the directions given by M. Volta for preparing the imperfect conductors prove, that the effect produced is to make them as perfect conductors as possible for any degree of electricity that exceeds a certain small intensity, but such as shall not suffer this very weak electricity to clear the first step of the conducting space. The marble must be thoroughly dried, and even heated in an oven, and either used in this warm state, or must be varnished, so as to prevent the reabsorption of moisture. We know that marble of slender dimensions, so as to be completely dried throughout, will not conduct electricity till it has again become moist. A thick piece of marble is rendered dry only superficially, and still conducts internally. It is then in the best possible state for a condenser. The same is the case with dry unbaked wood. Varnishing the upper surface of a piece of marble or wood is equivalent to covering it with a thin glass plate. Now by this method of covering the top of the marble, a book, or even the table, with a piece of clean dry silk, they all become most perfect condensators. This view of the matter has great advantage. We learn from it how to form a condensing apparatus much more simple and at the same time much more efficacious. We require only the simple moveable plate, which must be covered on the under side with a very thin coating of the finest coach-painters varnish. By connecting this, by a wire, with the substance whose weak electricity is to be examined, this electricity will be raised in the proportion of the thickness of the varnish to the fourth of the plate's diameter. This condensation will be produced by detaching the wire from the insulating handle of the condensing plate, and then lifting this from the table on which it was lying. It will then afford sparks, though the original electricity

# ELECTROMETER. PLATE CC.

Fig. 1.

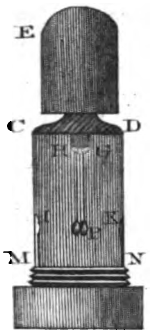


Fig. 2.

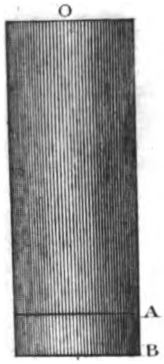


Fig. 3.

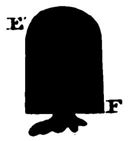


Fig. 4.

Fig. 6.

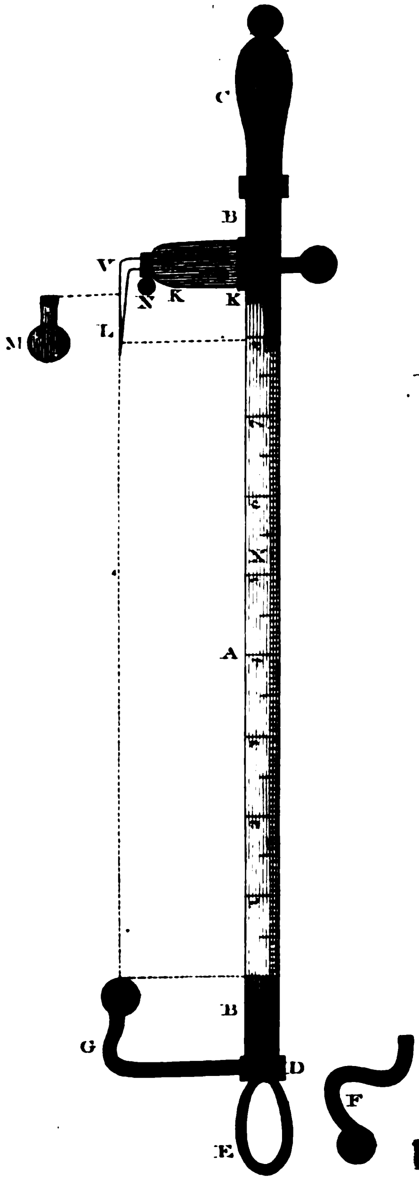


Fig. 7.

Fig. 8.

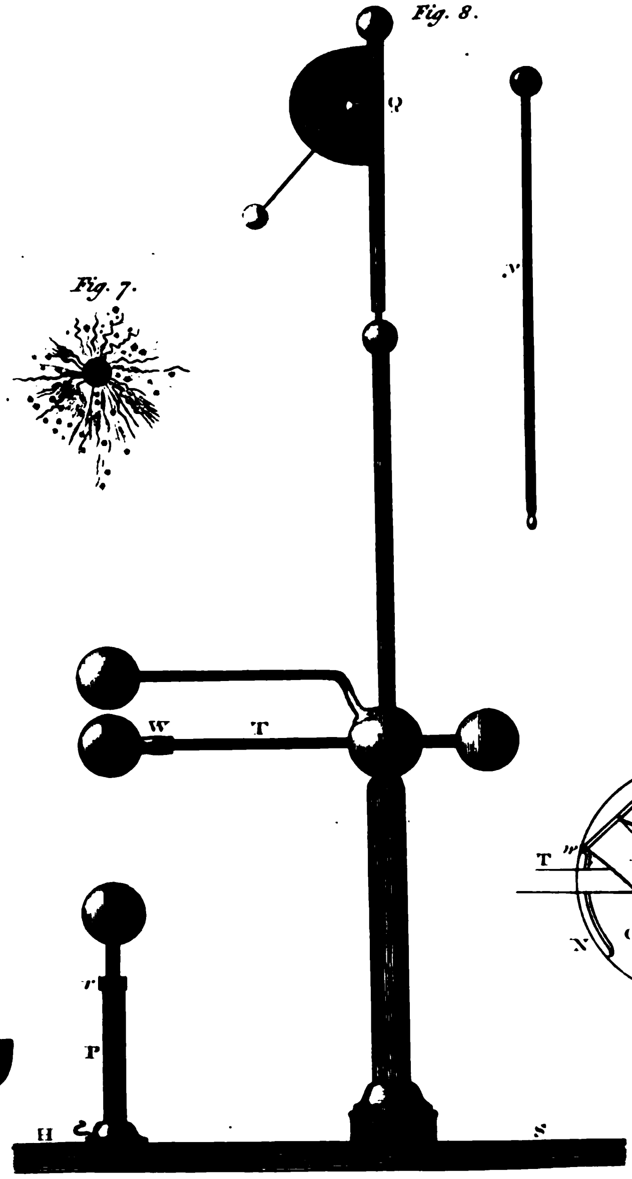
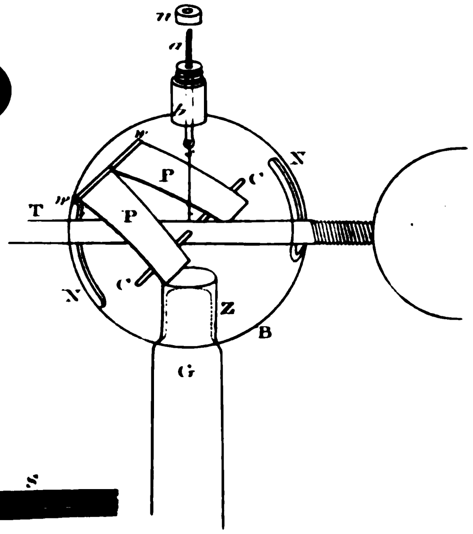


Fig. 5.

Fig. 9.



Archibald sculp.

ELECTROMETER. PLATE CCI.

Fig. 10.

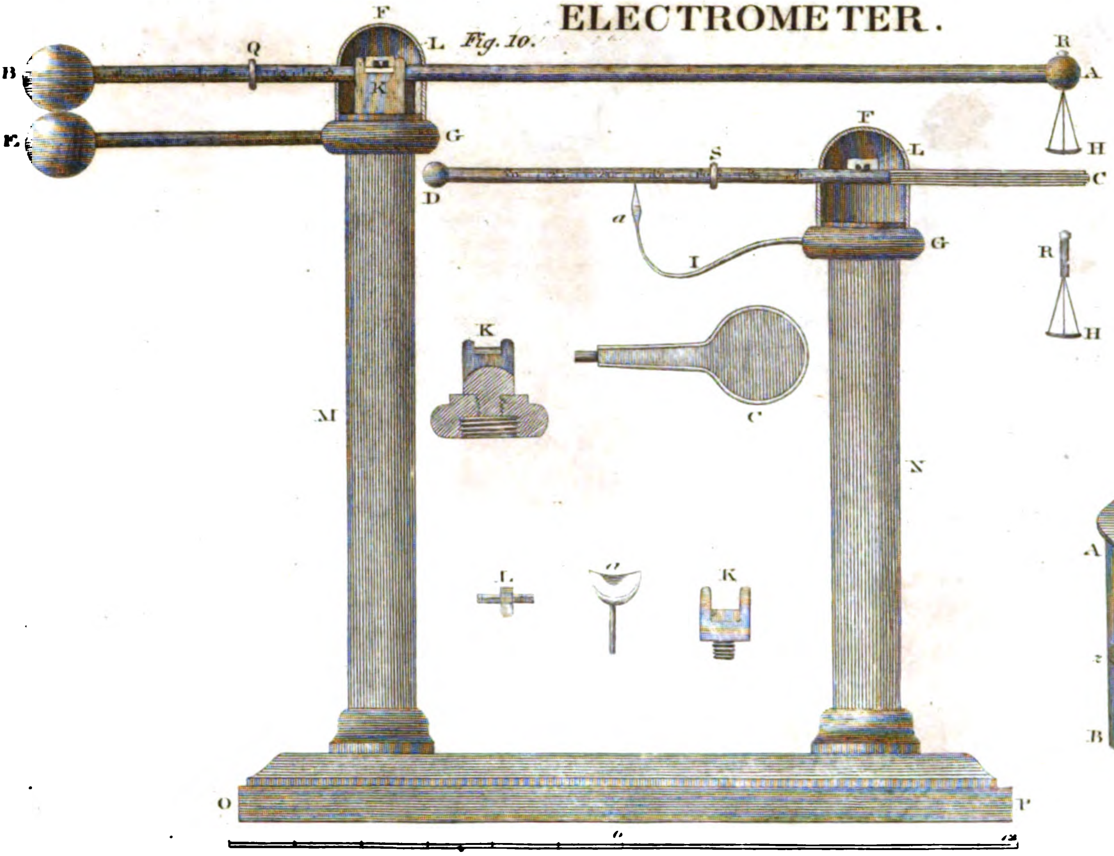
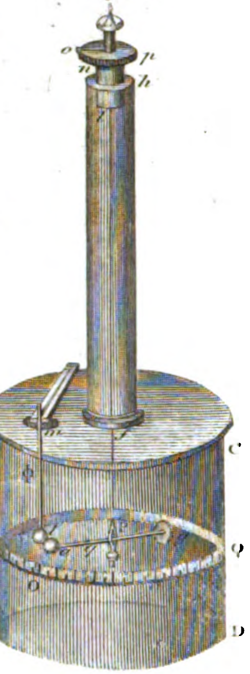


Fig. 11.



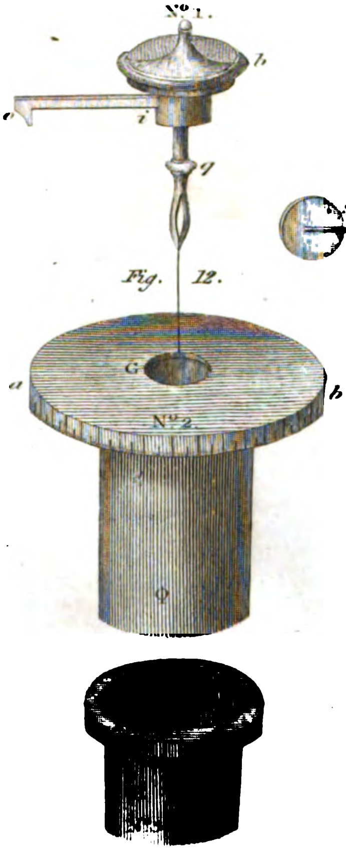


Fig. 12.

Fig. 13.

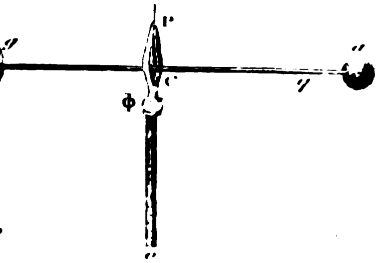


Fig. 14.

Fig. 15.

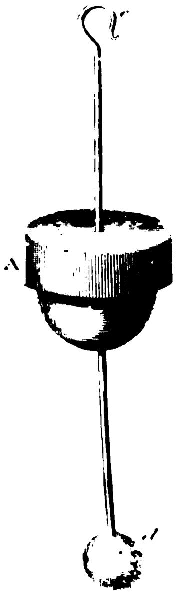
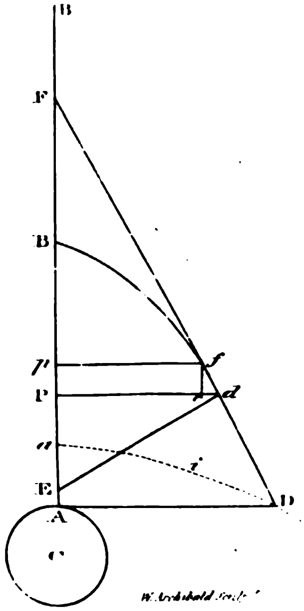


Fig. 16.



W. Archibald Sculp.

electricity was not strong enough to affect the most delicate electrometer.

**ELECTROPHORUS.** See ELECTRICITY *Index*.

**ELECTRUM,** in *Natural History*. See AMBER.

**ELECTUARY,** in *Pharmacy*, a form of medicine composed of powders and other ingredients, incorporated with some conserve, honey, or syrup; to be divided into doses, like boluses, when taken.

Vossius observes, that all the remedies prescribed for the sick, as well as the confections taken by way of regale, were called by the Greeks εκλειγματα, and εκλεικτα, of the verb λειχω, "I like;" whence, says he, was formed the Latin *electarium*, and afterwards *electuarium*. This conjecture he supports from the laws of Sicily, where it is ordained, that *electuaries*, syrups, and other remedies, be prepared after the legal manner. The Bollandists, who relate this etymology, seem to confirm it. For the composition and different sorts of electuaries, see PHARMACY.

**ELEEMOSYNA** *Carucarum*, or *pro Aratris*, or *Aratri*, in our ancient customs, a penny which King Ethelred ordered to be paid for every plough in England towards the support of the poor. Sometimes it is also called *eleemosyna regis*, because first appointed by the king.

**ELEEMOSYNARIUS,** in our old writers, is used for the almoner or peculiar officer who received the eleemosynary rents and gifts, and distributed them to pious and charitable uses. There was such an officer in all religious houses. The bishops also used to have their almoners, as now the king has.

**ELEGANCE,** (from *eligo*, "I choose,") denotes a manner of doing or saying things politely, agreeably, and with choice. With choice, so as to rise above the common manners; politely, so as to strike people of delicate taste; and agreeably, so as to diffuse a relish which gratifies every body.

ELEGANCE, in oratory and composition, an ornament of politeness and agreeableness shown in any discourse, with such a choice of rich and happy expressions, as to rise politely above the common manners, so as to strike people of a delicate taste.

It is observed, that elegance, though irregular, is preferable to regularity without elegance: that is, by being so scrupulous of grammatical construction, we lose certain licences wherein the elegance of language consists.

**ELEGIAC,** in ancient poetry, any thing belonging to elegy. See ELEGY.

**ELEGIT,** in *Law*, a writ of execution, which lies for a person who has recovered debt or damages; or upon a recognizance in any court against a defendant that is not able to satisfy the same in his goods.

**ELEGY,** a mournful and plaintive kind of poem. See the article POETRY.

**ELEMENTS,** in *Physics*, the first principles of which all bodies in the system of nature are composed.

These are supposed to be few in number, unchangeable, and by their combinations to produce that extensive variety of objects to be met with in the works of nature.

That there is in reality some foundation for this doctrine of elementary bodies is plain; for there are some principles evidently exempted from every change or decay, and which can be mixed or changed into different forms of matter. A person who surveys the works of nature in an inattentive manner, may perhaps form a contrary opinion, when he considers the numerous tribes of fossils, plants, and animals, with the wonderful variety that appears among them in almost every instance. He may from thence be induced to conclude, that nature employs a vast variety of materials in producing such prodigious diversity. But let him inquire into the origin of this apparent diversity, and he will find that these bodies which seem the most different from each other are composed nearly of the same elements. Thus the blood, chyle, milk, urine, &c. as well as the various solid parts of animals, are all composed of one particular substance; grass, for instance, by the assistance of air and water, and even sometimes of very insipid kinds of grass. The same simplicity presents itself in the original composition of the nourishment of vegetables, notwithstanding the variety among them with respect to hardness, softness, elasticity, taste, odour, and medical qualities. They chiefly depend, for these, upon water, and the light of the sun; and the same simplicity must take place in animals that are fed on vegetables. The analysis of animal substances confirms this hypothesis; for they can all be reduced into a few principles, which are the same in all, and only differ with regard to the proportions in which they are combined. With regard to animals, the case appears to be the same: and the more we are acquainted with them, the more reason we have to believe that the variety in their origin is very small.

Notwithstanding the infinite variety of natural productions, therefore, it appears, that the materials employed in their formation are but few; that these are uniformly and certainly the same, totally exempted from any change or decay; and that the constant and gradual change of one body into another is produced by the various separations and combinations of the original and elementary parts, which is plain from the regularity and uniformity of nature at all times. There is a change of forms and combinations through which it passes, and this has been the case from the earliest accounts of time; the productions of nature have always been of the same kind, and succeeded one another in the same order. If we examine an oak, for instance, we find it composed of the same matter with that of any other that has existed from the earliest ages. This regularity and uniformity in the course of nature shows that the elementary parts of bodies are permanent and unchangeable; for if these elementary particles which constituted an oak some thousand years ago, had been undergoing any gradual decay, the oaks of the present times would have been found considerably different from those that existed long ago; but as no difference has been observed, it would seem that the ultimate elements of bodies have always continued the same.

Reflections of this kind have suggested an idea of several principal elements of which all other bodies are composed, which by their various combinations furnished all the variety of natural bodies. Democritus, and other great philosophers of antiquity, fixed the number to four, which have retained the name of elements ever since. These are, fire, air, earth, and water; each of which they imagined was naturally disposed to hold its own place in the universe. Thus the earth, as heaviest, naturally tended towards the centre, and occupied the lower parts; the water as approaching next to it in gravity, was spread chiefly on the outside of the earth: the air, being more subtile and rare, occupied the middle place; while the fire, being still more subtile and active, receded to the greatest distance of all, and was supposed to compose the planets and stars. This system was extended to all the productions of nature. Meteors were produced from a combination of fire and air; animals were considered as composed of earth and water; and those that were warm had likewise a proportion of the element of fire. Thus they went on, explaining some of the most striking qualities of the several productions of nature from the different proportions of the four elements they contained.

But though this system appears not at all destitute of beauty and propriety, and on this account has been long received, we know from modern discoveries that these four substances are not really elementary bodies; nor do they answer our purpose in forming a system, as we know too little of the intimate structure and texture of them to enable us to explain other bodies by them.

Any other attempts that have been made to assign the number of elementary bodies have been much less fortunate. The older chemists, with Paracelsus at their head, pretend to speak of four elementary bodies, salt, sulphur, earth, and mercury: but when we attempt to form an idea of what they mean, we find it very perplexed; and that the expressions concerning them are enveloped in so much obscurity, that they cannot be comprehended; and the theory is built entirely upon experiments made on metallic substances.

Attempts have been made by some to show that the elements, whatever they are, must necessarily be invisible or imperceptible by any of our senses. An inquiry into their number or properties therefore must be attended with very little success; and all the knowledge we can have upon the subject must be drawn from a view of their combinations, and reasoning analogically from the transmutations we observe to take place in nature. The modern discoveries in aerology have enabled us to proceed farther in this way than what it was possible for the ancient philosophers to do. We now find that all the different kinds of air are composed of that invisible and subtile fluid named *heat*, united in a certain way with some other substance; by which union the compound acquires the properties of gravitation, expansion, rarefaction, &c. for pure heat, unless when united with some terrestrial substance, neither gravitates nor expands. This is evident from the phenomena of the burning glass, where the light concentrated in the focus will neither heat the air nor water, unless it meets with something with which it can form a permanent union. Heat, therefore, is justly to be considered as one of the original elements; being always capable of uniting with bodies, and of being extricated from them unchanged: while the same bodies are by their union with it changed into various forms; water, for instance, into ice or vapour, both of which return into their original state by the abstraction or addition of heat in a certain degree. Hence it becomes almost natural to conclude, that there are only two elements in the universe; and this opinion we find adopted by several philosophers, particularly the count de Tressan in his Essay on the Electric Fluid. According to his doctrine, two primitive material substances seem to exist in nature; one that incessantly acts, and to which it is essential to be in motion; the other absolutely passive, and whose nature it is to be inert, and move entirely as directed by the former. Should this doctrine be adopted, little difficulty would occur in determining the active matter to be that universal fluid, which, in its various modifications of light, heat, and electricity, has such a share in the operations of nature. But in fixing on the passive element we are greatly embarrassed; nor are the discoveries in aerology or any other science as yet able to remove the difficulty entirely. According to the doctrines which long prevailed among chemical philosophers, there are three things that seem to be unchangeable, viz. earth; phlogiston; and that invisible, though terrestrial and gravitating principle, called by the antiphlogistians the *oxygenous* or acidifying principle, and by the phlogistians the basis of dephlogisticated air. In our experiments, say they, on the first, we find that earth, though vitrified by the most intense fire, may be recovered in its proper form: and some very pure earths, particularly magnesia alba, cannot be changed even in the focus of the most powerful mirror. In like manner we may dissipate charcoal *in vacuo* by the solar rays, and the compound is inflammable air: we may decompose this compound by a metallic calx, and we have our charcoal again unchanged, for all metals contain charcoal in substance. Let us try to destroy it by common fire, and we have it then in the fixed air produced, from which it may be recovered unchanged by means of the electric spark. With the basis of dephlogisticated air the case is still more difficult; for we cannot by any means procure a sight of it by itself. We may combine it with heat, and we have dephlogisticated air; to the compound we may add charcoal, and we have fixed air: by decomposing the former by burning iron in it, we have the metal greatly increased in weight by some unknown substance: and if we attempt to separate the latter, we have water, or some kind of vapour which still conceals it from our view.

In some experiments which were made by the ingenious Mr Watt, it was found that nitrous acid might be phlogisticated by the purest earth or metallic calx; whence, according to this doctrine, it is not unreasonable to suppose that phlogiston may be only a certain modification of earth, and not an element distinct from it: but with regard to the basis of dephlogisticated air, no experiment has ever shown that it can either be procured by itself, or changed into any other substance; so that it appears to have the nature of an element as much as light or heat. Though we should therefore be inclined to divide the whole matter of the universe into two classes, the one active and the other acted upon, we must allow that the passive matter even on this earth is not precisely of the same kind: much less are we to extend our speculations in this respect to the celestial regions; for who can determine whether the substance of the moon is the same with that of our earth, or that the elements of Jupiter are the same with those of Saturn? There is even a difficulty with regard to the division which seems so well established, viz. of matter in general into active and passive; for no person can prove, that the matter which is active in one case may not be passive in another, and occasionally resume its activity. Something like this certainly happens in the case of the electric fluid, which is modified into heat or light, according to different circumstances; and we cannot know but it is the very same substance that constitutes the most solid bodies. This opinion at least did not seem absurd to Sir Isaac Newton, who proposed it as a query, Whether gross bodies and light were not convertible into one another? The end of our inquiries on this subject therefore must be, That the universe may be composed of many elements, or of one element; and of the nature of these elements, or of the single one, we know nothing.

ELEMENT, in a figurative sense, is used for the principles and foundations of any art or science; as Euclid's Elements, &c.

ELEMENTS, in *Astronomy*, are those principles deduced from astronomical observations and calculations, and those fundamental numbers which are employed in the construction of tables of the planetary motions. Thus, the elements of the theory of the sun, or rather of the earth, are his mean motion and eccentricity, and the motion of the aphelia. The elements of the theory of the moon are its mean motion; that of its node and apogee, its eccentricity, the inclination of its orbit to the plane of the ecliptic, &c.

ELEMI, or ELEMY, in the *Materia Medica*. See AMYRIS.

ELENCHUS, in antiquity, a kind of ear-rings set with large pearls.

ELENCHUS, in *Logic*, by the Latins called *argumentum* and *inquisitio*, is a vicious or fallacious argument, which deceives under the appearance of a truth; the same with what is otherwise called *sophism*.

ELEPHANT. See ELEPHAS, MAMMALIA *Index*.

*American ELEPHANT;* an animal only known in a fossil state, and that but partially, from the teeth, some of the jaw-bones, the thigh-bones, and vertebræ, found with many others five or six feet beneath the surface on the banks of the Ohio. But these bones differ in several respects from those of the elephant; for which, see *Fossil BONES*. As yet the living animal has evaded our search. Mr Pennant thinks it "more than probable, that it still exists in some of those remote parts of the vast new continent unpenetrated yet by Europeans. Providence maintains and continues every created species; and we have as much assurance that no race of animals will any more cease while the earth remains, than *seed-time and harvest, cold and heat, summer and winter, day or night.*" See MAMMUTH.

*ELEPHANT Beetle.* See SCARABÆUS, ENTOMOLOGY *Index*.

*Knights of the ELEPHANT*, an order of knighthood in Denmark, conferred upon none but persons of the first quality and merit. It is also called the *order of St Mary*. Its institution is said to have been owing to a gentleman among the Danish croises having killed an elephant, in an expedition against the Saracens, in 1184; in memory of which, King Canutus instituted this order, the badge of which is a towered elephant, with an image of the holy virgin encircled with rays, and hung on a watered sky-coloured ribbon, like the george in England.

ELEPHANTA, a small, but very remarkable island, about five miles from the castle of Bombay in the East Indies. Of this we have the following description in Mr Grose's Voyage to the East Indies. "It can at most be but about three miles in compass, and consists almost all of hill; at the foot of which, as you land, you see, just above the shore, on your right, an elephant, coarsely cut out in stone, of the natural bigness, and at some little distance not impossible to be taken for a real elephant, from the stone being naturally of the colour of that beast. It stands on a platform of stones of the same colour. On the back of this elephant was placed, standing, another young one, appearing to have been all of the same stone, but has been long broken down. Of the meaning, or history, of this image, there is no tradition old enough to give any account. Returning then to the foot of the hill, you ascend an easy slant, which about half way up the hill brings you to the opening or portal of a large cavern hewn out of a solid rock into a magnificent temple: for such surely it may be termed, considering the immense workmanship of such an excavation; and seems to me a far more bold attempt than that of the pyramids of Egypt. There is a fair entrance into this subterraneous temple, which is an oblong square, in length about 80 or 90 feet, by 40 broad. The roof is nothing but the rock cut flat at top, and in which I could not discern any thing that did not show it to be all of one piece. It is about ten feet high, and supported towards the middle, at equidistance from the sides and from one another, with two regular rows of pillars of a singular order. They are very massive, short in proportion to their thickness, and their capital bears some resemblance to a round cushion pressed by the superincumbent mountain, with which they are also of one piece. At the further end of this temple are three gigantic figures: the face of one of them is at least five feet in length, and of a proportionable breadth. But these representations have no reference or connection either to any known history or the mythology of the Gentoos. They had continued in a tolerable state of preservation and wholeness, considering the remoteness of their antiquity, until the arrival of the Portuguese, who made themselves masters of the place; and in the blind fury of their bigotry, not suffering any idols but their own, they must have even been at some pains to maim and deface them, as they now remain, considering the hardness of the stone. It is said they even brought field-pieces to the demolition of images, which so greatly deserved to be spared for the unequalled curiosity of them. Of this Queen Catherine of Portugal was, it seems, so sensible, that she could not conceive that any traveller would return from that side of India without visiting the wonders of this cavern; of which too the sight appeared to me to exceed all the descriptions I had heard of them. About two-thirds of the way up this temple, on each side, and fronting each other, are two doors or outlets into smaller grots or excavations, and freely open to the air. Near and about the door-way, on the right hand, are several mutilated images, single and in groups. In one of the last, I remarked a kind of resemblance to the story of Solomon dividing the child, there standing a figure with a drawn sword, holding in one hand an infant with the head downwards, which it appears in act to cleave through the middle. The biggest, in commemoration of the travels of the goddess, and, of her lighting a torch in the flames of Mount Ætna. The sixth day was called Ιακχος, from Iacchus, the son of Jupiter and Ceres, who accompanied his mother in her search after Proserpine, with a torch in his hand. From that circumstance his statue had a torch in his hand, and was carried in solemn procession from the Ceramicus to Eleusis. The statue, with those that accompanied it, called Ιακχαγωγον, was crowned with myrtle. In the way nothing was heard but singing and the noise of brazen kettles as the votaries danced along. The way through which they issued from the city was called Ἱερα ὁδος, *the sacred way*, the resting place Ἱερα συκη, from a *fig-tree* which grew in the neighbourhood. They also stopped on a bridge over the Cephisus, where they derided those that passed by. After they had passed this bridge, they entered Eleusis by a place called μυστικη εισοδος, *the mystical entrance.* On the seventh day were sports, in which the victors were rewarded with a measure of barley, as that grain had been first sown in Eleusis. The eighth day was called Επιδαυρειων ἡμερα, because once Æsculapius at his return from Epidaurus to Athens, was initiated by the repetition of the less mysteries. It became customary therefore to celebrate them a second time upon this, that such as had not hitherto been initiated might be lawfully admitted. The ninth and last day of the festival was called Πλημοχοαι, *earthen vessels*, because it was usual to fill two such vessels with wine; one of them being placed towards the east, and the other towards the west; which, after the repetition of some mystical words, were both thrown down, and the wine being spilt on the ground, was offered as a libation.

The story of Ceres and Proserpine, the foundation of the Eleusinian mysteries, was partly local. It was both verbally delivered, and represented in allegorical show. Proserpine was gathering flowers when she was stolen by Pluto. Hence the procession of the holy basket, which was placed on a car dragged along by oxen, and followed by a train of females, some carrying the mystic chests, shouting, *Hail, Ceres!* At night a procession was made with lighted torches, to commemorate the goddess searching for her daughter. A measure of barley, the grain which, it was believed, she had given, was the reward of the victors in the gymnic exercises; and the transactions at the temple had a reference to the legend. A knowledge of these things and places, from which the profane were excluded, was the amount of initiation; and the mode of it, which had been devised by craft, was skilfully adapted to the reigning superstitions. The operation was forcible, and the effect in proportion. The priesthood flourished as piety increased. The dispensation was corrupt, but its tendency not malignant. It produced sanctity of manners and an attention to the social duties; desire to be as distinguished by what was deemed virtue as by silence.

Some have supposed the principal rites at this festival to have been obscene and abominable, and that from thence proceeded all the mysterious secrecy. They were carried from Eleusis to Rome in the reign of Adrian, where they were observed with the same ceremonies as before, though perhaps with more freedom and licentiousness. They lasted about 1800 years, and were at last abolished by Theodosius the Great.

ELEUSIS, in *Ancient Geography*, a town in Attica, between Megara and the Piræus, celebrated for the festivals of Ceres. See the preceding article.—These rites were finally extinguished in Greece upon the invasion of Alaric the Goth. Eleusis, on the overthrow of its goddess and the cessation of its gainful traffic, probably became soon an obscure place, without character or riches. For some ages, however, it was not entirely forsaken, as is evident from the vast consumption of the ancient materials, and from the present remains, of which the following account is given by Dr Chandler *. "The port was small and of a circular form. The stones of one pier are seen above water, and the corresponding side may be traced. About half a mile from the shore is a long hill, which divides the plain. In the side next the sea are traces of a theatre, and on the top are cisterns cut in the rock. In the way to it, some masses of wall and rubbish, partly ancient, are standing; with ruined churches; and beyond, a long broken aqueduct crosses to the mountains. The Christian pirates had infested the place so much, that in 1676 it was abandoned. It is now a small village at the eastern extremity of the rocky brow, on which was once a castle; and is inhabited by a few Albanian families, employed in the culture of the plain, and superintended by a Turk, who resides in an old square tower. The proprietor was Achmet Aga, the primate or principal person of Athens.

"The mystic temple at Eleusis was planned by Ictinus, the architect of the Parthenon. Pericles was overseer of the building. It was of the Doric order; the cell so large as to admit the company of a theatre. The columns on the pavement within, and their capitals, were raised by Coræbus. Mentagenes of Xypete added the architraves and the pillars above them, which sustained the roof. Another completed the edifice. This was a temple *in antis*, or without exterior columns, which would have occupied the room required for the victims. The aspect was changed to *Prostylos* under Demetrius the Phalerean; Philo, a famous architect, erecting a portico, which gave dignity to the fabric, and rendered the entrance more commodious. The site was beneath the brow, at the east end, and encompassed by the fortress. Some marbles, which are uncommonly massive, and some pieces of the columns, remain on the spot. The breadth of the cell is about 150 feet; the length, including the pronaos and portico is 216 feet; the diameter of the columns, which are fluted, 6 inches from the bottom of the shafts, is 6 feet, and more than six inches. The temple was a decastyle, or had 10 columns in the front, which was to the east. The peribolus or inclosure, which surrounded it on the north-east and on the south side, measures 387 feet in length from north to south, and 328 feet in breadth from east to west. On the west side it joined the angles of the west end of the temple in a straight line. Between the west wall of the inclosure and temple and the wall of the citadel was a passage of 42 feet 6 inches wide, which led to the summit of a high rock at the north-west angle of the inclosure, on which are visible the traces of a temple *in antis*, in length 74 feet 6 inches from north to south, and in breadth from the east

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* *Travels into Greece*, p. 189.

east to the wall of the citadel, to which it joined on the west, 54 feet. It was perhaps that sacred to Triptolemus. This spot commands a very extensive view of the plain and bay. About three-fourths of the cottages are within the precincts of the mystic temple, and the square tower stands on the ruined wall of the inclosure.

"At a small distance from the north end of the inclosure is a heap of marble, consisting of fragments of the Doric and Ionic orders; remains, it is likely, of the temples of Diana Propylea and of Neptune, and of the Propyleum or gateway. Wheler saw some large stones carved with wheat-ears and bundles of poppy. Near it is the bust of a colossal statue of excellent workmanship, maimed, and the face disfigured; the breadth at the shoulders, as measured by Pococke, five feet and a half; and the basket on the head above two feet deep. It probably represented Proserpine. In the heap are two or three inscribed pedestals; and on one are a couple of torches, crossed. We saw another fixed in the same stairs, which lead up the square tower on the outside. It belonged to the statue of a lady, who was hierophant or priestess of Proserpine, and had covered the altar of the goddess with silver. A well in the village was perhaps that called Callichorus, where the women of Eleusis were accustomed to dance in honour of Ceres. A tradition prevails, that if the broken statue be removed, the fertility of the land will cease. Achmet Aga was fully possessed with this superstition, and declined permitting us to dig or measure there, until I had overcome his scruples by a present of a handsome snuff-box containing several zechins or pieces of gold."

ELEUTHERIA, a festival celebrated at Platæa in honour of Jupiter *Eleutherius*, or "the assertor of liberty," by delegates from almost all the cities of Greece. Its institution originated in this: After the victory obtained by the Grecians under Pausanias over Mardonius the Persian general, in the country of Platæa, an altar and statue were erected to Jupiter Eleutherius, who had freed the Greeks from the tyranny of the barbarians. It was further agreed upon in a general assembly, by the advice of Aristides the Athenian, that deputies should be sent every fifth year, from the different cities of Greece, to celebrate Eleutheria, festivals of liberty. The Platæans celebrated also an anniversary festival in memory of those who had lost their lives in that famous battle. The celebration was thus: At break of day a procession was made with a trumpeter at the head, sounding a signal for battle. After him followed chariots loaded with myrrh, garlands, and a black bull, and certain free young men, as no signs of servility were to appear during the solemnity, because they in whose honour the festival was instituted had died in the defence of their country. They carried libations of wine and milk in large-eared vessels with jars of oil, and precious ointments. Last of all appeared the chief magistrate, who, though not permitted at other times to touch iron, or wear garments of any colour but white, yet appeared clad in purple, and taking a water-pot out of the city-chamber, proceeded through the middle of the town, with a sword in his hand, towards the sepulchres. There he drew water from a neighbouring spring, and washed and anointed the monuments, after which he sacrificed a bull upon a pile of wood, invoking Jupiter and infernal Mercury, and inviting to the entertainment the souls of those happy heroes who had perished in the defence of their country. After this he filled a bowl with wine, saying, I drink to those who lost their lives in the defence of the liberties of Greece. There was also a festival of the same name observed by the Samians in honour of the god of love. Slaves, also, when they obtained their liberty, kept a holiday, which they called *Eleutheria*.

ELF, a term now almost obsolete, formerly used to denote a fairy or hobgoblin; an imaginary being, the creature of ignorance, superstition, and craft. See FAIRY.

*ELF-Arrows*, in *Natural History*, a name given to the flints anciently fashioned into arrow-heads, and still found fossil in Scotland, America, and several other parts of the world: they are believed by the vulgar to be shot by fairies, and that cattle are sometimes killed by them.

ELGIN, the capital of the county of Moray in Scotland, and formerly a bishop's see, is situated on the river Lossie, about six miles north from the Spey, in W. Long. 2. 25. N. Lat. 57. 40. Mr Pennant says, it is a good town, and has many of the houses built over piazzas; but, excepting its great cattle-fairs, has little trade. It is principally remarkable for its ecclesiastical antiquities. The cathedral, now in ruins, has been formerly a very magnificent pile. The west door is very elegant and richly ornamented. The choir is very beautiful, and has a fine and light gallery running round it; and at the east end are two rows of narrow windows in an excellent Gothic taste. The chapter-house is an octagon; the roof supported by a fine single column, with neat carvings of coats of arms round the capital. There is still a great tower on each side of this cathedral; but that in the centre, with the spire and whole roof, are fallen in; and form most awful fragments, mixed with the battered monuments of knights and prelates. Boethius says, that Duncan, who was killed by Macbeth at Inverness, lies buried here. The place is also crowded with a number of modern tomb-stones.—The cathedral was founded by Andrew de Moray, in 1224, on a piece of land granted by Alexander II.; and his remains were deposited in the choir, under a tomb of blue marble, in 1244. The great tower was built principally by John Innes bishop of this see, as appears by the inscription cut on one of the great pillars: "Hic Jacet in Xto, pater et dominus, Dominus *Johannes de Innes*, hujus ecclesiæ Episcopus;—qui hoc notabile opus incepit et per septennium ædificavit." Elgin is a royal borough. Population of the town and parish 4602.

ELGINSHIRE, is the middle district of the ancient county of Moray. It is bounded on the north by that branch of the German ocean called the *Moray Frith*; on the east and south-east by Banff-shire; on the south-west, by Inverness-shire; and on the west by the counties of Inverness and Nairn. It extends about 42 miles in length, and its average breadth is about 20. The southern part is rocky and mountainous, called the district of *Braemoray*, which is occupied with extensive forests. The lower parts, towards the north, are rich and fertile; but might easily be rendered more productive. The principal rivers are, the *Spey*, *Findhorne*, and *Lossie*; all of which abound with salmon. It contains two royal boroughs, viz. Elgin, the county town, and Forres; and several considerable towns, as *Grantown*, *Garmouth*, *Lossiemouth*, &c. The principal seats are *Gordon-castle*, the seat of the duke of Gordon; *Castle Grant*, the seat of Sir James Grant; *Altyre*, the seat of Colonel Cumming, &c. Morayshire abounds with many remains of antiquity; the principal of which are the magnificent cathedral of Elgin, the priory of Pluscardine near the town of Elgin, the bishop's palace at Spynie, the castles of *Lochindorb*, *Dunphail*, and the *dun* of *Relugas*, in the parish of Edenkeillie. The ancient Scottish historians, particularly Fordun and Buchanan, give accounts of the Danes landing in Moray, about 1008, when Malcolm II. marched against them, and was defeated near Forres: after this they brought over their wives and children, and were in possession of the country for some time; until they were finally expelled by that monarch, after the victories gained over them at Luncarty near Perth, at Barrie in the county of Angus, and at Mortlach in the county of Banff. There are many monuments of that nation; the most remarkable of which is *Sweno's stone* or *pillar*, on the road from Nairn and Forres, in the parish of Rafford. Except freestone, limestone, and marl, no mineral substance of value has been discovered.

| | *Parishes.* | Population in 1755. | Population in 1790—1798. |
|---|---|---|---|
| 1 | Alves | 1691 | 1111 |
| | Birnie | 525 | 402 |
| | Dallas | 700 | 888 |
| | Drainy | 1174 | 1040 |
| 5 | Duffus | 1679 | 1800 |
| | Duthil | 1785 | 1110 |
| | Dyke and Moy | 1826 | 1529 |
| | Edenkeillie | 1443 | 1800 |
| | Elgin | 6306 | 4534 |
| 10 | Forres | 1993 | 2987 |
| | Kinloss | 1191 | 1031 |
| | Knockandow | 1267 | 1500 |
| | Rafford | 1313 | 1072 |
| | Rothes | 1940 | 1500 |
| 15 | St Andrews | 1132 | 777 |
| | Speymouth | 994 | 1347 |
| | Spynie | 865 | 602 |
| 18 | Urquhart | 1110 | 1050 |
| | | 28,934 | 26,080 |
| | Population in 1811, | 28,108 | |

**ELI**, high priest of the Israelites, and judge over them for forty years, was descended from Ithamar, a junior branch of the house of Aaron, and seems to have blended the priestly with the judicial character in the year 1156 before the commencement of the Christian æra. It appears that the Jews were in a state of subjection or vassalage to the Philistines during the greater part of Eli's administration, and, what may at first appear singular, he contributed to the degeneracy of his countrymen, although his own piety and goodness were unquestionably great. He did not exert his magisterial authority in the exemplary punishment of vice, and even permitted his own sons with impunity to perpetrate the most atrocious acts of impiety and debauchery. This want of firmness, to give it no worse a name, was very reprehensible in one who filled such an important office, and peculiarly so in a man who was himself a saint.

The celebrated Samson made his appearance during the administration of Eli, taking part in the management of public affairs for about 20 years, by whose astonishing deeds the independent spirit of that people was in some measure revived. The circumstances attending the death of Samson, which proved so calamitous to the nobility of the Philistines, might have induced the Jews to throw off the yoke; but they did not possess a sufficient degree of virtue and public spirit for such an exertion. Eli at this period was very far advanced in years, and, if possible, still more negligent in the discharge of his duty as a chief magistrate, allowing his two sons, Hophni and Phineas, to proceed to the most extravagant height of impiety and debauchery, whose example had a most powerful influence on the manners of the people. He was far from being unacquainted with their conduct, but he reproved them with such gentleness as was highly reprehensible, and but ill calculated to produce any change on the behaviour of his sons.

The deity was so justly offended with this deportment of Eli, that a sacred seer was commissioned to upbraid him for his ingratitude and want of resolution. Young Samuel likewise was favoured with a vision of the approaching ruin of Eli's family, which he related to the otherwise venerable old man, on being solemnly adjured not to conceal a single circumstance. When Eli heard the declaration of the young prophet, being fully convinced that his conduct had been highly reprehensible, he exclaimed, "It is the Lord; let him do what seemeth him good." Soon after this the Israelites sustained a considerable loss in attempting to procure their emancipation, carrying the ark of God into their camp to animate the people, and intimidate their enemies; but the ark was captured by the Philistines, and Hophni and Phineas were slain. This intelligence having been brought to Eli, he no sooner heard that the ark of God was taken, than he fell backwards from his seat, broke his neck, and died in the 98th year of his age.

**ELIAS**, the prophet, memorable for having escaped the common catastrophe of mankind; being taken up alive into heaven, in a fiery chariot, about 895 B. C. See *the Bible*.

**ELIJAH**, who is sometimes denominated Elias, was one of the most distinguished of the Jewish prophets, and surnamed the *Tishbite*, probably from the district in which he was born. He began his prophetic office about 920 years before Christ, in the reign of wicked Ahab, by whom the Sidonian idolatry was introduced among the Israelites. The prophet was commissioned to appear before this impious prince, and threaten the country with a long drought as a punishment for his crimes. The indignation of Ahab was so great against the prophet for this prediction, that he resolved to punish him in a signal manner; but Elijah withdrew to a secret place from his fury, at the divine command, where he was sustained in a miraculous manner. He was afterwards ordered to go to Sarepta, in the territory of Sidon, where a miraculous interposition of heaven, in the house of an indigent widow, sustained him for some time, whose son the prophet restored to life.

When the three years of famine, occasioned by the drought, were expired, the prophet was ordered to appear before the king, and exhort him to that genuine repentance which an interposition of the deity so very remarkable unquestionably demanded. He had an interview with Obadiah, the governor of the king's house, who was a religious man, and had frequently screened many from the vengeance of Jezebel the queen, at the hazard of his own life. Fired with undaunted fortitude, the prophet said to Obadiah, "Go, tell thy lord, behold Elijah is here." The good man's regard for the prophet was so great, that he was afraid to deliver this message, since he knew that Ahab had used every effort to discover the prophet's retreat. The king was informed of his coming; and the first interview was distinguished by invectives on the part of the intrepid prophet and the proud sovereign, the former giving a promise of rain on the following terms. The priests of the Sidonian gods, and an assembly of the people of Israel, were to meet on Mount Carmel, where the prophet Elijah intended to give an incontestable proof of the almighty power of the God of Israel, and the total insignificance of the Sidonian divinities. For a detailed account of this memorable experiment, we must refer our readers to the book of Kings, as an abridgement of such a beautiful narration would do it manifest injury. It produced the fullest conviction in the minds of the Israelites, that Jehovah alone was entitled to adoration; and the priests of Baal were instantaneously put to death, as the most abominable perverters of the divine law.

This was followed by abundance of rain, in answer to the devout prayers of the prophet; but his glorious triumph over idolatry so exasperated Jezebel, that she resolved to murder the prophet, to avoid whose rage he fled into the wilderness, till the deity again employed him in the honourable, but often hazardous, duties of a prophet. He afterwards foretold that Hazael should be king of Syria, Jehu king over Israel; and he appointed Elisha the son of Shaphat to be his own successor. He denounced dreadful judgments against Ahab and his wicked queen Jezebel; but those which respected the king were not executed during his life, on account of the genuine repentance which he discovered. The successor of Ahab having been confined to bed in consequence of an accident, the god of Ekron was consulted relative to his recovery, which induced the prophet to declare that he should assuredly die. The king being informed that it was Elijah who dared to send such a message, he dispatched a captain and 50 men to force him into the royal presence; but they were destroyed by fire from heaven, and a second company shared the same fate. A third company confessed the visible interference of heaven in the prophet's behalf, and the captain throwing himself on the mercy of Elijah, went with him to the king. In the royal presence he undauntedly repeated the same denunciation against the idolatrous monarch, which was very soon accomplished; and not long after this the holy prophet, at the divine command, divided asunder the waves of Jordan, dropped his prophetic mantle to the astonished Elisha, took the flaming chariot commissioned for his reception, and rode in majesty to heaven.

ELIQUATION, in *Chemistry*, an operation by which a more fusible substance is separated from one that is less so, by means of a heat sufficiently intense to melt the former, but not the latter. Thus an alloy of copper and lead may be separated by a heat capable of melting the latter, but not the former.

ELIS. See ELEA.

ELIS, in *Ancient Geography*, the capital of the district of that name in Peloponnesus, situated on the Peneus, which ran through it. It was the country of Phædo the philosopher, scholar of Socrates, and friend of Plato; who inscribes with his name the dialogue on the immortality of the soul. Pyrrho also was of this city, at the head of the sect called after him *Pyrrhonists*.

The city of Elis owed its origin to an union of small towns after the Persian war. It was not encompassed immediately with a wall; for it had the care of the temple at Olympia, and its territory was solemnly consecrated to Jupiter. To invade or not protect it was deemed impiety; and armies, if marching through, delivered up their weapons, which, on their quitting it, were restored. Amid warring states the city enjoyed repose, was resorted to by strangers, and flourished. The region round about it was called *cœle* or *hollow*, from the inequalities. The country was reckoned fertile, and particularly fit for the raising of flax. This, which grew nowhere else in Greece, equalled the produce of Judæa in fineness, but was not so yellow. Elis was a school, as it were, for Olympia, which was distant 37 miles. The athletic exercises were performed there, before the more solemn trial, in a gymnasium, by which the Peneus ran. The helanodicæ or præfects of the games paired the rival combatants by lot, in an area called *Plethrum* or *The Acre*. Within the wall grew lofty plane trees; and in the court, which was called the *Xystus*, were separate courses made for the foot races. A smaller court was called the *Quadrangle*. The præfects, when chosen, resided for ten months in a building erected for their use, to be instructed in the duties of their office. They attended before sunrise to preside at the races; and again at noon, the time appointed for the pentathlum or five sports. The horses were trained in the agora or market-place, which was called the *Hippodrome*. In the gymnasium were altars and a cenotaph of Achilles. The women, besides other rites, beat their bosoms in honour of this hero, on a fixed day towards sunset. There also was the town-hall, in which extemporary harangues were spoken and compositions recited. It was hung round with bucklers for ornaments. A way led from it to the baths through the Street of Silence; and another to the market-place, which was planned with streets between porticoes of the Doric order adorned with altars and images. Among the temples, one had a circular peristyle or colonnade; but the image had been removed and the roof was fallen in the time of Pausanias. The theatre was ancient, as was also a temple of Bacchus, one of the deities principally adored at Elis. Minerva had a temple in the citadel, with an image of ivory and gold, made (it was said) by Phidias. At the gate leading to Olympia was the monument of a person, who was buried, as an oracle had commanded, neither within nor without the city. The structures of Elis, Dr Chandler observes, seem to have been raised with materials far less elegant and durable than the produce of the Ionian and Attic quarries. The ruins are of brick, and not considerable, consisting of pieces of ordinary wall, and an octagon building with niches, which, it is supposed, was the temple, with a circular peristyle. These stand detached from each other, ranging in a vale southward from the wide bed of the river Peneus; which, by the margin, has several large stones, perhaps relicks of the gymnasium. The citadel was on a hill, which has on the top some remnants of a wall.

**ELISHA** the prophet, famous for the miracles he performed, died about 830 B. C. See *the Bible*.

**ELISION**, in *Grammar*, the cutting off or suppressing a vowel at the end of a word, for the sake of sound or measure, the next word beginning with a vowel.

Elisions are pretty frequently met with in English poetry, but more frequently in the Latin, French, &c. They chiefly consist in suppressions of the *a*, *e*, and *i*, though an elision suppresses any of the other vowels.

**ELIXATION**, in *Pharmacy*, the extracting the virtues of ingredients by boiling or stewing.

**ELIXIR**, in *Medicine*, a compound tincture extracted from many efficacious ingredients. Hence the difference between a tincture and an elixir seems to be this, that a tincture is drawn from one ingredient, sometimes with an addition of another to open it and to dispose it to yield to the menstruum; whereas an elixir is a tincture extracted from several ingredients at the same time.

**ELIZABETH**, queen of England, daughter of Henry VIII. and Anne Boleyn, was born at Greenwich, September 7. 1533. According to the humour of the times, she was early instructed in the learned languages, first by Grindal, who died when she was about 17, and afterwards by the celebrated Roger Ascham. She acquired likewise considerable knowledge of the Italian, Spanish, and French languages. Dr Grindal was also her preceptor in divinity, which she is said to have studied with uncommon application and industry. That Elizabeth became a Protestant, and her sister Mary a Papist, was the effect of that cause which determines the religion of all mankind; namely, the opinion of those by whom they were educated: and this difference of opinion, in their tutors, is not at all surprising, when we recollect, that their father Harry was of both religions, or of neither.

But the studies of Elizabeth were not confined merely to languages and theology: she was also instructed in the political history of the ancients; and was so well skilled in music, as to sing and play "artfully and sweetly."

After the short reign of her brother Edward, our heroine being then about 20 years of age, her *firebrand* sister acceding to the crown, Elizabeth experienced a considerable degree of persecution, so as to be not a little apprehensive of a violent death. She was accused of nobody knows what; imprisoned; and, we are told, inhumanly treated. At last, by the intercession of King Philip of Spain, she was set at liberty; which she continued to enjoy, till, on the death of her *pious* sister, she, on the 17th of November 1558, ascended the throne of England. Her political history as a queen, is universally known and admired *: but her attention to the government of her kingdom did not totally suspend her pursuit of learning. Ascham, in his *Schoolmaster*, tells us, that, about the year 1563, five years after her accession, she being then at Windsor, besides her perfect readiness in Latin, Italian, French, and Spanish, she read more Greek in one day than some prebendaries of that church did read Latin in a whole week, (p. 21.)—She employed Sir John Fortescue to read to her Thucydides, Xenophon, Polybius, Euripides, Æschines, and Sophocles. (*Ballard*, p. 219.). That the Latin language was familiar to her, is evident from her speech to the university of Oxford, when she was near sixty; also from her spirited answer to the Popish ambassador in the year 1598. And that she was also skilled in the art of poetry, appears not only from the several scraps which have been preserved, but likewise from the testimony of a contemporary writer, Puttenham, in his *Art of Engl. Poetry* (a very scarce book). These are his words: "But, last in recital, and first in degree, is the queen, whose learned, delicate, noble muse, easily surmounteth all the rest, for sense, sweetness, or subtility, be it in ode, elegy, epigram, or any other kind of poem," &c. In this author are to be found only a specimen of 16 verses of her English poetry. "But," says Mr Walpole, "a greater instance of her genius, and that too in Latin, was her extempore reply to an insolent prohibition delivered to her from Philip II. by his ambassador, in this tetrastic.

Te veto ne pergas bello defendere Belgas:
Quæ Dracus eripuit, nunc restituantur oportet:
Quas pater evertit, jubeo te condere cellas:
Religio papæ fac restituatur ad unguem.

"She instantly answered him, with as much spirit as she used to return his invasions;

Ad Græcas, bone rex, fient mandata kalendas."

Being earnestly pressed by a Romish priest, during his persecution, to declare her opinion concerning the real presence of Christ's body in the wafer, she answered,

Christ was the word that spake it;
He took the bread, and brake it:
And what that word did make it,
That I believe and take it.—*Fuller's Holy State.*

She gave the characters of four knights of Nottinghamshire in the following distich:

Gervase the Gentle, Stanhope the stout,
Markham the lion, and Sutton the lout. *Walp. Cat.*

Coming into a grammar-school, she characterized three classic authors in this hexameter:

Persius a crab-staff; bawdy Martial; Ovid a fine wag.
*Full. Worth. of Warw.* 126.

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* See (History of) *England*.

Sir Walter Raleigh having wrote on a window,

> Fain would I climb, yet fear I to fall;

She immediately wrote under it,

> If thy heart fail thee, climb not at all.

*Worth. of Devonsh.* 261.

Doubtless, she was a woman of singular capacity and extraordinary acquirements: and if we could forget the story of the Scottish Mary, and of her favourite Essex, together with the burning of a few Anabaptists; in short, could we forbear to contemplate her character through the medium of religion and morality, we might pronounce her the most illustrious of illustrious women. See further the articles ENGLAND, MARY, and SCOTLAND. She died in her palace at Richmond, the 24th of March 1602, aged 70, having reigned 44 years; and was interred in the chapel of Henry VII. in Westminster Abbey. Her successor James erected a magnificent monument to her memory.—She wrote, 1. The Mirror, or Glass of the Sinful Soul. This was translated out of French verse into English prose, when she was eleven years old. It was dedicated to Queen Catharine Parr. Probably it was never printed; but the dedication and preface are preserved in the *Sylloge epistolarum*, in Hearne's edition of *Livii Foro-Juliensis*, p. 161. 2. Prayers and Meditations, &c. Dedicated to her father, dated at Hatfield, 1545. Manuscript, in the royal library. 3. A Dialogue out of Xenophon, in Greek, between Hiero a King, yet some time a private person, and Simonides a Poet, as touching the life of the Prince and Private Man. First printed from a manuscript in her majesty's own handwriting, in the Gentleman's Magazine for 1743. 4. Two Orations of Isocrates, translated into Latin. 5. Latin Oration at Cambridge. Preserved in the king's library: also in Hollinshed's Chron. p. 1206.; and in Fuller's Hist. of Cambr. p. 138. 6. Latin Oration at Oxford. See Wood's Hist. and Antiq. of Oxf. lib. i. p. 289. also in Dr Jebb's Append. to his Life of Mary Queen of Scots. 7. A Comment on Plato. 8. *Boethius de consolatione philosophiæ*, translated into English anno 1593. 9. *Sallust de bello Jugurthino*, translated into English anno 1590. 10. A play of Euripides, translated into Latin, (Cat. of Royal Auth.). 11. A Prayer for the use of her fleet in the great expedition in 1596. 12. Part of Horace's Art of Poetry, translated into English anno 1598. 13. *Plutarch de curiositate*, translated into English. 14. Letters on various occasions to different persons: several speeches to her parliament; and a number of other pieces.

ELIZABETH PETROWNA, (daughter of Peter the Great), the last empress of Russia, distinguished herself by her signal clemency. She made a vow that no person should be put to death in her reign, and she strictly observed it. The example was followed, and confirmed by law, under the august sovereign of Russia, Catharine II. Elizabeth died in 1762, in the 21st year of her reign and 52d of her age.

ELK, in *Zoology*. See CERVUS, MAMMALIA *Index*.

ELL, (*ulna*,) a measure which obtains, under different denominations, in most countries, whereby cloths, stuffs, linens, silks, &c. are usually measured; answering nearly to the yard of England, the canna of Italy, the vara of Spain, the palm of Sicily, &c.

Servius will have the ell to be the space contained between the two hands when stretched forth; but Suetonius makes it only the cubit.

The ells most frequently used with us are the English and Flemish; the former containing three feet nine inches, or one yard and a quarter; the latter only 27 inches, or three quarters of a yard; so that the ell English is to the Flemish ell as five to three. In Scotland, the ell contains 37 $\frac{2}{10}$ English inches.

M. Ricard, in his Treatise of Commerce, reduces the ells thus: 100 ells of Amsterdam are equal to 98¼ of Brabant, Antwerp, and Brussels; to 58½ of England and France; to 120 of Hamburgh, Francfort, Leipsic, and Cologne; 125 of Breslaw; 110 of Bergen and Drontheim; and 117 of Stockholm.

ELLIOT, the Right Honourable George Augustus, Lord Heathfield, was the youngest son of the late Sir Gilbert Elliot, Baronet, of Stobbs (A) in Roxburghshire; and was born about the year 1718. He received the first rudiments of his education under a private tutor: and at an early time of life was sent to the university of Leyden, where he made considerable progress in classical learning, and spoke with fluency and elegance the German and French languages. Being designed for a military life, he was sent from thence to the celebrated *Ecole Royale du Genie Militaire*, conducted by the great Vauban at La Fere in Picardy; where he laid the foundation of what he so conspicuously exhibited at the defence of Gibraltar. He completed his military course on the continent by a tour, for the purpose of seeing in practice what he had studied in theory. Prussia was the model for discipline, and he continued some time as a volunteer in that service.

Mr Elliot returned in the 17th year of his age to his native country, Scotland; and was the same year, 1735, introduced by his father Sir Gilbert to Lieutenant-Colonel Peers of the 23d regiment of foot, then lying at Edinburgh, as a youth anxious to bear arms for

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(A) The ancient and honourable family of Elliot of Stobbs, as well as the collateral branch of Elliot of Minto in the same county, and of Elliot of Port-Elliot in Cornwall, are originally from Normandy. Their ancestor, Mr Aliott, came over with William the Conqueror, and held a distinguished rank in his army. There is a traditionary anecdote in the family relating to an honourable distinction in their coat, which, as it corresponds with history, bears the probability of truth. When William set foot on English land, he slipped and fell on the earth. He sprung up, and exclaimed that it was a happy omen—he had embraced the country of which he was to become the lord. Upon this Aliott drew his sword, and swore by the honour of a soldier, that he would maintain, at the hazard of his blood, the right of his lord to the sovereignty of the earth which he had embraced. On the event of his conquest, King William added to the arms of Aliott, which was a baton *or*, on a field *azure*, an arm and sword as a crest, with the motto, *Per saxa, per ignes, fortiter et rectè*.

for his king and country. He was accordingly entered as a volunteer in that regiment, where he continued for a year or more. From the 23d regiment he went into the engineer corps at Woolwich, and made great progress in that study, until his uncle Colonel Elliot brought him in his adjutant of the second troop of horse grenadiers. With these troops he went upon service to Germany, and was with them in a variety of actions. At the battle of Dettingen he was wounded. In this regiment he bought the rank of captain and major, and afterwards purchased the lieutenant-colonelcy from Colonel Brewerton, who succeeded to his uncle. On arriving at this rank, he resigned his commission as an engineer, which he had enjoyed along with his other rank, and in which service he had been actively employed very much to the advantage of his country. He received the instructions of the famous engineer Bellidor, and made himself completely master of the science of gunnery. Had he not so disinterestedly resigned his rank in the engineer department, he would long before his death, by regular progression, have been at the head of that corps. Soon after this he was appointed aid-de-camp to George II. and was distinguished for his military skill and discipline. In the year 1759, he quitted the second troop of horse grenadier guards, being selected to raise, form, and discipline, the first regiment of light horse, called after him *Elliot's*. As soon as they were raised and formed, he was appointed to the command of the cavalry in the expedition on the coasts of France, with the rank of brigadier-general. After this he passed into Germany, where he was employed on the staff, and greatly distinguished himself in a variety of movements; where his regiment displayed a strictness of discipline, an activity and enterprise, which gained them signal honour: and indeed they have been the pattern regiment both in regard to discipline and appointment, to the many light dragoon troops that have been since raised in our service. From Germany he was recalled for the purpose of being employed as second in command in the memorable expedition against the Havannah; the circumstances of which conquest are well known.

On the peace, his gallant regiment was reviewed by the king, when they presented to his majesty the standards which they had taken from the enemy. Gratified with their fine discipline and high character, the king asked General Elliot what mark of his favour he could bestow on his regiment equal to their merit? He answered that his regiment would be proud if his majesty should think, that, by their services, they were entitled to the distinction of *Royals*. It was accordingly made a royal regiment, with this flattering title, "The 15th, or *King's* Royal Regiment of Light Dragoons." At the same time the king expressed a desire to confer some honour on the general himself; but the latter declared, that the honour and satisfaction of his majesty's approbation of his services was his best reward.

During the peace he was not idle. His great talents in the various branches of the military art gave him ample employment. In the year 1775, he was appointed to succeed General A'Court as commander in chief of the forces in Ireland; but did not continue long in this station, not even long enough to unpack all his trunks; for finding that interferences were made by petty authority derogatory of his own, he resisted the practice with becoming spirit; and not choosing to disturb the government of the sister kingdom on a matter personal to himself, he solicited to be recalled. He accordingly was so, and appointed to the command of Gibraltar in a fortunate hour for the safety of that important fortress. The system of his life, as well as his education, peculiarly qualified him for this trust. He was perhaps the most abstemious man of the age; neither indulging himself in animal food or wine. He never slept more than four hours at a time; so that he was up later and earlier than most other men. He so inured himself to habits of hardiness, that the things which are difficult and painful to other men, were to him his daily practice, and rendered pleasant by use. It could not be easy to starve such a man into a surrender, nor possible to surprise him. The example of the commander in chief in a besieged garrison has the most persuasive efficacy in forming the manners of a soldiery. Like him his brave followers came to regulate their lives by the most strict rules of discipline, before there arose a necessity for so doing; and severe exercise, with short diet, became habitual to them by their own choice. The military system of discipline which he introduced, and the preparations which he made for his defence, were contrived with so much judgment, and executed with so much address, that he was able with a handful of men to preserve his post against an attack, the constancy of which, even without the vigour, had been sufficient to exhaust any common set of men. Collected within himself, he in no instance destroyed, by premature attacks, the labours which would cost the enemy time, patience, and expence to complete; he deliberately observed their approaches, and seized on the proper moment, with the keenest perspection, in which to make his attack with success. He never spent his ammunition in useless parade or in unimportant attacks. He never relaxed from his discipline by the appearance of security, nor hazarded the lives of his garrison by wild experiments. By a cool and temperate demeanour, he maintained his station for three years of constant investment, in which all the powers of Spain were employed. All the eyes of Europe were on this garrison; and his conduct has justly exalted him to the most elevated rank in the military annals of the day. On his return to England, the gratitude of the British senate was as forward as the public voice in giving him that distinguished mark his merit deserved. Both houses of parliament voted an unanimous address of thanks to the general. The king conferred on him the honour of Knight of the Bath, with a pension during his own and a second life of his own appointment; and on June 14. 1787, his majesty advanced him to the peerage, by the title of *Lord Heathfield, Baron Gibraltar*, permitting him to take, in addition to his family arms, the arms of the fortress he had so bravely defended, to perpetuate to futurity his noble conduct.

His lordship died on the 9th of July 1790, at his chateau at Aix-la-Chapelle, of a second stroke of the palsy, after having for some weeks preceding enjoyed tolerable good health and an unusual flow of spirits. His death happened two days before he was to have set out for Leghorn on his way to Gibraltar; of which place he was once more appointed to the defence,

fence, in the view of an approaching war. He married Anne, daughter of Sir Francis Drake of Devonshire; and had by her (who died in 1769) Francis-Augustus, now Lord Heathfield, lieutenant-colonel of the 6th regiment of horse.

**ELLIPOMACROSTYLA**, an old term in *Natural History*, from the Greek, ελλιπης *imperfect*, μακρος *long*, and στυλος *a column*; which expresses an imperfect crystal with a long column.

**ELLIPOPACHYSTYLA**, an old term in *Natural History*, derived from the Greek, and expresing a crystal of the imperfect kind with a thick column.

**ELLIPSIS**, in *Geometry*, a curve line returning into itself, and produced from the section of a cone by a plane cutting both its sides, but not parallel to the base. See *Conic Sections*.

**Ellipsis**, in *Grammar*, a figure of syntax, wherein one or more words are not expressed; and from this deficiency it has got the name *ellipsis*.

**ELLIPTIC**, or **Elliptical**, something belonging to an ellipsis.

*Elliptic Turning*, a method of giving a piece of wood an elliptic figure. See Supplement.

**ELLIPTOGRAPH**, an instrument for drawing ellipses. See Supplement.

**ELLISIA**, a genus of plants belonging to the pentandria class; and in the natural method ranking under the 28th order, *Luridæ*. See Botany *Index*.

**ELLYS, Dr Anthony**, who was born in 1693, and educated at Clarehall, Cambridge, after rising through many inferior degrees of dignity in the church of England, was, in 1752, promoted to the see of St David's. He died at Gloucester in 1761, and is mentioned here only for the sake of his works, which are less known than they should in the present time of novel opinions. They are, besides occasional sermons, 1. A Plea for the Sacramental Test, as a just security to the Church established, and very conducive to the welfare of the State. 2. Remarks on Hume's Essay on Miracles. 3. Tracts on the Liberty spiritual and temporal of Protestants in England, addressed to J. N. Esq. at Aix-la-Chapelle; the first part of which was printed in 1763, the second in 1765. In these tracts, as the editors of them truly observe, he "discovers not only fine parts, extensive knowledge, and sound judgement, but a heart overflowing with benevolence and candour, and a most Christian temper: for he always thought a person, though on the right side of the question, with principles of persecution, to be a worse man than he that was on the wrong." This amiable and respectable writer affords in his own conduct a proof that a man may be steadily attached to a party, without wishing to encroach upon the rights of others.

**ELM.** See Ulmus, Botany *Index*.

**ELMACINUS, George**, author of a *History of the Saracens*, was born in Egypt towards the middle of the 13th century. His history comes down from Mahomet to the year of the Hegira 512, answering to the year of our Lord 1134; in which he sets down year by year, in a very concise manner, whatever regards the Saracen empire, intermixed with some passages relating to the eastern Christians. His abilities must have been considerable; since, though he professed Christianity, he held an office of trust near the persons of the Mahometan princes. He was son to Yaser Al Amid, secretary to the council of war under the sultans of Egypt for 45 years; and in 1238, when his father died, succeeded him in his place. His history of the Saracens was translated from Arabic into Latin by Erpinius: and printed in these two languages in folio, at Leyden, in 1625. Erpinius died before the publication; but Golius took care of it, and added a preface. It was dedicated by Erpinius's widow to Dr Andrews, bishop of Winchester.

**ELOCUTION.** See Oratory, Part III.

**ELOGY**, a praise or panegyric bestowed on any person or thing, in consideration of its merit. The beauty of elogy consists in an expressive brevity. Eulogiums should not have so much as one epithet, properly so called, nor two words synonymous: they should strictly adhere to truth; for extravagant and improbable elogies rather lessen the character of the person or thing they would extol.

**ELOHI, Eloi**, or *Elohim*, in scripture, one of the names of God. But it is to be observed, that angels, princes, great men, judges, and even false gods, are sometimes called by this name. The sequel of the discourse is what assists us in judging rightly concerning the true meaning of this word. It is the same as *Eloha*. One is the singular, the other the plural. Nevertheless *Elohim* is often construed in the singular number, particularly when the true God is spoken of: but when false gods are spoken of, it is construed rather in the plural.

**ELOINED**, in *Law*, signifies restrained or hindered from doing something: thus it is said, that if those within age be eloined, so that they cannot sue personally, their next friend shall sue for them.

**ELONGATION**, in *Astronomy*, the digression or recess of a planet from the sun, with respect to an eye placed on our earth. The term is chiefly used in speaking of Venus or Mercury, the arch of a great circle intercepted between either of these planets and the sun being called the *elongation* of that planet from the sun.

**Elongation**, in *Surgery*, is an imperfect luxation, occasioned by the stretching or lengthening of the ligaments of any part.

**ELOPEMENT**, in *Law*, is where a married woman departs from her husband, and cohabits with an adulterer; in which case the husband is not obliged to allow her any alimony out of her estate, nor is he chargeable for necessaries for her of any kind. However, the bare advertising a wife in the gazette, or other public paper, is not a legal notice to persons in general not to trust her; though a personal notice given by the husband to particular persons is said to be good. An action lies, and large damages may be recovered, against a person for carrying away and detaining another man's wife.

**ELOQUENCE**, the art of speaking well, so as to affect and persuade. See Oratory.

**ELPHINSTON, William**, a Scotch prelate and statesman of considerable eminence, who flourished in the end of the 15th and commencement of the 16th century, was born at Glasgow in the year 1431. At the university of this city he received his education, and in the learning which distinguished that period he made extraordinary proficiency. His studies being completed, he went over to France, to make himself master of the civil and canon law in the university of Paris, where he afterwards became a professor, and for the space of six years acquired considerable reputation in the discharge of his duty. On his return to Scotland, he entered into holy orders, was soon appointed official of Glasgow, and afterwards of St Andrews. He was admitted a member of the king's council; and on a misunderstanding taking place between James III. of Scotland and Louis XI. of France, his powerful mediation at the latter court, in conjunction with the bishop of Dunkeld and the earl of Buchan, effected an amicable reconciliation. As Elphinston on this occasion displayed such prudence and eloquence, the king was so grateful for his meritorious services, that he rewarded him with the see of Ross, from which he was translated to the diocese of Aberdeen about the year 1484, and also appointed to the high office of chancellor of the kingdom, which he managed with so much moderation and equity, that all parties esteemed and admired him. When the civil wars broke out between James and the discontented nobility, Bishop Elphinston appears to have declined all interference with public affairs of a political nature, and confined himself to the discharge of his ministerial duties. But when James IV. ascended the throne, his abilities as a statesman were again called forth, and he was chosen ambassador to the emperor Maximilian, in order to bring about a marriage alliance between his royal master and the emperor's daughter; but she had been previously promised to another. Yet the bishop's mission was not without its salutary effects, as he was the mean of terminating an enmity which had long existed between the Dutch and Scots. This he conducted in such a masterly manner, that James never undertook any thing of importance, without first procuring the sanction of his approbation. He was equally the zealous patron of learning; and it is generally believed that the establishment of a university at Aberdeen was entirely owing to his influence with the Pope, from whom he obtained a bull for that purpose; and by his exertions was King's college undertaken and completed. He bequeathed, at the time of his decease, large sums of money for its support. He terminated his mortal career in 1514, about 83 years of age, at which advanced period his constitutional vigour was very little impaired, and all the faculties of his mind were in full force; but the serious losses at the memorable battle of Flowden had broken his heart. He wrote a history of his native country, which is among the manuscripts of Sir Thomas Fairfax, in the Bodleian library at Oxford.

**EDSHEMIER**, Adam, a celebrated painter, born at Francfort on the Maine, in 1574. He was first a disciple of Philip Uffenbach, a German; but his desire of improvement carrying him to Rome, he soon became a most excellent artist in landscapes, history, and night-pieces, with small figures. His works are but few; and the great pains he bestowed in finishing them raised their prices so high, that they are hardly anywhere to be found but in the cabinets of princes. He was of a melancholy turn, and sunk under the embarrassments of his circumstances in 1610. James Ernest Thomas of Landau was his disciple; and imitated his style so nicely, that their performances are not easily distinguished.

**ELSIMBURG**, a port town of Sweden, in the province of Gothland, and territory of Schonen, seated on the side of the Sound, over against Elsinore. It was formerly a fortress belonging to the Danes; but all the fortifications were demolished in 1679, and there is only one tower of a castle which remains undemolished. It now belongs to Sweden. E. Long. 13. 20. N. Lat. 56. 2.

**ELSINORE**, or Elsineur, a port town of Denmark, seated on the Sound, in the isle of Zealand. E. Long. 13. 23. N. Lat. 56. 0.—It was a small village, containing a few fishermen's huts, until 1445, when it was made a staple town by Eric of Pomerania; who conferred upon the new settlers considerable immunities, and built a castle for their defence. From that period it gradually increased in size and wealth, and is now the most commercial place in Denmark next to Copenhagen. It contains about 7000 inhabitants, amongst whom are a considerable number of foreign merchants, and the consuls of the principal nations trading to the Baltic. The passage of the Sound is guarded by the fortress of Cronborg, which is situated upon the edge of a peninsular promontory, the nearest point of land from the opposite coast of Sweden. It is strongly fortified towards the shore by ditches, bastions, and regular entrenchments; and towards the sea by several batteries, mounted with 60 cannon, the largest whereof are 48 pounders. Every vessel, as it passes, lowers her top-sails, and pays a toll at Elsinore. It is generally asserted, that this fortress guards the Sound; and that all the ships must, on account of the shoal waters and currents, steer so near the batteries as to be exposed to their fire in case of refusal. This, however, is a mistaken notion. On account indeed of the numerous and opposite currents in the Sound, the safest passage lies near the fortress; but the water in any part is of sufficient depth for vessels to keep at a distance from the batteries, and the largest ships can even sail close to the coast of Sweden. The constant discharge, however, of the toll, is not so much owing to the strength of the fortress as to a compliance with the public law of Europe. Many disputes have arisen concerning the right by which the crown of Denmark imposes such a duty. The kings of Sweden, in particular, claiming an equal title to the free passage of the Strait, were for some time exempted by treaty from paying it; but in 1720, Frederic I. agreed that all Swedish vessels should for the future be subject to the usual imposts. All vessels, beside a small duty, are rated at 1½ per cent. of their cargoes, except the English, French, Dutch, and Swedish, which pay only one per cent.; and in return the crown takes the charge of constructing light-houses, and erecting signals to mark the shoals and rocks, from the Categate to the entrance into the Baltic. The tolls of the Sound, and of the two Belts, supply an annual revenue of 120,000l. or according to others 150,000l.

**ELVAS**, a large town, and one of the best and most important in Portugal, seated in the province of Alentejo, a few miles from the frontiers of Estremadura in Spain. It is built on a mountain, and is strongly fortified with works of free-stone. The streets of the town are handsome, and the houses neat; and there is a cistern so large, that it will hold water enough to supply the whole town six months. The water is conveyed to it by a magnificent aqueduct, three miles in length, sustained in some places by four or five high arches, one upon another. It was bombarded by the French and Spaniards in 1706, but without effect. It has generally a garrison of 1000 men. The king founded an academy here, in 1733, for young gentlemen. W. Long. 7. 28. N. Lat. 38. 39.

ELUDING, the act of evading or rendering a thing vain and of no effect; a dexterous getting clear, or escaping out of an affair, difficulty, embarrassment, or the like. We say, to *elude* a proposition, &c. The design of chicanery is, to *elude* the force of the laws: This doctor has not resolved the difficulty, but *eluded* it. Alexander, says the historian, in cutting the Gordian knot, either *eluded* the oracle or fulfilled it: *Ille nequicquam luctatus cum latentibus nodis, Nihil, inquit, interest, quomodo solvatur; gladioque ruptis omnibus loris, oraculi sortem vel* eludit *vel implevit.*

ELVELA, a genus of plants belonging to the cryptogamia class, and order of fungi. The fungus is turbinated, or like an inverted cone. See BOTANY *Index.*

ELUL, in ancient chronology, the 12th month of the Jewish civil year, and the sixth of the ecclesiastical: it consisted of only 29 days, and answered pretty nearly to our August.

ELUTRIATION, in *Chemistry*, an operation performed by washing solid substances with water, stirring them well together, and hastily pouring off the liquid, while the lighter part remains suspended in it, that it may thereby be separated from the heavier part. By this operation metallic ores are separated from earth, stones, and other unmetallic particles adhering to them.

ELY, a city and bishop's see of Cambridgeshire, situated about 12 miles north of Cambridge. E. Long. 0. 51. N. Lat. 52. 24. It is a county of itself, including the territory around; and has a judge who determines all causes civil and criminal within its limits. The church hath undergone various alterations since it was first established by Etheldra, the wife of Egfride, king of Northumberland, who founded a religious house here, and planted it with virgins, and became the first abbess of it herself. The Danes entirely ruined this establishment; then Ethelwald, the 27th bishop of Winchester, rebuilt the monastery, and filled it with monks; to whom King Edgar, and many succeeding monarchs, bestowed many privileges, and great grants of land; so that this abbey became in process of time the best of any in England. Richard, the 11th abbot, wishing to free himself of the bishop of Lincoln, within whose diocese his monastery was situated, and not liking so powerful a superior, he made great interest with King Henry I. to get Ely erected into a bishopric; and spared neither purse nor prayers to bring this about. He even brought the bishop of Lincoln to consent to it, by giving him and his successors the manors of Bugden, Biggleswade, and Spalding, which belonged to the abbey, in lieu of his jurisdiction; but he lived not to taste the sweets of his industry and ambition, he dying before his abbey was erected into a see. His successor was the first bishop of Ely: but the great privileges the bishop enjoyed were almost wholly taken away, or much restricted, by the act of parliament, 27th Henry VIII. regarding the restoring to the crown the ancient royalties: So, instead of being palatine of the isle of Ely, the bishop and his temporal steward were by that act declared to be from thenceforth justices of the peace in the said island. This diocese contains all Cambridgeshire, and the isle of Ely, excepting Iselham, which belongs to the see of Rochester, and 15 other parishes, that are in the diocese of Norwich; but it has a parish in Norfolk, viz. Emneth. The number of parishes in this diocese are 141, whereof 75 are impropriate. It hath but one archdeacon, viz. of Ely. It is valued in the king's books at 2134l. 18s. 5d. The clergy's tenth amounting to the sum of 384l. 14s. 9½d. The bishopric is computed to be worth annually 8000l. The church is dedicated to St Ethelred. The building, as it now appears, has been the work of several of its bishops. The west parts were rebuilt by Bishop Ridal; the choir and lanthern were begun by Bishop Norwold, and finished by Bishop Frodsham. This see hath given two saints and two cardinals to the church of Rome; and to the English nation nine lord chancellors, seven lord treasurers, one lord privy seal, one chancellor of the exchequer, one chancellor to the university of Oxford, two masters of the rolls, and three almoners. To this cathedral belong a bishop, a dean, an archdeacon, eight prebendaries, with vicars, lay-clerks, choristers, a schoolmaster, usher, and 28 king's scholars.

ELYMAIS, the capital city of the land of Elam, or the ancient Persia. We are told (1 Mac. vi. 1.) that Antiochus Epiphanes, having understood that there were very great treasures lodged in a temple at Elymais, determined to go and plunder it: but the citizens getting intelligence of his design, made an insurrection, forced him out of the city, and obliged him to fly. The author of the second book of Maccabees (ix. 2.) calls this city *Persepolis*, in all probability because formerly it was the capital of Persia; for it is known from other accounts, that Persepolis and Elymais were two very different cities, the latter situated upon the Eulæus, the former upon the Araxis.

ELYMUS, a genus of plants belonging to the triandria class, and in the natural method ranking under the fourth order, *Gramina.* See BOTANY *Index.*

ELYOT, SIR THOMAS, a gentleman of eminent learning into the 16th century, was educated at Oxford, travelled into foreign countries, and upon his return was introduced to court. His learning recommended him to Henry VIII. who conferred the honour of knighthood on him, and employed him in several embassies: particularly in 1532, to Rome, about the divorce of Queen Catharine, and afterwards to Charles V. about 1536. He wrote, *The Castle of Health, the Governor, Banquet of Sapience, Of the Education of Children, De rebus memorabilibus Angliæ*, and other books; and was highly esteemed by all his learned contemporaries.

ELYSIUM (Ελυσιος), in the ancient theology, or rather mythology, a place in the *inferi* or lower world, furnished with fields, meads, agreeable woods, groves, shades, rivers, &c. whither the souls of good people were supposed to go after this life.

Orpheus, Hercules, and Æneas, were supposed to have

have descended into Elysium in their life time, and to have returned again; (Virg. lib. vi. ver. 638 &c.). Tibullus (lib. i. eleg. 3.) gives us fine descriptions of the Elysian fields.

Virgil opposes Elysium to Tartarus; which was the place where the wicked underwent their punishment.

> *Hic locus est, partes ubi se via findit in ambas:*
> *Dextera, quæ Ditis magni sub mœnia tendit:*
> *Hac iter* Elysium *nobis: at læva malorum*
> *Exercet pœnas, et ad impia Tartara mittit.*

He assigns Elysium to those who died for their country, to those of pure lives, to truly inspired poets, to the inventors of arts, and to all who have done good to mankind.

Some authors take the fable of Elysium to have been borrowed from the Phœnicians; as imagining the name *Elysium* formed from the Phœnician עלז *alaz*, or עלצ *alats*, or עלס, *alas*, "to rejoice," or "to be in joy;" the letter *a* being only changed into *e*, as we find done in many other names; as in *Enakim* for *Anakim*, &c. On which footing, Elysian fields should signify the same thing as a place of pleasure; or

> ——— *Locos lætos, et amœna vireta*
> *Fortunatorum nemorum, sedesque beatas.* VIRG.

Others derive the word from the Greek λυω, *solvo*, "I deliver, I let loose or disengage;" because here men's souls are freed or disencumbered from the fetters of the body. Beroaldus, and Hornius (Hist. Philosoph. lib. iii. cap. 2.) take the place to have derived its name from Eliza, one of the first persons who came into Greece after the deluge, and the author and father of the Ætolians.

The Elysian fields were, according to some, in the Fortunate islands on the coast of Africa, in the Atlantic. Others place them in the island of Leuce; and, according to the authority of Virgil, they were situated in Italy. According to Lucian, they were near the moon; or in the centre of the earth, if we believe Plutarch. Olaus Wormius contends that it was in Sweden the Elysian fields were placed.

**ELZEVIRS**, celebrated printers at Amsterdam and Leyden, who greatly adorned the republic of letters with many beautiful editions of the best authors of antiquity. They fell somewhat below the Stephenses in point of learning, as well as in their editions of Greek and Hebrew authors; but as to the choice of good books, they seem to have equalled, and in the neatness and elegance of their small characters, greatly to have exceeded them. Their Virgil, Terence, and Greek Testament, have been reckoned their masterpieces; and are indeed so very fine, that they justly gained them the reputation of being the first printers in Europe. There were five of these Elzevirs, namely, Lewis, Bonaventure, Abraham, Lewis, and Daniel. Lewis began to be famous at Leyden in 1595, and was remarkable for being the first who observed the distinction between the *v* consonant and *u* vowel, which had been recommended by Ramus and other writers long before, but never regarded. Daniel died in 1680 or 1681; and though he left children who carried on the business, passes nevertheless for the last of his family who excelled in it. The Elzevirs have printed several catalogues of their editions; but the last, published by Daniel is considerably enlarged, and abounds with new books. It was printed at Amsterdam, 1674, in 12mo, and divided into seven volumes.

**EMANATION**, the act of flowing or proceeding from some source or origin. Such is the emanation of light from the sun; or that of effluvia from odorous, &c. bodies; of wisdom from God, &c.—The word is formed of the Latin *è*, "out of," and *manare*, "to flow or stream."

EMANATION is also used for the thing that proceeds, as well as the act of proceeding. The power given a judge is an emanation from the regal power; the reasonable soul is an emanation from the Divinity.

**EMANCIPATION**, in the Roman law, the setting free a son from the subjection of a father; so that whatever moveables he acquires belongs in property to him, and not his father, as before emancipation.

Emancipation puts the son in a capacity of managing his own affairs, and of marrying without his father's consent, though a minor. Emancipation differs from manumission, as the latter was the act of a master in favour of a slave, whereas the former was that of a father in favour of his son.

There were two kinds of emancipation: the one tacit, which was by the son's being promoted to some dignity, by his coming of age, or by his marrying; in all which cases he became his own master of course. The other, express; where the father declared before a judge, that he emancipated his son. In performing this, the father was first to sell his son imaginarily to another, whom they called *pater fiduciarius*, father in trust; of whom being bought back again by the natural father, he manumitted him before the judge by a verbal declaration.

Emancipation formerly obtained in France with regard to minors or pupils, who were hereby set at liberty to manage their own effects, without the advice or direction of their parents or tutors.

**EMARGINATED**, among botanists. See BOTANY *Index*.

**EMASCULATION**, the act of castrating or depriving a male of those parts which characterize his sex. See CASTRATION and EUNUCH.

**EMAUS**, EMMAUS, or *Ammaus*, in *Ancient Geography*, a village, 60 stadia to the north-west of Jerusalem, or about seven miles: it afterwards became a town and a Roman colony, *Nicopolis*, (Jerome). Reland has another *Emmaus* towards Lydda, 22 miles from Jerusalem, (Itinerary); a third, near Tiberias.

**EMBALMING**, is the opening a dead body, taking out the intestines, and filling the space with odoriferous and desiccative drugs and spices, to prevent it putrefying. The Egyptians excelled all other nations in the art of preserving bodies from corruption; for some that they have embalmed upwards of 2000 years ago, remain whole to this day, and are often brought into other countries as great curiosities. Their manner of embalming was thus: they scooped the brain with an iron scoop out at the nostrils, and threw in medicaments to fill up the vacuum: they also took out the entrails, and having filled the body with myrrh, cassia, and other spices, except frankincense, proper to dry up the humours, they pickled it in nitre, where it lay soaking for 70 days. The body was then wrapped up in bandages of fine linen and gums, to make it stick like glue; and so was delivered to the kindred of the deceased, entire in all its features, the very hairs of the eyelids being preserved. They used to keep the bodies of their ancestors, thus embalmed, in little houses magnificently adorned, and took great pleasure in beholding them, alive as it were, without any change in their size, features, or complexion. The Egyptians also embalmed birds, &c. The prices for embalming were different; the highest was a talent, the next 20 minæ, and so decreasing to a very small matter: but they who had not wherewithal to answer this expence, contented themselves with infusing, by means of a syringe, through the fundament, a certain liquor extracted from the cedar; and, leaving it there, wrapped up the body in salt of nitre: the oil thus preyed upon the intestines, so that when they took it out, the intestines came away with it, dried, and not in the least putrified: the body being enclosed in nitre, grew dry, and nothing remained besides the skin glued upon the bones.

The method of embalming used by the modern Egyptians, according to Maillet, is to wash the body several times with rose-water, which, he elsewhere observes, is more fragrant in that country than with us; they afterwards perfume it with incense, aloes, and a quantity of other odours, of which they are by no means sparing; and then they bury the body in a winding-sheet, made partly of silk and partly of cotton, and moistened, as is supposed, with some sweet-scented water or liquid perfume, though Maillet uses only the term *moistened;* this they cover with another cloth of unmixed cotton, to which they add one of the richest suits of clothes of the deceased. The expence, he says, on these occasions, is very great, though nothing like what the genuine embalming cost in former times.

EMBANKMENT, a mound or wall of earth, or some other material, used as a defence against inundations. See SUPPLEMENT.

EMBARCADERO, in commerce, a Spanish term, much used along the coasts of America. It signifies a place which serves some other considerable city farther within land, for a port or place of shipping, i. e. of embarking and disembarking commodities. Thus Calao is the embarcadero of Lima. There are some embarcaderos 50 leagues from the city they serve in that capacity.

EMBARGO, in commerce, an arrest on ships or merchandise, by public authority; or a prohibition of state, commonly on foreign ships, in time of war, to prevent their going out of port, sometimes to prevent their coming in, and sometimes both, for a limited time.

The king may lay embargoes on ships, or employ those of his subjects, in time of danger, for the service and defence of the nation; but they must not be for the private advantage of a particular trader or company; and therefore a warrant to stay a single ship is no legal embargo. No inference can be made from embargoes which are only in war-time; and are a prohibition by advice of council, and not at prosecution of parties. If goods be laden on board, and after an embargo or restraint from the prince or state comes forth, and then the master of the ship breaks ground, or endeavours to sail, if any damage accrues, he must be responsible for the same; the reason is, because his freight is due, and must be paid, even though the goods be seized as contraband.

EMBARRASS, (*Embarrassment*), a French term, though now naturalized; denoting a difficulty or obstacle which perplexes or confounds a person, &c.

EMBASSADOR. See AMBASSADOR.

EMBASSY, the office or function of an AMBASSADOR.

EMBDEN, a port-town and city of Germany, capital of a county of the same name, now in possession of the king of Prussia. It is situated at the mouth of the river Ens. E. Long. 6. 45. N. Lat. 53. 50.

EMBER-WEEKS, are those wherein the *ember* or *embring days* fall.

In the laws of King Alfred, and those of Canute, those days are called *ymbren*, that is, circular days, from whence the word was probably corrupted into *ember-days:* by the canonists they are called *quatuor anni tempora*, the four cardinal seasons, on which the circle of the year turns: and hence Henshaw takes the word to have been formed, viz. by corruption from *temper*, of *tempora*.

The ember-days are, the Wednesday, Friday, and Saturday, after Quadragesima Sunday, after Whitsunday, after Holy-rood day in September, and after St Lucia's day in December: which four times answer well enough to the four quarters of the year, Spring, Summer, Autumn, and Winter.

Mr Somner thinks they were originally fasts, instituted to beg God's blessing on the fruits of the earth. Agreeable to which, Skinner supposes the word *ember* taken from the ashes, *embers*, then strewed on the head.

These ember-weeks, are now chiefly taken notice of, on account of the ordination of priests and deacons; because the canon appoints the Sundays next succeeding the ember-weeks, for the solemn times of ordination: Though the bishops, if they please, may ordain on any Sunday or holiday.

EMBERIZA, a genus of birds belonging to the order of passeres. See ORNITHOLOGY *Index*.

EMBLEM, a kind of painted ænigma, which, representing some obvious history, with reflections underneath, instructs us in some moral truth or other matter of knowledge. See DEVISE, ÆNIGMA, &c.

Such is that very significant image of Scævola holding his hand in the fire; with the words, *Agere et pati fortiter Romanum est*, "To do and suffer courageously is Roman."

The word is pure Greek, formed of the verb εμβαλλειν, "to cast in, to insert." Suetonius relates, that Tiberius made the word be erased out of the decree of the Roman senate, because borrowed from another language.

The emblem is somewhat plainer and more obvious than the ænigma. Gale defines emblem an ingenious picture, representing one thing to the eye, and another to the understanding.

The Greeks also gave the name EMBLEMS, εμβληματα, to inlayed or mosaic works, and even to all kinds of ornaments of vases, moveables, garments, &c. And the Latins used *emblema* in the same sense. Accordingly, Cicero reproaching Verres with the statues and fine wrought works he had plundered from the Sicilians, calls the ornament fixed thereto (and which on occasion might be separated from them) *emblemata*. Add, that Latin authors frequently compare the figures and ornaments of discourse to these *emblemata*. Thus, an ancient Latin poet praising an orator, says, that all his words were ranged like the pieces in mosaic:

> *Quam lepide* λέξεις *compostæ, ut tesserulæ omnes,*
> *At te pavimenti, atque* emblemate *vermiculato.*

With us emblem ordinarily signifies no more than a painting, basso-relievo, or other representation, intending to hold forth some moral or political instruction.

What distinguishes an emblem from a devise is, that the words of an emblem have a full complete sense of themselves; nay, all the sense and signification which they have, together with the figure. But there is a yet further difference between emblem and devise: for a devise is a symbol appropriated to some person, or that expresses something which concerns him particularly; whereas an emblem is a symbol that regards all the world alike.

These differences will be more apparent, from comparing the emblem above quoted, with the devise of a candle lighted, and the words *Juvando consumor*, "I waste myself in doing good." See Devise.

EMBOLISMUS, Εμβολισμος, in *Chronology*, signifies "intercalation." The word is formed of εμβαλλειν, "to insert."

As the Greeks made use of the lunar year, which is only 354 days; in order to bring it to the solar, which is 365 days, they had every two or three years an embolism, i. e. they added a 13th lunar month every two or three years, which additional month they called *embolimæus*, εμβολιμαιος, because inserted, or intercalated.

EMBOSSING, or Imbossing, in *Architecture* and *Sculpture*, the forming or fashioning works in relievo, whether cut with a chissel or otherwise.

Embossing is a kind of sculpture, wherein the figure sticks out from the plane whereon it is cut: and according as the figures are more or less prominent, they are said to be in alto, mezzo, or basso relievo; or high, mean, or low relief. See Enchasing.

EMBOTHRIUM, a genus of plants belonging to the tetrandria class. See Botany *Index*.

EMBRASURE, in *Architecture*, the enlargement made of the aperture of a door or window on the inside of the wall; its use being to give the greater play for the opening of the door or casement, or to admit the more light.

EMBROCATION, in *Surgery* and *Pharmacy*, an external kind of remedy, which consists in an irrigation of the part affected, with some proper liquor, as oils, spirits, &c. by means of a woollen or linen cloth, or a sponge, dipped in the same.

EMBROIDERY, a work in gold, or silver, or silk thread, wrought by the needle upon the cloth, stuffs, or muslin, into various figures. In embroidering stuffs, the work is performed in a kind of loom; because the more the piece is stretched, the easier it is worked. As to muslin, they spread it upon a pattern ready designed; and sometimes, before it is stretched upon the pattern, it is starched, to make it more easy to handle. Embroidery on the loom is less tedious than the other, in which, while they work flowers, all the threads of the muslin, both lengthwise and breadthwise must be continually counted; but, on the other hand, this last is much richer in points, and susceptible of greater variety. Cloths too much milled are scarce susceptible of this ornament, and in effect we seldom see them embroidered. The thinnest muslins are left for this purpose; and they are embroidered to the greatest perfection in Saxony; in other parts of Europe, however, they embroider very prettily, and especially in France.

There are several kinds of embroidery: as, 1. Embroidery on the stamp; where the figures are raised and rounded, having cotton or parchment put under them to support them. 2. Low embroidery; where the gold and silver lie low upon the sketch, and are stitched with silk of the same colour. 3. Guimped embroidery: this is performed either in gold or silver; they first make a sketch upon the cloth, then put on cut vellum, and afterwards sew on the gold and silver with silk thread: on this kind of embroidery they often put gold and silver cord, tinsel, and spangles. 4. Embroidery on both sides; that which appears on both sides of the stuff. 4. Plain embroidery; where the figures are flat and even, without cords, spangles, or other ornaments.

By stat. 22 Geo. II. c. 36. no foreign embroidery, or gold and silver brocade, shall be imported, upon pain of being forfeited and burnt, and penalty of 100l. for each piece. No person shall sell, or expose to sale, any foreign embroidery, gold and silver thread, lace, fringe, brocade, or make up the same into any garment, on pain of having it forfeited and burnt, and penalty of 100l. All such embroidery, &c. may be seized and burnt; and the mercer, &c. in whose custody it was found, shall forfeit 100l.

EMBRUN, or Ambrun, a city of Dauphiny, in France, near the confines of Piedmont. E. Long. 6. 6. N. Lat. 44. 35.

EMBRYO, in *Physiology*, the first rudiments of an animal in the womb, before the several members are distinctly formed; after which period it is denominated a *fetus*. See Generation and Fetus.

EMERALD, a precious stone belonging to the genus of siliceous earth. The word is derived, according to some, from the French *esmeraude*, and that from the Latin *smaragdus*, signifying the same thing; by others it is said to be derived from the Italian *smeraldo*, or the Arabian *somorrad*. According to Cronstedt the emerald is the softest of all the precious stones, though other naturalists place it the next after the diamond in this respect. It is perhaps the most beautiful of all the gems, and, according to Wallerius, when heated in the fire, changes its colour to a deep blue, and becomes phosphorescent; but recovers its green colour when cold. When pulverized it has a white appearance, and, with borax, melts to a very thin and colourless glass. It becomes electric by being rubbed, and some have the property of the tourmalin, viz. of being electrified by heat, and in that state attracting ashes or other light substances; though the emeralds are less powerful than the tourmalin, and after having attracted the ashes, they retain them without any signs of repulsion.

Pliny mentions twelve different kinds of these precious stones; though it appears, from the vast size of some of them, that they must have been only certain kinds of green spar, or other green stone, which at that time went under the name of *emerald* among the ancients. The true emerald is found only in very small crystals, from the size of $\frac{1}{16}$th of an inch in diameter to that of a walnut. Theophrastus, however, mentions one four cubits long and three broad; likewise an obelisk composed of only four emeralds, the whole length being 40 cubits, and the breadth from four to two.

Engestroom informs us, that the emeralds, in their rough or native state, consist of hexagonal columns mostly truncated at both ends; and that he had some in his possession, which in a gentle heat became colourless, but in a strong heat white and opaque, without any mark of fusion. Brunick distinguishes them into two classes. 1. The pale green emerald, which comes from the east and from Peru, the figure being that of an hexagonal truncated prism, and the basis a vein of white quartz. 2. The dark green emerald, which is also columnar, but very dark coloured, striped longitudinally, and has little transparency. The points are generally broken off longitudinally, though Davila mentions one resembling a blunt triangular pyramid; and in the imperial cabinet at Vienna there is one with a five-sided pyramid. These are the emeralds which become electrical by heat; though all of them do not; and those which do so cannot be known but by actual experiment. The finest specimen of the former kind of emeralds is to be seen in the treasury of the holy chapel of Loretto, containing upwards of 100 of these precious stones great and small. A fellow to this was made by art, and both were presents to the king of Sicily, designed to represent two Mount Calvaries.

Emeralds are distinguished by the jewellers into two kinds the oriental and occidental. The true oriental emerald is very scarce, and at present only found in the kingdom of Cambay. So great indeed is the scarcity of them, that an opinion prevailed that there are no oriental emeralds. This opinion is adopted, among others, by Mr Bruce; who informs us, that he made an excursion to the island of emeralds in the Red sea, and endeavours to show that there never were any emeralds but what came from America, and that those said to have been found in the East Indies were imported from that continent. It is probable, indeed, that in former times any kind of crystal tinged of a green colour might be called an *emerald*, and hence the green cockle spar brought from Egypt may have obtained the name of *mother of emeralds*; but of late some emeralds have been brought from Cambay into Italy, which greatly excelled those of America. The best emeralds of the western continent come from Peru, and are called *oriental* by the jewellers: some are found in Europe, principally in the duchy of Silesia in Germany.

*Rough Emeralds.*—Those of the first and coarsest sort, called *plasmes*, for grinding, are worth 27 shillings sterling the marc, or 8 ounces. The demi-morillons, 8l. sterling per marc. Good morillons, which are only little pieces, but of fine colour, from 13l. to 15l. por marc. Emeralds, larger than morillons, and called *of the third colour* or *sort*, are valued at from 50l. to 60l. the marc. Emeralds, called *of the second sort*, which are in larger and finer pieces than the preceding, are worth from 65l. to 75l. per marc. Lastly, those of the first colour, otherwise called *negres cartes*, are worth from 110l. to 115l.

*Emeralds ready cut, or polished and not cut, being of good stone, and a fine colour, are worth*—

| | | | L. | s. |
|---|---|---|---|---|
| Those weighing one carat, or four grains | | | 0 | 10 |
| Those of two carats | —— | —— | 1 | 7 |
| Those of three carats | —— | —— | 2 | 5 |
| Those of four carats | —— | —— | 3 | 10 |
| Those of five carats | —— | —— | 4 | 10 |
| Those of six carats | —— | —— | 7 | 10 |
| Those of seven carats | —— | —— | 15 | 0 |
| Those of eight carats | —— | —— | 19 | 0 |
| Those of nine carats | —— | —— | 23 | 0 |
| Those of ten carats | —— | —— | 33 | 0 |

*To counterfeit Emeralds*: Take of natural crystal, four ounces; of red lead, four ounces; verdigris, forty-eight grains; crocus martis, prepared with vinegar, eight grains: let the whole be finely pulverized and sifted: put this into a crucible, leaving one inch empty: lute it well, and put it into a potter's furnace, and let it stand there as long as they do their pots. When cold, break the crucible; and you will find a matter of a fine emerald colour, which, after it is cut and set in gold, will surpass in beauty an oriental emerald.

**EMERSION**, in *Physics*, the rising of any solid above the surface of a fluid specifically heavier than itself, into which it had been violently immerged or thrust.

It is one of the known laws of hydrostatics, that a lighter solid being forced down into a heavier fluid, immediately endeavours to emerge; and that with a force or moment equal to the excess of weight of a quantity of the fluid above that of an equal bulk of the solid. Thus, if a solid be immerged in a fluid of double its specific gravity, it will emerge again till half its bulk or body be above the surface of the fluid.

**Emersion**, in *Astronomy*, is when the sun, moon, or other planet, begins to re-appear, after its having been eclipsed, or hid by the interposition of the moon, earth, or other body.

The difference of longitude is sometimes found by observing the immersions and emersions of the first of Jupiter's satellites. The immersions are observed from the time of Jupiter's being in conjunction with the sun to his opposition; and the emersions, from the opposition to the conjunction; which two intervals are usually six months a-piece, and divide the year between them. But when Jupiter is in conjunction with the sun, and 15 days before and afterwards, there is nothing to be observed; the planet, with his satellites, being then lost in the light of the sun.

**Emersion** is also used when a star before hid by the sun, as being too near him, begins to re-appear and to get out of his rays.

**EMERSON, William**, an eminent mathematician, was born in June 1701, at Hurworth, a village about three miles south of Darlington; at least it is certain that he resided here from his childhood. His father Dudley Emerson was a tolerable proficient in mathematics; and without his books and instructions, perhaps his own genius (most eminently fitted for mathematical disquisitions) would have never been unfolded. He was instructed in the learned languages by a young clergyman, then curate of Hurworth, who was boarded at his father's house. In the earlier part of his life he attempted to teach a few scholars: but whether from his concise method (for he was not happy in explaining his ideas), or the warmth of his natural temper, he made no progress in his school: he therefore soon left it off; and satisfied with a moderate competence left him by his parents, he devoted himself to a studious retirement. Towards the close of the year 1781 (being sensible of his approaching dissolution), he disposed of the whole of his mathematical library to a bookseller at York; and on May 20th 1782, he died of a lingering and painful disorder at his native village, aged near 81 years.

Mr Emerson in his person was rather short, but strong and well made, with an open countenance and ruddy complexion. He was exceedingly singular in his dress. He had but one coat, which he always wore open before, except the lower button; no waistcoat; his shirt quite the reverse of one in common use, no opening before, but buttoned close at the collar behind; a kind of flaxen wig which had not a crooked hair in it, and probably had never been tortured with a comb from the time of its being made. He always walked up to London when he had any thing to publish, revising sheet by sheet himself.—Trusting no eyes but his own, was always a favourite maxim with him. He never advanced any mathematical proposition that he had not first tried in practice, constantly making all the different parts himself on a small scale, so that his house was filled with all kinds of mechanical instruments together or disjointed. He would frequently stand up to his middle in water while fishing, a diversion he was remarkably fond of. He used to study incessantly for some time, and then for relaxation take a ramble to any pot-alehouse where he could get any body to drink with and talk to. The duke of Manchester was highly pleased with his company, and used often to come to him in the fields and accompany him home, but could never persuade him to get into a carriage. On these occasions he would sometimes exclaim, "Damn your whim-wham! I had rather walk." He was a married man; and his wife used to spin on an old-fashioned wheel, whereof a very accurate drawing is given in his Mechanics. He was deeply skilled in the science of music, the theory of sounds, and the various scales both ancient and modern, but was a very poor performer.

The following is a list of Mr Emerson's works. 1. The Doctrine of Fluxions. 2. The Projection of the Sphere, orthographic, stereographic, and gnomonical. 3. The Elements of Trigonometry. 4. The Principles of Mechanics. 5. A Treatise of Navigation on the Sea. 6. A Treatise of Algebra, in two books. 7. The Arithmetic of Infinites, and the Differential Method, illustrated by Examples. 8. Mechanics; or the Doctrine of Motion. 9. The Elements of Optics, in four books. 10. A System of Astronomy. 11. The Laws of Centripetal and Centrifugal Force. 12. The Mathematical Principles of Geography. 13. Tracts, 8vo. 14. Cyclomathesis; or an easy Introduction to the several branches of the Mathematics. 15. A short comment on Sir Isaac Newton's Principia; to which is added, A Defence of Sir Isaac against the objections that have been made to several Parts of his Works. 16. A Miscellaneous Treatise, containing several Mathematical Subjects, 8vo, 1776.

EMERY, in *Natural History*, a rich iron ore found in large masses of no determinate shape or size, extremely hard, and very heavy. It is usually of a dusky brownish red on the surface; but when broken, is of a fine bright iron-gray, but not without some tinge of redness; and is spangled all over with shining specks, which are small flakes of a foliaceous talc, highly impregnated with iron. It is also sometimes very red, and then usually contains veins of gold. It makes no effervescence with any of the acid menstruums; and is found in some of the Greek islands, in Tuscany, and some parts of Germany.

Dr Lewis is of opinion, that some kinds of emery may contain the metal called *platina*, and on this subject has the following curious observations. "Alonso Barba mentions a substance called *chumpi*; which is a hard stone of the emery kind, participating of iron, of a gray colour, shining a little, very hard to work, because it resists the fire much, found in Potosi, Chocaya, and other places, along with blackish and reddish ores that yield gold. If platina is really found in large masses, either generally or only now and then, one might reasonably expect those masses to be such as are here described.

"Of the same kind perhaps also is the mineral mentioned by several authors under the name of Spanish emery, *smiris Hispanicus*, which should seem, from the accounts given of it, to be no other than platina or its matrix. The *smiris* is said to be found in the gold mines, and its exportation prohibited; to contain films or veins of native gold; to be in great request among the alchemists; to have been sometimes used for the adulteration of gold; to stand, equally with the noble metal, cupellation, quartation, antimony, and the regal cement; and to be separable from it by amalgamation with mercury, which throws out the *smiris* and retains the gold; properties strongly characteristic of platina, and which do not belong to any known substance besides. This debasement of gold *per extractum smiridis Hispanici* is mentioned by Becher in his *Minera arenaria*, and several times hinted at in his *Physica subterranea*. Both Becher and Stahl indeed call the substance which the gold receives from the emery an earth, whereas platina is undoubtedly a metal; but this does not at all invalidate our supposition, for they give the name of earth also to the substance which copper receives from calamine in being made into brass, which is now known to be metallic.

"From these observations I have been led to suspect, that the European emeries likewise might possibly participate of platina. If this was certain, it would account satisfactorily for the use which some of the alchemists are said to have made of emeries and other ferruginous ores; and we should no longer doubt, or wonder, that by treating gold with these kinds of minerals, they obtained a permanent augmentation; but this augmentation, though it resisted lead, antimony, aquafortis, and the regal cement, was separable, as Becher owns it was, by quicksilver; and that, when it exceeded certain limits, it rendered the gold pale and brittle.

"If emery contains platina, I imagined it might be discoverable by boiling the powdered mineral in melted lead, and afterwards working off the lead upon a test or cupel. The experiment was made with eight ounces of the finest powder of common emery, and the same quantity of lead; which were covered with black flux to prevent the scorification of the lead, and urged with a strong fire for two or three hours. The lead became hard, rigid, of a dark colour, and a granulated texture, as if it had really imbibed some platina from the emery; but in cupellation it worked almost entirely off, leaving only a head about the size of a small pin's head, which was probably no other than silver contained in the lead.

"I repeated the experiment with some variation, thinking to obtain a more perfect resolution of the emery by vitrifying it with the lead. Two ounces of fine emery and six ounces of minium were well mixed together, and urged with a strong fire, in a close crucible, for an hour: they melted into a uniform dark brownish glass. The glass was powdered, mixed with four ounces of fixt alkaline salt and some powdered charcoal, and put into a fresh crucible, with some common salt on the surface: The fire was pretty strongly excited: but the fusion was not so perfect as could be wished, and only about two ounces of lead were found revived. This lead had suffered nearly the same change as that in the foregoing experiment; and like it, gave no appearance of platina on being cupelled.

"It seems to follow from these experiments, that the emery employed in them contained no platina; but as it is not to be supposed that all emeries are of one composition, other sorts may deserve to be submitted to the same trials. Platina may therefore possibly be found in some European ores, though there is not the least footstep of it in other parcels of the same kind of ore."

**EMETICS**, medicines that induce vomiting. See MATERIA MEDICA *Index*.

**EMIGRATION**, the act of leaving one country to settle in another. See SUPPLEMENT.

**EMIMS**, ancient inhabitants of the land of Canaan beyond Jordan, who were defeated by Chedorlaomer and his allies, Gen. xiv. 5. Moses tells us, that they were beaten in Shaveh Kirjathaim, which was in the country of Sihon conquered from the Moabites, Josh. xiii. 19.—21. The Emims were a warlike people, of a gigantic stature, great and many, and tall as the Anakims.

**EMINENCE**, in *Geography*, a little hillock or ascent above the level of the adjoining champaign.

EMINENCE is also a title of honour given to cardinals. The decree of the Pope, whereby it was appointed that the cardinals should be addressed under the quality of *eminence*, bears date the 10th of January 1630. They then laid aside the titles of *illustrissimi* and *reverendissimi*, which they had borne before.

The grand master of Malta is likewise addressed under the quality of *eminence*. The Popes John VIII. and Gregory VII. gave the same title to the kings of France. The emperors have likewise borne it.

*Eminentissimus*, the superlative of *eminent*, has of late been attributed to the cardinals.

**EMIR**, a title of dignity among the Turks, signifying a prince. This title was first given to the caliphs; but when they assumed the title of Sultans, that of emir remained to their children; as that of Cæsar among the Romans. At length the title came to be attributed to all who were judged to descend from Mahomet by his daughter Fatimah, and who wear the green turban instead of the white. The Turks make an observation, that the emirs, before their fortieth year, are men of the greatest gravity, learning, and wisdom; but after this, if they are not great fools, they discover some signs of levity and stupidity. This is interpreted by the Turks as a sort of divine impulse in token of their birth and sanctity. The Turks also call the vizirs, bashaws, or governors of provinces, by this name.

**EMISSARY**, in a political sense, a person employed by another to sound the opinions of people, spread certain reports, or act as a spy over other people's actions.

*EMISSARY Vessels*, in *Anatomy*, the same with those more commonly called EXCRETORY.

**EMISSION**, in *Medicine*, a term used chiefly to denote the ejaculation of the semen or seed in the act of coition. See COITION and GENERATION.

**EMMANUEL**, or IMMANUEL, a Hebrew word, which signifies 'God with us.' Isaiah (viii. 14.), in that celebrated prophecy, wherein he declares to Ahaz the birth of the Messiah, who was to be born of a virgin, says, This child shall be called, and really be, Emmanuel, that is, *God with us*. The same prophet (viii. 8.) repeats the same thing, while he is speaking of the enemy's army, which, like a torrent, was to overflow Judea. 'The stretching out of his wings shall fill the breadth of thy land, O Emmanuel.' The evangelist Matthew (i. 23.) informs us, that this prophecy was accomplished in the birth of Christ, born of the virgin Mary, in whom the two natures divine and human were united, and so in this sense, he was really Emmanuel, or 'God with us.'

**EMMERICK**, a rich fortified town of Germany, in the circle of Westphalia, and duchy of Cleves. It carries on a good trade with the Dutch, and both Protestants and Catholics have the free exercise of their religion. The streets are neat and regular, and the houses tolerably built. It was taken by the French in 1672, but not retained. Since 1815 it has been subject to the king of Prussia. It is seated near the Rhine. E. Long. 5. 29. N. Lat. 52. 5.

**EMMIUS**, UBBO, born at Gretha in East Friesland in 1547, was a very learned professor, and chosen rector of the college of Norden in 1579. This seminary flourished exceedingly under his care; and declined as visibly after he was ejected, in 1587, for refusing to subscribe the Confession of Augsburg. The year after, he was made rector of the college of Leer; and when the city of Groningen confederated with the United Provinces, the magistrates appointed him rector of that college: which employment he filled with the highest repute near 20 years; until the college being erected into an university, he was the first rector, and one of the chief ornaments of it by his lectures, till his infirmities prevented his public appearance. His wisdom was equal to his learning; so that the governor of Friesland and Groningen often consulted him, and seldom failed to follow his advice. He wrote

*Vetus Græcia illustrata*, 3 vols; *Decades Rerum Fresicarum*; and many other valuable works. He died in 1625.

EMMENAGOGUES, Εμμηναγωγα, in *Medicine*, such remedies as promote the menstrual discharge. They are thus called from εν "in," μην "month," αγω *duco*, "I lead," because their natural periods of flowing are once a-month.

EMOLLIENTS, in *Medicine* and *Pharmacy*, are such remedies as sheath and soften the asperity of the humours, and relax and supple the solids at the same time.

EMOLUMENT is properly applied to the profits arising daily from an office or employ. The word is formed of the Latin *emolumentum*, which, according to some, primarily signifies the profits redounding to the miller from his mill; of *molo*, *molere*, "to grind."—The patent, or other instrument, whereby a person is preferred to an office, gives him a right to enjoy all the duties, honours, profits, and emoluments belonging thereto.—*Emolument* is also used, in a somewhat greater latitude, for profit or advantage in the general.

EMOTION and PASSION, in the human mind, are thus distinguished by a celebrated writer*. An internal motion or agitation of the mind, when it passeth away without desire, is denominated *an emotion*: when desire follows, the motion or agitation is denominated *a passion*. A fine face, for example, raiseth in me a pleasant feeling: if that feeling vanish without producing any effect, it is in proper language an *emotion*; but if the feeling, by reiterated views of the object, becomes sufficiently strong to occasion desire, it loses its name of emotion, and acquires that of *passion*. The same holds in all the other passions. The painful feeling raised in a spectator by a slight injury done to a stranger, being accompanied with no desire of revenge, is termed an emotion; but that injury raiseth in the stranger a stronger emotion, which being accompanied with desire of revenge, is a passion. External expressions of distress produce in the spectator a painful feeling, which being sometimes so slight as to pass away without any effect, is an emotion; but if the feeling be so strong as to prompt desire of affording relief, it is a passion, and is termed *pity*. Envy is emulation in excess: if the exaltation of a competitor be barely disagreeable, the painful feeling is an emotion; if it produce desire to depress him, it is a passion. See PASSION.

EMOUY, or HIA MEN, an island and port of China, under the jurisdiction of the province of FOKIEN.

The port is properly but an anchoring-place for ships, inclosed on one side by the island from which it takes its name, and on the other by the main-land: but it is so extensive, that it can contain several thousands of vessels; and the depth of its water is so great, that the largest ships may lie close to the shore without danger.

In the beginning of the present century it was much frequented by European vessels; but few visit it at present, as all the trade is carried on at Canton. The emperor keeps here a garrison of 6 or 7000 men, commanded by a Chinese general. In entering this road, a large rock must be doubled which stands at the mouth of it, and divides it almost as the Mingant divides the harbour of Brest. This rock is visible, and rises several feet above the surface of the water.

The island of Emouy is particularly celebrated on account of the magnificence of its principal pagod, consecrated to the deity Fo. This temple is situated in a plain, terminated on one side by the sea, and on the other by a lofty mountain. Before it the sea, flowing through different channels, forms a large sheet of water, which is bordered with turf of the most beautiful verdure. The front of this edifice is 180 feet in length, and its gate is adorned with figures in relief, which are the usual ornaments of the Chinese architecture. On entering, you find a vast portico, with an altar in the middle, on which is placed a gigantic statue of gilt brass, representing the god Fo, sitting cross-legged. Four other statues are placed at the corners of this portico, which are 18 feet high, although they represent people sitting. Each of these statues is formed from a single block of stone. They bear in their hands different symbols which mark their attributes, as formerly in Athens and Rome the trident and caduceus distinguished Neptune and Mercury. One holds a serpent in his arms, which is twisted round its body in several folds; the second has a bent bow and a quiver; the two others present, one a kind of battle-axe, and the other a guitar, or some instrument of the same kind.

After crossing this portico, you enter a square outer court, paved with large gray stones, the least of which is ten feet in length and four in breadth. At the four sides of this court arise four pavilions, which terminate in domes, and have a communication with one another by means of a gallery which runs quite round it. One of these contains a bell ten feet in diameter; the wooden-work which supports this heavy mass cannot be sufficiently admired. In the other is kept a drum of an enormous size, which the bonzes use to proclaim the days of new and full moon. It must be observed, that the clappers of the Chinese bells are on the outside, and made of wood in the form of a mallet. The two other pavilions contain the ornaments of the temple, and often serve to lodge travellers, whom the bonzes are obliged to receive. In the middle of this court is a large tower, which stands by itself, and terminates also in a dome, to which you ascend by a beautiful stone stair-case that winds round it. This dome contains a temple remarkably neat; the ceiling is ornamented with mosaic work, and the walls are covered with stone figures in relief, representing animals and monsters. The pillars which support the roof of this edifice are of wood varnished; and on festivals are ornamented with small flags of different colours. The pavement of the temple is formed of little shells, and its different compartments present birds, butterflies, flowers, &c.

The bonzes continually burn incense upon the altar, and keep the lamps lighted, which hang from the ceiling of the temple. At one extremity of the altar stands a brazen urn, which when struck sends forth a mournful sound: on the opposite side is a hollow machine of wood, of an oval form, used for the same purpose, which is to accompany with its sound their voices when they sing in praise of the tutelary idol of the pagod. The god Poussa is placed on the middle of this altar, on a flower of gilt brass, which serves as a base, and holds

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* Elem. of Criticism, vol. i. p. 45.

holds a young child in his arms; several idols, which are no doubt subaltern deities, are ranged around him, and show by their attitudes their respect and veneration.

The bonzes have traced out on the walls of this temple several hieroglyphical characters in praise of Poussa; there is also to be seen an historical or allegorical painting in fresco, which represents a burning lake, in which several men appear to be swimming, some carried by monsters, others surrounded by dragons and winged serpents. In the middle of the gulf rises a steep rock, on the top of which the god is seated, holding in his arms a child, who seems to call out to those who are in the flames of the lake; but an old man, with hanging ears and horns on his head, prevents them from climbing to the summit of the rock, and threatens to drive them back with a large club. The bonzes are at a loss what answer to give, when any questions are asked them concerning this painting. Behind the altar is a kind of library, containing books which treat of the worship of idols.

On descending from this dome you cross the court, and enter a kind of gallery, the walls of which are lined with boards; it contains 24 statues of gilt brass, representing the same number of philosophers, ancient disciples of Confucius. At the end of this gallery you find a large hall, which is the refectory of the bonzes; and after having traversed a spacious apartment, you at length enter the temple of Fo, to which there is an ascent by a large stone staircase. It is ornamented with vases full of artificial flowers (a work in which the Chinese excel); and here also are found the same kind of musical instruments as those mentioned before. The statue of the god is not to be seen but through a piece of black gauze, which forms a kind of veil or curtain before the altar. The rest of the pagod consists of several large chambers, exceedingly neat, but badly disposed; the gardens and pleasure grounds are on the declivity of the mountain; and a number of delightful grottoes are cut out in the rock, which afford an agreeable shelter from the excessive heat of the sun.

There are several other pagods in the isle of Emouy; among which is one called *The Pagod of the Ten Thousand Stones*, because it is built on the brow of a mountain where there is a like number of little rocks, under which the bonzes have formed grottoes and very pleasant covered seats. A certain rural simplicity reigns here, which captivates and delights.

Strangers are received by these bonzes with great politeness, and may freely enter their temples; but they must not attempt to gratify their curiosity fully, nor to enter those apartments into which they are not introduced, especially if they are accompanied by suspicious persons; for the bonzes, who are forbid under pain of severe punishment to have any intercourse with women, and who often keep them in private, might, from fear of being discovered, revenge themselves for too impertinent a curiosity.

**EMPALEMENT**, an ancient kind of punishment, which consisted in thrusting a stake up the fundament. The word comes from the French *empaler*, or the Italian *impalare*; or rather, they are all alike derived from the Latin *palus*, "a stake," and the preposition *in*, "in or into." We find mention of empaling in Juvenal. It was frequently practised in the time of Nero, and continues to be so in Turkey.

*Empalement of a Flower*, the same with Calyx.

**EMPANNELLING.** See Impanelling.

**EMPARLANCE.** See Imparlance.

**EMPEDOCLES**, a celebrated philosopher and poet, was born at Agrigentum, a city in Sicily. He followed the Pythagorean philosophy, and admitted the metempsychosis. He constantly appeared with a crown of gold on his head; to maintain, by this outward pomp, the reputation he had acquired of being a very extraordinary man. Yet Aristotle says, that he was a great lover of liberty, extremely averse to state and command, and that he even refused a kingdom that was offered him. His principal work was a Treatise in verse on the Nature and Principles of Things. Aristotle, Lucretius, and all the ancients, make the most magnificent elogiums on his poetry and eloquence.

He taught rhetoric; and often alleviated the anxieties of his mind, as well as the pains of his body, with music. It is reported, that his curiosity to visit the flames of the crater of Ætna proved fatal to him. Some maintain that he wished it to be believed that he was a god; and that his death might be unknown, he threw himself into the crater and perished in the flames. His expectations, however, were frustrated; and the volcano, by throwing up one of his sandals, discovered to the world that Empedocles had perished by fire. Others report that he lived to an extreme old age; and that he was drowned in the sea about 440 years before the Christian era.

**EMPEROR**, (*Imperator*), among the ancient Romans, signified a general of an army, who, for some extraordinary success, had been complimented with this appellation. Thus Augustus, having obtained no less than twenty famous victories, was as often saluted with the title *emperor*; and Titus was denominated *emperor* by his army after the reduction of Jerusalem.

Afterwards it came to denominate an absolute monarch or supreme commander of an empire. In this sense Julius Cæsar was called *emperor*: the same title descended with the dignity to Octavius Augustus, Tiberius, and Caligula; and afterwards it became elective.

In strictness, the title *emperor* does not, and cannot, add any thing to the rights of sovereignty: its effect is only to give precedence and pre-eminence above other sovereigns; and as such, it raises those invested with it to the summit of all human greatness.

It is disputed, whether or not emperors have the power of disposing of the regal title. It is true, they have sometimes taken upon them to erect kingdoms; and thus it is that Bohemia and Poland are said to have been raised to the dignity: thus also, the emperor Charles the Bald, in the year 877, gave Provence to Boson, putting the diadem on his head, and decreeing him to be called "king," *ut more priscorum imperatorum regibus videretur dominari.* Add, that the emperor Leopold erected the ducal Prussia into a kingdom in favour of the elector of Brandenburg; and though several of the kings of Europe refused for some time to acknowledge him in that capacity, yet by the treaty of Utrecht in 1712 they all came in.

In the east, the title and quality of emperor are more frequent than they are among us; thus, the sovereign princes of China, Japan, Mogul, Persia, &c. are all emperors of China, Japan, &c. In the year 1723, the czar of Muscovy assumed the title of *emperor of all Russia*, and procured himself to be recognized as such by most of the princes and states of Europe.

In the West, the title has been a long time restrained to the emperors of Germany. The first who bore it was Charlemagne, who had the title of emperor conferred on him by Pope Leo III. though he had all the power before. The imperial prerogatives were formerly much more extensive than they are at present. At the close of the Saxon race, A. D. 1024, they exercised the right of conferring all the ecclesiastical benefices in Germany; of receiving the revenues of them during a vacancy; of succeeding to the effects of intestate ecclesiastics; of confirming or annulling the elections of the popes; of assembling councils, and of appointing them to decide concerning the affairs of the church; of conferring the title of king on their vassals; of granting vacant fiefs; of receiving the revenues of the empire; of governing Italy as its proper sovereigns; of erecting free cities, and establishing fairs in them; of assembling the diets of the empire, and fixing the time of their duration; of coining money, and conferring the same privilege on the states of the empire; and of administering both high and low justice within the territories of the different states: but in the year 1437, they were reduced to the right of conferring all dignities and titles, except the privilege of being a state of the empire; of *preces primariæ*, or of appointing once during their reign a dignitary in each chapter or religious house; of granting dispensations with respect to the age of majority; of erecting cities, and conferring the privilege of coining money; of calling the meetings of the diet, and presiding in them.

To which some have added, 1. That all the princes and states of Germany are obliged to do them homage, and swear fidelity to them. 2. That they, or their generals, have a right to command the forces of all the princes of the empire when united together. 3. That they receive a kind of tribute from all the princes and states of the empire, for carrying on a war which concerns the whole empire, which is called the *Roman month*. For the rest, there is not a foot of land or territory annexed to his title: but ever since the reign of Charles IV. the emperors have depended entirely on their hereditary dominions as the only source of their power, and even of their subsistence. See DIET and ELECTORS.

The kings of France were anciently also called emperors, at the time when they reigned with their sons, whom they associated to the crown. Thus Hugh Capet, having associated his son Robert, took the title of emperor, and Robert that of king; under which titles they are mentioned in the History of the Council of Rheims, by Gerbert, &c. King Robert is also called emperor of the French by Helgau of Fleury. Louis le Gros, upon associating his son, did the same. In the First Register of the King's Charters, fol. 166, are found letters of Louis le Gros, dated in 1116, in favour of Raymond bishop of Maguelonne, wherein he styles himself, *Ludovicus, Dei ordinante providentia, Francorum imperator augustus.* The kings of England had likewise anciently the title of emperors, as appears from a charter of King Edgar: *Ego Edgarus Anglorum basileus, omniumque regum insularum oceani quæ Britanniam circumjacent, &c. imperator et dominus.*

**EMPETRUM**, BERRY-BEARING HEATH; a genus of plants belonging to the monœcia class. In the natural method this genus is ranked by Linnæus under the 54th order, *Miscellaneæ*. See BOTANY *Index*.

**EMPHASIS**, in *Rhetoric*, a particular stress of the voice and action, laid on such parts or words of the oration as the orator wants to inforce upon his audience. See DECLAMATION; ORATORY, Part IV.; and READING.

**EMPHYSEMA**, in *Surgery*, a windy tumor, generally occasioned by a fracture of the ribs, and formed by the air insinuating itself, by a small wound, between the skin and muscles, into the substance of the cellular or adipose membrane, spreading itself afterwards up to the neck, head, belly, and other parts, much after the manner in which butchers blow up their veal.

**EMPIRE** (*imperium*), in political geography, a large extent of land, under the jurisdiction or government of an emperor.

In ancient history we read of four great monarchies or empires, viz. that of the Babylonians, Chaldeans, and Assyrians; that of the Medes and Persians; that of the Greeks; and that of the Romans. The first subsisted from the time of Nimrod, who founded it in the year of the world 1800, according to the computation of Usher, to Sardanapalus their last king in 3257, and consequently lasted above 1450 years. The empire of the Medes commenced under Arbaces, in the year of the world 3257, and was united to that of the Babylonians and Persians under Cyrus, in 3468, and it closed with the death of Darius Codomannus in 3674. The Grecian empire lasted only during the reign of Alexander the Great, beginning in the year of the world 3674, and terminating with the death of this conqueror in 3681, his conquests being divided among his captains. The Roman empire commenced with Julius Cæsar, when he was made perpetual dictator, in the year of the city 708, and of the world 3956, 48 years before Christ. The seat of the empire was removed to Byzantium by Constantine, in the year of our Lord 334; the east and west were then united under the title of the Roman empire, till the Romans proclaimed Charlemagne emperor, A. D. 800. From this epocha the east and west formed two separate empires; that of the east, governed by Greek emperors, commenced A. D. 302: and being gradually weakened, terminated under Constantine Palæologus in 1453. The western empire was afterwards known by the appellation of the empire, or German empire.

Antiquaries distinguish between the medals of the *upper*, and *lower* or *bas*, *empire*.—The curious only value those of the upper empire, which commences with Cæsar or Augustus, and ends in the year of Christ 260. The lower empire comprehends near 1200 years, reckoning down to the destruction of Constantinople in 1453.—They usually distinguish two ages, or periods, of the lower empire: the first beginning where the upper ends, viz. with Aurelian, and ending with Anastasius, including 200 years; the second beginning with Anastasius, and ending with the Palæologi, which includes 1000 years.

EMPIRE, or *The empire*, used absolutely and without any addition, signifies the empire of Germany: called also, in juridical acts and laws, The holy Roman empire. It had its beginning with the ninth century; Charlemagne being created first emperor by Pope Leo III. who put the crown on his head in St Peter's church on Christmas-day in the year 800.

Authors are at a loss under what form of government to range the empire. Some of them maintain it to be a monarchical state, because all the members thereof are obliged to ask the investiture of their states of the emperor, and to take an oath of fidelity to him. Others consider it as a republic, or aristocratic state, because the emperor cannot resolve or determine any thing without the concurring suffrages of the princes. It is added, that if they require investiture from, and swear fealty to him, it is only as head of the republic, and in the name of the republic, and not in his own; just as at Venice every thing is transacted in name of the doge. Others will have the empire to be a monarcho-aristocratic state, *i. e.* a mixture of monarchy and aristocracy; because, though the emperor in many cases seems to act sovereignly, yet his decrees and resolves have no force, in case the state refuse to confirm them. Lastly, it has been called an aristo-democratic state, because the diet, wherein the sovereignty is lodged, is composed of princes and the deputies of the cities; and is divided into three orders or bodies, called *colleges*, viz. the college of electors, the college of princes, and the college of cities.

We say, diet of the empire, circles of the empire, fiefs of the empire, princes of the empire, estates of the empire, members of the empire, capitulations of the empire. See DIET, CIRCLE, PRINCE, CAPITULATION, &c.

The states or estates of the empire are of two kinds, mediate and immediate. The immediate states are those who hold immediately of the empire: Whereof, again, there are two kinds; the first, such as have seats and voices in the imperial diet; the second, such as have none. The mediate states are those who hold of the immediate.

The states which now compose the empire are, The princes of the empire, the counts of the empire, the free barons of the empire, the prelates of the empire, the princesses or abbesses of the empire, the nobles of the empire, and the imperial cities.

EMPIRIC, an appellation given to those physicians who conduct themselves wholly by their own experience, without studying physic in a regular way. Some even use the term, in a still worse sense, for a quack who prescribes at random, without being at all acquainted with the principles of the art.

EMPIS, a genus of insects belonging to the order Diptera. See ENTOMOLOGY *Index*.

EMPLASTER. See PLASTER.

EMPORIÆ, a double city of the Hither Spain, near the Pyrenees; separated by a wall; one part occupied by the Greeks of Phocæa, whence originally are the Massilienses; the other, by native Spaniards, to whom was added by Augustus a Roman colony. Now Ampurias, in Catalonia. E. Long. 2. 50. N. Lat. 42. 15.

EMPORIUM, in *Medicine*, is often used for the common sensory in the brain. See BRAIN.

EMPORIUM, in *Ancient Geography*, two cities near Placentia; one well fortified, and guarded by a strong garrison, at which Hannibal met a repulse: the other, Hannibal took and plundered. Now thought to be Pont-Nura, in the duchy of Placentia.

EMPRESS, the spouse of an emperor, or a woman who governs an empire. See EMPEROR.

EMPROSTHOTONOS, a species of convulsion, wherein the head bends forward.

EMPYÆMA, in *Medicine*, a disorder wherein purulent matter is contained in the thorax or breast, after an inflammation and suppuration of the lungs and pleura. See MEDICINE *Index*.

EMPYREAL AIR. So Dr Higgins denominates that which Dr Priestley calls *dephlogisticated* air, and other philosophers *vital* or *pure* air.

EMPYREUM, a term used by divines for the highest heaven, where the blessed enjoy the beatific vision. The word is formed of εν, and πυρ, *fire*, because of its splendour.

EMPYREUMA, in *Chemistry*, signifies a very disagreeable smell produced from burnt oils. It is often perceived in distillations of animal as well as vegetable substances, when they are exposed to a quick fire.

EMRODS. See HEMORRHOIDS.

EMULATION, a generous ardour kindled by the praise-worthy examples of others, which impels us to imitate, to rival, and, if possible, to excel them. This passion involves in it esteem of the person whose attainments or conduct we emulate, of the qualities and actions in which we emulate him, and a desire of resemblance, together with a joy springing from the hope of success. The word comes originally from the Greek αμιλλα, *dispute*, *contest*; whence the Latin *æmulus*, and thence our *emulation*.

Plato observes of emulation, that it is the daughter of envy; if so, there is a great difference between the mother and the offspring; the one is a virtue and the other a vice. Emulation admires great actions, and strives to imitate them; envy refuses them the praises that are their due; emulation is generous, and only thinks of surpassing a rival; envy is low, and only seeks to lessen him. Perhaps, therefore, it would be more just to suppose emulation the daughter of admiration: admiration, however, is a principal ingredient in the composition of it.

EMULGENT, or RENAL, ARTERIES, those which supply the kidneys with blood; being sometimes single, sometimes double, on each side. See ANATOMY *Index*.

EMULSION, a soft liquid remedy, of a colour and consistence resembling milk. See PHARMACY.

EMUNCTORY, in *Anatomy*, a general term for all those parts which serve to carry off the excrementitious parts of the blood and other humours of the body. Such more especially are the kidneys, bladder, and most of the glands.

ENALLAGE, in *Grammar*, is when one word is substituted for another of the same part of speech: A substantive for an adjective; as *exercitus victor*, for *victoriosus*; *scelus*, for *scelestus*: A primitive for a derivative; as *Dardana arma*, for *Dardania*: An active for a passive; as *nox humida cælo precipitat*, for *præcipitatur*, &c.

ENAMEL, in general, is a vitrified matter betwixt

the

the parts of which is dispersed some unvitrified matter: hence enamel ought to have all the properties of glass except transparency.

Enamels have for their basis a pure crystal glass or frit, ground up with a fine calx of lead and tin prepared for the purpose, with the addition usually of white salt of tartar. These ingredients baked together are the matter of all enamels, which are made by adding colours of this or that kind of powder to this matter, and melting or incorporating them together in a furnace.

For white enamel, Neri (*De Arte Vitriar.*) directs only manganese to be added to the matter which constitutes the basis. For azure, zaffer mixed with calx of brass. For green, calx of brass with scales of iron, or with crocus martis. For black, zaffer with manganese or with crocus martis; or manganese with tartar. For red, manganese, or calx of copper and red tartar. For purple, manganese with calx of brass. For yellow, tartar and manganese. And for violet-coloured enamel, manganese with thrice-calcined brass.

In making these enamels, the following general cautions are necessary to be observed. 1. That the pots must be glazed with white glass, and must be such as will bear the fire. 2. That the matter of enamels must be very nicely mixed with the colours. 3. When the enamel is good, and the colour well incorporated, it must be taken from the fire with a pair of tongs. 4. The general way of making the coloured enamel is this: Powder, sift, and grind, all the colours very nicely, and first mix them with one another, and then with the common matter of enamels: then set them in pots in a furnace; and when they are well mixed and incorporated, cast them into water; and when dry, set them in a furnace again to melt; and when melted, take a proof of it. If too deep-coloured, add more of the common matter of enamels; and if too pale, add more of the colours.

Enamels are used either in counterfeiting or imitating precious stones, in painting in enamel; or by enamellers, jewellers, and goldsmiths, in gold, silver, and other metals. The two first kinds are usually prepared by the workmen themselves, who are employed in these arts. That used by jewellers, &c. is brought to us chiefly from Venice or Holland, in little cakes of different sizes, commonly about four inches diameter, having the mark of the maker struck upon it with a puncheon. It pays 1s. $7\frac{41}{100}$d. the pound on importation, and draws back 1s. $5\frac{90}{100}$d. at the rate of 4s. per pound.

**ENAMELLING**, the art of laying enamel upon metals, as gold, silver, copper, &c. and of melting it at the fire, or of making divers curious works in it at a lamp. It signifies also to paint in enamel.

*The method of painting in* ENAMEL. This is performed on plates of gold or silver, and most commonly of copper, enamelled with the white enamel; whereon they paint with colours which are melted in the fire, where they take a brightness and lustre like that of glass. This painting is the most prized of all for its peculiar brightness and vivacity, which is very permanent, the force of its colours not being effaced or sullied with time as in other painting, and continuing always as fresh as when it came out of the workmen's hands. It is usual in miniature; it being the more difficult the larger it is, by reason of certain accidents it is liable to in the operation. Enamelling should only be practised on plates of gold, the other metals being less pure: copper, for instance, scales with the application, and yields fumes; and silver turns the yellow white. Nor must the plate be made flat; for in such case the enamel cracks; to avoid which, they usually forge them a little round or oval, and not too thick. The plate being well and evenly forged, they usually begin the operation by laying on a couch of white enamel (as we observed above) on both sides, which prevents the metal from swelling and blistering; and this first layer serves for the ground of all the other colours. The plate being thus prepared, they begin at first by drawing out exactly the subject to be painted with red vitriol, mixed with oil of spike, marking all parts of the design very lightly with a small pencil. After this, the colours (which are to be before ground with water in a mortar of agate extremely fine, and mixed with oil of spike somewhat thick) are to be laid on, observing the mixtures and colours that agree to the different parts of the subject; for which it is necessary to understand painting in miniature. But here the workman must be very cautious of the good or bad qualities of the oil of spike he employs to mix his colours with, for it is very subject to adulterations.

Great care must likewise be taken, that the least dust imaginable come not to your colours while you are either painting or grinding them; for the least speck, when it is worked up with it, and when the work comes to be put into the reverberatory to be made red-hot, will leave a hole, and so deface the work.

When the colours are all laid, the painting must be gently dried over a slow fire to evaporate the oil, and the colours afterwards melted to incorporate them with the enamel, making the plate red hot in a fire like what the enamellers use. Afterwards that part of the painting must be passed over again which the fire hath any thing effaced, strengthening the shade and colours, and committing it again to the fire, observing the same method as before, which is to be repeated till the work be finished.

*Method of* ENAMELLING *by the Lamp.* Most enamelled works are wrought at the fire of a lamp, in which, instead of oil, they put melted horse-grease, which they called *caballine oil.* The lamp, which is of copper, or white iron, consists of two pieces; in one of which is a kind of oval plate, six inches long, and two high, in which they put the oil and the cotton. The other part, called the *box*, in which the lamp is inclosed, serves only to receive the oil which boils over by the force of the fire. This lamp, or, where several artists work together, two or three more lamps are placed on a table of proper height. Under the table, about the middle of its height, is a double pair of organ-bellows, which one of the workmen moves up and down with his foot to quicken the flame of the lamps, which are by this means excited to an incredible degree of vehemence. Grooves made with a gauge in the upper part of the table, and covered with parchment, convey the wind of the bellows to a pipe of glass before each lamp; and that the enamellers may not be incommoded with the heat of the lamp, every pipe is covered at six inches distance with a little tin plate, fixed into the table by a wooden handle. When the works do not require a long blast, they only use a glass pipe, into which they blow with their mouth.

It is incredible to what a degree of fineness and delicacy the threads of enamel may be drawn at the lamp. Those which are used in making false tufts of feathers are so fine, that they may be wound on the reel like silk or thread. The fictitious jets of all colours, used in embroideries, are also made of enamel; and that with so much art, that every small piece hath its hole to pass the thread through wherewith it is sewed. These holes are made by blowing them into long pieces; which they afterwards cut with a proper tool.

It is seldom that the Venetian or Dutch enamels are used alone; they commonly melt them in an iron ladle, with an equal part of glass or crystal; and when the two matters are in perfect fusion, they draw it out into threads of different sizes, according to the nature of the work. They take it out of the ladle while liquid, with two pieces of broken tobacco-pipes, which they extend from each other at arm's length. If the thread is required still longer, then another workman holds one end, and continues to draw it out, while the first holds the enamel to the flame. Those threads, when sold, are cut into what lengths the workman thinks fit, but commonly from 10 to 12 inches: and as they are all round, if they are required to be flat, they must be drawn through a pair of pinchers while yet hot. They have also another iron instrument in form of pinchers, to draw out the enamel by the lamp when it is to be worked and disposed in figures. Lastly, they have glass tubes of various sizes, serving to blow the enamel into various figures, and preserve the necessary vacancies therein; as also to spare the stuff, and form the contours. When the enameller is at work, he sits before the lamp with his foot on the step that moves on the bellows; and holding in his left hand the work to be enamelled, or the brass or iron wires the figures are to be formed on, he directs with his right the enamel thread, which he holds to the flame with a management and patience equally surprising. There are few things they cannot make or represent with enamel: and some figures are as well finished, as if done by the most skilful carvers.

**ENARTHROSIS**, in *Anatomy*, a species of DIARTHROSIS.

**ENCÆNIA**, the name of three several festivals celebrated by the Jews in memory of the dedication, or rather purification, of the temple by Judas Maccabæus, Solomon, and Zorobbabel. This term is likewise used in church history for the dedication of Christian churches.

**ENCAMPMENT**, the pitching of a CAMP.

**ENCANTHIS**, in *Surgery*, a tubercle arising either from the caruncula lachrymalis, or from the adjacent red skin; sometimes so large, as to obstruct not only the puncta lachrymalia, but also part of the sight or pupil itself. See SURGERY.

**ENCAUSTIC** and ENCAUSTUM, the same with enamelling and enamel. See ENAMELLING and ENAMEL.

*ENCAUSTIC Painting*, a method of painting made use of by the ancients, in which wax was employed to give a gloss to their colours, and to preserve them from the injuries of the air.

This ancient art, after having been long lost, was restored by Count Caylus, a member of the Academy of Inscriptions in France; and the method of painting in wax was announced to the Academy of Painting and Belles Lettres in the year 1753; though M. Bachelier, the author of a treatise *De l'Histoire et du Secret de la Peinture en Cire*, had actually painted a picture in wax in 1749; and he was the first who communicated to the public the method of performing the operation of inustion, which is the principal characteristic of the encaustic painting. The Count kept his method a secret for some time, contenting himself with exhibiting a picture at the Louvre in 1754, representing the head of Minerva, painted in the manner of the ancients, which excited the curiosity of the public, and was very much admired. In the interval of suspense, several attempts were made to recover the ancient method of painting. The first scheme adopted was that of melting wax and oil of turpentine together, and using this composition as a vehicle for mixing and laying on the colours. But this method did not explain Pliny's meaning, as the wax is not burnt in this way of managing it. In another attempt, which was much more agreeable to the historian's description of encaustic painting, the wax was melted with strong lixivium of salt of tartar, and with this the colours were ground. When the picture was finished, it was gradually presented to the fire, so as to melt the wax; which was thus diffused through all the particles of the colours, so that they were fixed to the ground, and secured from the access of air or moisture. But the method of Count Caylus is much more simple: the cloth or wood which he designed for the basis of his picture, is waxed over, by only rubbing it simply with a piece of bees-wax; the wood or cloth, stretched on a frame, being held horizontally over, or perpendicularly before a fire, at such a distance, that the wax might gradually melt, whilst it is rubbed on, diffuse itself, penetrate the body, and fill the interstices of the texture of the cloth, which, when cool, is fit to paint upon; but as water colours, or those that are mixed up with common water, will not adhere to the wax, the whole picture is to be first rubbed over with Spanish chalk or white, and then the colours are applied to it; when the picture is dry, it is put near the fire, whereby the wax melts, and absorbs all the colours.

Mr J. H. Muntz, in a treatise on this subject, has proposed several improvements in the art of encaustic painting. When the painting is on cloth, he directs it to be prepared by stretching it on a frame, and rubbing one side several times over with a piece of bees-wax, or virgin wax, till it is covered with a coat of wax of considerable thickness. In fine linen, this is the only operation necessary previous to painting; but coarse cloth must be rubbed gently on the unwaxed side with a pumice-stone, to take off all these knots which would prevent the free and accurate working of the pencil. Then the subject is to be painted on the unwaxed side with colours prepared and tempered with water; and when the picture is finished, it must be brought near the fire, that the wax may melt and fix the colours. This method, however, can only be applied to cloth or paper, through the substance of which the wax may pass; but in wood, stone, metals, or plaster, the former method of Count Caylus must be observed.

Mr Muntz has also discovered a method of forming grounds for painting with crayons, and fixing these, as well as water-colours employed with the pencil. On the unwaxed side of a linen cloth, stretched and waxed as before, lay an even and thick coat of the colour proper for the ground; having prepared this colour by mixing some proper pigment with an equal quantity of chalk, and tempering them with water. When the colour is dry, bring the picture to the fire, that the wax may melt, pass through the cloth, and fix the ground. An additional quantity of wax may be applied to the back of the picture, if that which was first rubbed on should not be sufficient for the body of colour; but as this must be laid on without heat, the wax should be dissolved in oil of turpentine, and applied with a brush, and the canvas be again exposed to the fire, that the fresh supply of wax may pass through the cloth, and be absorbed by the colour; and thus a firm and good body will be formed for working on with the crayons. If cloth and paper are joined together, the cloth must be first fixed to the straining frame, and then the paper must be pasted to it with a composition of paste made with wheaten flour, or starch and water, and about a twelfth part of its weight of common turpentine. The turpentine must be added to the paste when it is almost sufficiently boiled, and the composition well stirred, and left to simmer over the fire for five or six minutes: let wax be dissolved in oil of turpentine to the consistence of a thin paste: and when the cloth and paper are dry, let them be held near a fire; and with a brush lay a coat of the wax and turpentine on both sides the joined cloth and paper, in such a degree of thickness, that both surfaces may shine throughout without any appearance of dull spots. Then expose the cloth to the fire, or to the sun; by which means the oil will evaporate, and the wax become solid, and be fit to receive any composition of colour for a ground, which is to be laid on as above directed in the case of cloth without paper.

Almost all the colours that are used in oil-painting may be also applied in the encaustic method. Mr Muntz objects, indeed, to brown, light pink, and unburnt *terra di Sienna;* because these, on account of their gummy or stony texture, will not admit such a cohesion with the wax as will properly fix them; but other colours which cannot be admitted in oil-painting, as red lead, red orpiment, crystals of verdegris, and red precipitate of mercury, may be used here. The crayons used in encaustic painting are the same with those used in the common way of crayon painting, excepting those that in their composition are too tenacious; and the method of using them is the same in both cases.

The encaustic painting has many peculiar advantages: though the colours have not the natural varnish or shining which they acquire with oil, they have all the strength of paintings in oil, and all the airiness of water-colours, without partaking of the apparent character or defects of either: they may be looked at in any light and in any situation, without any false glare: the colours are firm, and will bear washing; and a picture, after having been smoked, and then exposed to the dew, becomes as clean as if it had been but just painted. It may also be retouched at pleasure without any detriment to the colours; for the new colours will unite with the old ones, without spots, as is the case in common size painting; nor is it necessary to rub the places to be touched with oil as in oil pictures; it is not liable to crack, and easily repaired, if it should chance to suffer any injury. The duration of this painting is also a very material advantage; the colours are not liable to fade and change; no damp can affect them, nor any corrosive substance injure them; nor can the colour fall off in shivers from the canvas. However, notwithstanding all these and other advantages enumerated by the Abbe Mazeas and Mr Muntz, this art has not yet been much practised. Many of these properties belong to a much higher species of encaustic painting afterwards discovered in England, the colours of which are fixed by a very intense heat; nor are the colours or grounds on which they are laid liable to be dissolved or corroded by any chemical menstruum, nor like the glassy colours of enamel, to run out of the drawing on the fire. What this method consists in will appear from the following account communicated in a letter from Josiah Colebrook to the earl of Macclesfield, president of the Royal Society in 1756.

"The art of painting with burnt wax (says he) has long been lost to the world. The use of it to painters in the infancy of the art of painting was of the utmost consequence. Drying oil being unknown, they had nothing to preserve their colours entire from the injury of damps and the heat of the sun: a varnish of some sort was therefore necessary; but they being unacquainted with distilled spirits, could not, as we now do, dissolve gums to make a transparent coat for their pictures: this invention therefore of burnt wax supplied that defect to them; and with this manner of painting the chambers and other rooms in their houses were furnished: this Pliny calls *encaustum*, and we *encaustic painting*.

"The following experiments, which I have the honour to lay before your Lordship and the Society, were occasioned by the extract of a letter from the Abbe Mazeas, translated by Dr Parsons, and published in the second part of the 49th volume of the Philosophical Transactions, N° 100. concerning the ancient method of painting with burnt wax, revived by Count Caylus.

"The count's method was, 1. To rub the cloth or board designed for the picture simply over with bees-wax. 2. To lay on the colours mixed with common water: but as the colours will not adhere to the wax, the whole picture was first rubbed over with (A) Spanish

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(A) "Spanish chalk is called by Dr Parsons, in a note, *Spanish white*. This is a better kind of whitening than the common, and was the only white that had the name of *Spanish* annexed to it that I could procure, though I inquired for it at most if not all the colour shops in town.

nish chalk, and then the colours are used. 3. When the picture is dry it is put near the fire, whereby the wax melts, and absorbs all the colours.

" *Exp.* 1. A piece of oak board was rubbed over with bees-wax, first against the grain of the wood, and then with the grain, to fill up all the pores that remained after it had been planed, and afterwards was rubbed over with as much dry Spanish white as could be made to stick on it. This, on being painted (the colours mixed with water only), so clogged the pencil, and mixed so unequally with the ground, that it was impossible to make an even outline, but what was so much thicker in one part than another, that it would not bear so much as the name of painting; neither had it any appearance of a picture. However, to pursue the experiment, this was put at a distance from the fire, on the hearth, and the wax melted by slow degrees: but the Spanish white (though laid as smooth as so soft a body would admit, before the colour was laid on), on melting the wax into it, was not sufficient to hide the grain of the wood, nor show the colours by a proper whiteness of the ground; the wax, in rubbing on the board, was unavoidably thicker in some parts than in others, and the Spanish white the same: on this I suspected there must be some mistake in the Spanish white, and made the inquiry mentioned in the note (A).

" To obviate the inequality of the ground in the first experiment.

" *Exp.* 2. A piece of old wainscot (oak-board) $\frac{1}{4}$th of an inch thick; which, having been part of an old drawer, was not likely to shrink on being brought near the fire: this was smoothed with a fish-skin; made quite warm before the fire; and then, with a brush dipped in white wax, melted in an earthen pipkin, smeared all over, and applied to the fire again. That the wax might be equally thick in all parts of the board, a ground was laid (on the waxed board) with levigated chalk mixed with gum-water (viz. gum-arabic dissolved in water): When it was dry, I painted it with a kind of landscape; and pursuing the method laid down by Count Caylus, brought it gradually to the fire. I fixed the picture on a fire screen, which would preserve the heat and communicate it to the back part of the board. This was placed first at the distance of three feet from the fire, and brought forwards by slow degrees, till it came within one foot of the fire, which made the wax swell and bloat up the picture; but as the chalk did not absorb the wax, the picture fell from the board and left it quite bare.

" *Exp.* 3. I mixed three parts white wax, and one part white resin, hoping the tenacity of the resin might preserve the picture. This was laid on a board heated with a brush as in the former; and the ground was chalk prepared as before. This was placed horizontally on an iron box, charged with a hot heater, shifting it from time to time, that the wax and resin might penetrate the chalk; and hoping from this position, that the ground, bloated by melting the wax, would subside into its proper place; but this, like the other, came from the board, and would not at all adhere.

" *Exp.* 4. Prepared chalk four drams, white wax, white resin, of each a dram, burnt alabaster half a dram, were all powdered together and sifted, mixed with spirit of molasses instead of water, and put for a ground on a board smeared with wax and resin, as in *Exp.* 3. This was also placed horizontally on a box-iron as the former: the picture blistered, and was cracked all over; and though removed from the box-iron to an oven moderately heated (in the same horizontal position), it would not subside, nor become smooth. When it was cold, I took an iron spatula made warm, and moved it gently over the surface of the picture, as if I were to spread a plaster. (This thought occurred, from the board being prepared with wax and resin, and the ground having the same materials in its composition, the force of the spatula might make them unite). This succeeded so well, as to reduce the surface to a tolerable degree of smoothness; but as the ground was broke off in many places, I repaired it with flake white, mixed up with the yolk of an egg and milk, and repainted it with molasses spirit (instead of water), and then put it into an oven with a moderate degree of heat. In this I found the colours fixed, but darker than when it was at first painted; and it would bear being washed with water, not rubbed with a wet cloth.

" *Exp.* 5. A board (that had been used in a former experiment) was smeared with wax and resin, of each equal parts; was wetted with molasses spirit, to make whitening (or Spanish white) mixed with gum water adhere. This, when dry, was scraped with a knife, to make it equally thick in all places. It was put into a warm oven, to make the varnish incorporate partly with the whitening before it was painted; and it had only a small degree of heat; water was only used to mix the colours. This was again put into an oven with a greater degree of heat; but it flaked off from the board: whether it might be owing to the board's having had a second coat of varnish (the first having been scraped and melted off), and that the unctuous parts of the wax had so entered its pores, that it would not retain a second varnish, I cannot tell.

" *Exp.* 6. Having miscarried in these trials, I took a new board, planed smooth, but not polished either with a fish skin or rushes: I warmed it, and smeared it with wax only; then took *cimolia* (tobacco-pipe clay) divested of its sand, by being dissolved in water and poured off, leaving the coarse heavy parts behind. After this was dried and powdered, I mixed it with a small quantity of the yolk of an egg and cow's milk, and made a ground with this on the waxed board: this I was induced to try, by knowing that the yolk of an egg will dissolve almost all unctuous substances, and make them incorporate with water; and I apprehended, that a ground thus prepared, would adhere so much the more firmly to the board than the former had done, as to prevent its flaking off. The milk, I thought, might

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" My friend M. da Costa showed me a piece of Spanish chalk in his collection, which seemed more like CIMOLIA (tobacco pipe-clay), and was the reason of my using that in one of the experiments.

might answer two purposes; first, by uniting the ground with the wax; and secondly, by answering the end of size or gum-water, and prevent the colours from sinking too deep into the ground, or running one into another. When the ground was near dry, I smoothed it with a pallet knife, and washed with milk and egg where I had occasion to make it smooth and even: when dry I painted it, mixing the colours with common water; this, on being placed horizontally in an oven only warm enough to melt the wax, flaked from the board; but held so much better together than any of the former, that I pasted part of it on paper.

" *Exp.* 7. Flake-white (or the purest sort of white-lead) mixed with egg and milk, crumbled to pieces in the oven, put on the waxed board, as in the last experiment.

" The bad success which had attended all the former experiments, led me to consider of what use the wax was in this kind of painting: and it occurred to me, that it was only as a varnish to preserve the colours from fading.

" In order to try this:

" *Exp.* 8. I took what the brick-layers call *fine stuff*, or *putty* (B): to this I added a small quantity of burnt alabaster, to make it dry: this it soon did in the open air; but before I put on any colours, I dried it gently by the fire, lest the colours should run. When it was painted, I warmed it gradually by the fire (to prevent the ground from cracking) till it was very hot. I then took white wax three parts, white resin one part; melted them in an earthen pipkin, and with a brush spread them all over the painted board, and kept it close to the fire in a perpendicular situation, that what wax and resin the plaster would not absorb might drop off. When it was cold, I found the colours were not altered, either from the heat of the fire, or passing the brush over them. I then rubbed it with a soft linen cloth, and thereby procured a kind of gloss, which I afterwards increased by rubbing it with a hard brush; which was so far from scratching or leaving any marks on the picture, that it became more smooth and polished by it.

" After I had made all the foregoing experiments, in conversation with my honoured and learned friend Dr Kidby, a fellow of this society, I said I had been trying to find out what the encaustic painting of the ancients was. Upon which he told me, that there was a passage in Vitruvius *de Architectura* relative to that kind of painting: and was so good as to transcribe it for me from the 7th book, chap. 9. *De minii temperatura.* Vitruvius's words are: *At si quis subtilior fuerit, et voluerit expolitionem miniaceam suum colorem retinere, cum paries expolitus et aridus fuerit, tunc ceram Punicam liquefactam igni, paulo oleo temperatam, seta inducat, deinde postea carbonibus in ferreo vase compositis, eam ceram apprime cum pariete, calefaciendo sudare cogat, fiatque ut peræquetur, deinde eam candela linteisque puris subigat, uti signa marmorea nuda curantur. Hæc autem γανωσις Græcè dicitur. Ita obstans ceræ Punicæ lorica non patitur, nec lunæ splendorem, nec solis radios lambendo eripere ex his politionibus colorem.*

" Which I thus translate: ' But if any one is more wary, and would have the polishing [painting] with vermilion hold its colour, when the wall is painted and dry, let him take Carthaginian [Barbary] wax, melted with a little oil, and rub it on the wall with a hair-pencil; and afterwards let him put live coals into an iron vessel [chafing-dish], and hold it close to the wax, when the wall, by being heated, begins to sweat; then let it be made smooth: afterwards let him rub it with a (C) candle and (D) clean linen rags, in the same manner as they do the naked marble statues. This the Greeks call γανωσις. The coat of Carthaginian wax (thus put on) is so strong, that it neither suffers the moon by night, nor the sun-beams by day, to destroy the colour.'

" Being satisfied, from this passage in Vitruvius, that the manner of using wax in *Exp.* 8. was right, I was now to find if the wax-varnish, thus burnt into the picture, would bear washing. But here I was a little disappointed; for rubbing one corner with a wet linen cloth, some of the colour came off; but washing it with a soft hair-pencil dipped in water, and letting it dry without wiping, the colour stood very well.

" A board painted, as in *Exp.* 8. was hung in the most smoky part of a chimney for a day, and exposed to the open air in a very foggy night. In the morning the board was seemingly wet through, and the water ran off the picture. This was suffered to dry without wiping: and the picture had not suffered at all from the smoke or the dew, either in the ground or the colours; but when dry, by rubbing it, first with a soft cloth, and afterwards with a brush, it recovered its former gloss.

" Suspecting that some tallow might have been mixed with the white wax I had used, which might cause the colours to come off on being rubbed with a wet cloth, I took yellow wax which had been melted from the honeycomb in a private family, and consequently not at all adulterated: to three parts of this I added one part resin, and melted them together.

" *Exp.* 9. Spanish white, mixed with fish glue, was put for a ground on a board, and painted with water-colours only. The board was made warm; and then the wax and resin were put on with a brush, and kept close to the fire till the picture had imbibed all the varnish,

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(B) " Putty is lime slaked, and while warm, dissolved in water, and strained through a sieve.

(C) " The account of the method of polishing [painting] walls coloured with vermilion, gave me great satisfaction, as it proved the method I had taken in experiment 8. (which I had tried before I saw or knew of this passage in Vitruvius) was right. The use of the candle, as I apprehend, was to melt the wax on the walls where by accident the brush had put on too much, or afford wax where the brush had not put on enough, or had left any part bare.

(D) " The rubbing the wall with a linen cloth, while warm, will do very well where there is only one colour to be preserved; but where there are many, as in a landscape, it will be apt to take off some, or render the colouring rather faint; which I found by wiping the wax off from a painting while it was hot.

varnish, and looked dry. When it was cold, I rubbed it first with a linen cloth, and then polished it with a hard brush.

"In these experiments I found great difficulties with regard to colours. Many water colours being made from the juices of plants, have some degree of an acid in them; and these when painted on an alkaline ground, as chalk, whitening, *cimolia*, and plaster, are totally changed in their colours, and from green become brown; which contributes much to make the experiments tedious. I would therefore advise the use of mineral or metallic colours for this sort of painting, as most likely to preserve their colour: for although I neutralized Spanish white, by fermenting it with vinegar, and afterwards washed it very well with water, it did not succeed to my wish.

"These experiments, and this passage from Vitruvius, will in some measure explain the obscurity of part of that passage in Pliny, which Dr Parsons, in his learned comment on the encaustic painting with wax, seems to despair of.

"*Ceris pingere*, was one species of encaustic painting. *Εγκαυστον*, *inustum*, may be translated, "forced in by the means of fire; burnt in:" for whatever is forced in by the help of fire can be rendered into Latin by no other significant word that I know of but *inustum*. If this is allowed me, and I think I have the authority of Vitruvius (a writer in the Augustan age) for it, who seems to have wrote from his own knowledge, and not like Pliny, who copied from others much more than he knew himself, the difficulty with regard to this kind of painting, is solved, and the encaustic with burnt wax recovered to the public.

"What he means by the next kind he mentions, *in ebore cestro id est viriculo*, I will not attempt to explain at present.

"The ship-painting is more easily accounted for, the practice being in part continued to this time; and is what is corruptly called *breaming*, for brenning or burning.

"This is done by reeds set on fire, and held under the side of a ship till it is quite hot; then resin, tallow, tar, and brimstone, melted together, and put on with a hair brush while the placks remain hot, make such a kind of paint as Pliny describes: which, he says, *nec sole, nec sale ventisque corrumpitur*. As they were ignorant of the use of oil painting, they mixed that colour with the wax, &c. which they intended for each particular part of the ship, and put it on in the manner above described.

In the pictures painted for these experiments, and now laid before your lordship and the society, I hope neither the design of the landscape, nor the execution of it, will be so much taken into consideration as the varnish (which was the thing wanted in this inquiry): and I think that will evince, that the encaustic painting with burnt wax is fully restored by these experiments; and though not a new invention, yet having been lost for so many ages, and now applied further, and to other purposes, than it was by Vitruvius (who confined it to vermilion only), may also amount to a new discovery, the use of which may be a means of preserving many curious drawings to posterity; for this kind of painting may be on paper, cloth, or any other substance that will admit a ground to be laid on it. The process is very simple, and is not attended with the disagreeable smell unavoidable in oil-painting, nor with some inconveniences inseparable from that art; and as there is no substance we know more durable than wax, it hath the greatest probability of being lasting."

Still, however, there seem to have been some defects or inconveniences attending these and other subsequent attempts; for we find the ancient or some similar method of painting in wax remaining a desideratum upwards of 25 years after the publication of the preceding experiments; when in 1787 a method was communicated to the Society of Arts by Miss Greenland, for which she was rewarded with a prize. The ground of her information she received at Florence, through the acquaintance of an amateur of painting, who procured her the satisfaction of seeing some paintings in the ancient Grecian style, executed by Signora Parenti, a professor at that place, who had been instructed by a Jesuit at Pavia, the person who made the farthest discoveries in that art. Miss Greenland's friend knowing she was fond of painting, informed her what were the materials the paintress used, but could not tell her the proportions of the composition; however, from her anxiety to succeed in such an acquisition, she made various experiments, and at last obtained such a sufficient knowledge of the quantities of the different ingredients as to begin and finish a picture, which she afterwards presented to the Society for their inspection.

Her method is as follows: "Take an ounce of white wax, and the same weight of gum mastich powdered. Put the wax in a glazed earthen vessel over a very slow fire; and when it is quite dissolved, strew in the mastich, a little at a time, stirring the wax continually until the whole quantity of gum is perfectly melted and incorporated: then throw the paste into cold water, and when it is hard, take it out of the water, wipe it dry, and beat it in one of Mr Wedgwood's mortars, observing to pound it at first in a linen cloth to absorb some drops of water that will remain in the paste, and would prevent the possibility of reducing it to a powder, which must be so fine as to pass through a thick gauze. It should be pounded in a cold place and but a little while at a time, as after long beating the friction will in a degree soften the wax and gum, and instead of their becoming a powder they will return to a paste.

"Make some strong gum-arabic water; and when you paint, take a little of the powder, some colour, and mix them together with the gum-water. Light colours require but a small quantity of the powder, but more of it must be put in proportion to the body and darkness of the colours; and to black there should be almost as much of the powder as colour.

"Having mixed the colours, and no more than can be used before they grow dry, paint with fair water, as is practised in painting with water-colours, a ground on the wood being first painted of some proper colour prepared in the same manner as is described for the picture; walnut-tree and oak are the sorts of wood commonly made use of in Italy for this purpose. The painting should be very highly finished; otherwise, when varnished, the tints will not appear united.

"When the painting is quite dry, with rather a hard brush, passing it one way, varnish it with white wax, which is put into an earthen vessel, and kept melted over a very slow fire till the picture is varnished, taking great care the wax does not boil. Afterwards hold the picture before a fire, near enough to melt the wax, but not make it run; and when the varnish is entirely cold and hard, rub it gently with a linen cloth. Should the varnish blister, warm the picture again very slowly, and the bubbles will subside. When the picture is dirty, it need only be washed with cold water."

The opinion given by the society upon the above is: The method made use of by Miss Greenland provides against all inconveniences; and the brilliancy of the colours in the picture painted by her, and exhibited to the Society, fully justifies the opinion, that the art of painting in wax, as above described, highly merited the reward of a gold pallet voted to her on this occasion.

ENCEINTE, in *Fortification*, is the wall or rampart which surrounds a place, sometimes composed of bastions or curtains, either faced or lined with brick or stone, or only made of earth. The enceinte is sometimes only flanked by round or square towers, which is called a *Roman wall.*

ENCEPHALI, in *Medicine*, worms generated in the head, where they cause so great a pain as sometimes to occasion distraction.

The encephali are very rare; but there are some diseases wherein they swarm: from whence we are told pestilential fevers have wholly arisen. Upon the dissection of one who died of this fever, a little, short, red worm was found in the head, which malmsey wine, wherein horse-raddish had been boiled, could alone destroy. This medicine was afterwards tried on the sick, most of whom it cured.

The like worms have also been taken out by trepanning, and the patient cured. Those worms that generate in the nose, ears, and teeth, are also called *encephali.*

ENCHANTER, a person supposed to practise enchantment or fascination. See FASCINATION, WITCHCRAFT, &c.

*ENCHANTER's Nightshade.* See CIRCÆA, BOTANY *Index.*

ENCHASING, INCHASING, or *Chasing*, the art of enriching and beautifying gold, silver, and other metal-work, by some design or figures represented thereon in low relievo.

Enchasing is practised only on hollow thin works, as watch-cases, cane-heads, tweezer-cases, or the like. It is performed by punching or driving out the metal, to form a figure, from withinside, so as to stand out prominent from the plane or surface of the metal. In order to this, they provide a number of fine steel blocks or puncheons of divers sizes; and the design being drawn on the surface of the metal, they apply the inside upon the heads or tops of these blocks, directly under the lines or parts of the figures; then, with a fine hammer, striking on the metal, sustained by the block, the metal yields, and the block makes an indenture or cavity on the inside, corresponding to which there is a prominence on the outside, which is to stand for that part of the figure.

Thus the workman proceeds to chase and finish all the parts by the successive application of the block and hammer to the several parts of the design. And it is wonderful to consider with what beauty and justness, by this simple piece of mechanism, the artists in this kind will represent foliages, grotesques, animals, histories, &c.

ENCLITICA, in *Grammar*, particles which are so closely united with other words as to seem part of them, as in *virumque*, &c.—There are three enclitic particles in Latin, viz. *que, ne, ve.*

ENCRATITES, in church-history, heretics who appeared towards the end of the second century: they were called *Encratites*, or *Continentes*, because they gloried in abstaining from marriage and the use of wine and animal food.

ENCURECK, in *Natural History*, a venomous insect found in Persia, and said to be a kind of tarantula. According to Olearius, as quoted by Mr Boyle, it neither stings nor bites; but lets fall its venom like a drop of water, which causes insufferable pain in the part for a time, and afterwards so profound a sleep, that, as report says, nothing can awake the patient except crushing one of the creatures on the part affected. It is nevertheless said, that the sheep eat these insects without damage.

ENCYCLOPÆDIA, a term nearly synonymous with CYCLOPÆDIA; but adopted in preference to it in denominating the present work, as being more definite and of better authority. According to an observation of the late learned printer Mr Bowyer, the preposition EN makes the meaning of the word more precise. For *Cyclopædia* may denote "the instruction OF a circle," as *Cyropædia* is "the instruction OF Cyrus," whereas in *ENcyclopædia*, the preposition determines the word to be from the dative of *cyclus*, "instruction IN a circle." And Vossius, in his book *De vitiis sermonis*, has observed, "That *Cyclopædia* is used by some authors, but *Encyclopædia* by the best."

ENDEMIC, or ENDEMICAL, DISEASES, those to which the inhabitants of particular countries are subject more than others, on account of the air, water, situation, and manner of living.

ENDIVE. See CICHORIUM, BOTANY and GARDENING *Index.*

ENDLESS, something without an end: thus authors mention endless rolls, the endless screw, &c.

ENDOR, in *Ancient Geography*, a town of Galilee, four miles to the south of Mount Tabor, in the tribe of Manasseh, where the Pythoness was consulted by Saul: at this day, says Jerome, a large village.

ENDORSED, in *Heraldry*, an ordinary, containing the eighth part of a pale, which Leigh says is only used when a pale is between two of them.

ENDORSED, in *Heraldry*, is said of things borne back to back, more usually called ADOSSE.

ENDORSEMENT, in *Law* and *Commerce*. See INDORSEMENT.

ENDOWMENT, in *Law*, denotes the settling a dower on a woman; though sometimes it is used figuratively, for settling a provision upon a parson, on the building of a church; or the severing a sufficient portion of tithes for a vicar, when the benefice is appropriated.

ENDYMION, in fabulous history, a shepherd, son of Æthlius and Calyce. It is said that he required of Jupiter to grant to him to be always young, and to sleep as much as he would; whence came the proverb of *Endymionis somnum dormire*, to express a long sleep. Diana saw him naked as he slept on Mount Latmos;

and was so struck with his beauty, that she came down from heaven every night to enjoy his company. Endymion married Chromia daughter of Itonus; by whom he had three sons Pæon, Epeus, and Æolus, and a daughter called *Eurydice*. The fable of Endymion's amours with Diana, or the moon, arose from his knowledge of astronomy; and as he passed the night on some high mountain to observe the heavenly bodies, it came to be reported that he was courted by the moon. Some suppose that there were two of that name; the son of a king of Elis, and the shepherd or astronomer of Caria. The people of Heraclea maintained that Endymion died on Mount Latmos; and the Eleans pretended to show his tomb at Olympia in Peloponnesus.

ENEMY, in *Law*, an alien or foreigner, who publicly invades the kingdom.

ENERGUMENS, in church-history, persons supposed to be possessed by the devil, concerning whom there were many regulations among the primitive Christians. They were denied baptism and the eucharist; at least, this was the practice of some churches: and though they were under the care of exorcists, yet it was thought a becoming act of charity to let them have the public prayers of the church, at which they were permitted to be present. See EXORCISM.

ENERGY, a term of Greek origin, signifying the power, virtue, or efficacy of a thing. It is also used, figuratively, to denote emphasis of speech.

ENERVATING, the act of destroying the force, use, or office, of the nerves, either by cutting them, by weakening them with debauchery, or by some other violence.

Excess of wine, and other strong, hot, spirituous liquors, enervate or weaken the nerves. When they would render a horse useless, they enervate him, or cut his nerves.

ENFANS PERDUS, the same with forlorn hope. See FORLORN.

ENFIELD, WILLIAM, LL. D. an elegant and very justly admired writer, was born in the year 1741, at Sudbury. His original destination was for the sacred office of the ministry, and he was educated among the protestant dissenters at Daventry, where the high polish which he gave to his compositions, distinguished him from many of his contemporaries. The congregation of Benn's-garden of Liverpool made choice of him for their minister in the year 1763, when he was not more than 22 years of age; and in this situation he was soon taken notice of as an amiable member of society, and an engaging preacher. While he resided in Liverpool, he published two volumes of sermons, 12mo, as well as a collection of hymns and family prayers, which met with a very favourable reception. In the year 1770, he was appointed tutor and lecturer in the belles lettres at Warrington academy, which he filled for some years with general approbation and unwearied diligence. He was the compiler of many useful books, among the most popular of which we may rank his "Speaker," composed of pieces of recitation from the best and most approved English authors. At the beginning of this collection there is an excellent essay on elocution. The Preacher's Directory; the English Preacher, a collection of sermons in 9 vols 12mo, from the most celebrated authors; Biographical Sermons on the principal characters in the Old and New Testament, with a number of single sermons on particular occasions, were also the productions of his pen. The controversy relative to literary property also engaged his attention, and on this he wrote a quarto pamphlet. He likewise published, in one volume 4to, Institutes of Natural Philosophy, theoretical and experimental; and during the time of his residence at Warrington, as teacher in the academy, the university of Edinburgh conferred on him the degree of LL. D. When that academy was dissolved in 1783, Dr Enfield continued for two years at Warrington in the capacity of a private tutor, after which he was chosen pastor of the Octagon meeting-house at Norwich, in the year 1785. He at length gave up his private tuition, and entirely devoted his time to literary labours, and the peculiar duties of his pastoral charge. About this time he lost his eldest son, who had been appointed to the office of town-clerk of Nottingham. This event would have been productive of very serious effects on his health and spirits, had it not been for the consolation of religion and philosophy, which are sufficient to support the human mind under the pressure of the severest calamities. He undertook and executed the laborious task of abridging Brucker's History of Philosophy, which in 1791 he published in 2 vols 4to. It has been allowed that the tenets of the different sects of philosophers were never before exhibited to the world with such perspicuity and elegance: qualifications for which Dr Enfield was undoubtedly eminent. He contributed largely to the Biographical Dictionary, published under the inspection of Dr Aiken and others.

An unsuspected distemper hastened the termination of his useful life, and on the 3d of November 1797, he expired in the 57th year of his age. The general love of mankind which Dr Enfield possessed, falls to the lot of few; nor does it often happen that an individual dies so universally lamented. It was essential to him to be amiable in every station and condition of life. His posthumous sermons, in 3 vols 8vo, had a very numerous list of subscribers, a strong proof of the estimation in which he was held by all who knew him, either personally or by report. In these discourses he treats chiefly on moral topics, which he discusses with the nicest discrimination, and in a train of the most pleasing and manly eloquence.

ENFILADE, in the art of war, is used in speaking of trenches, or other places, which may be scoured by the enemy's shot along their whole length. In conducting the approaches at a siege, care must be taken that the trenches be not enfiladed from any work of the place.

ENFINE', formerly ANTINOE, a city of Egypt, built by Adrian in honour of his favourite Antinous. It is situated towards the middle of the Said, or Upper Egypt, and still contains several stately monuments of antiquity. In ancient times this city was very magnificent. It was about half a league in circumference, having two principal streets 45 feet wide, intersecting each other at right angles, and running through its whole length. The others were more narrow, but equally straight; the two largest having gates at each end, part of which still remain. According to the Nubian geographer, it was called the city of the Magi, because Pharaoh is said to have caused the magicians come from thence to his court. Near it were the ruins of Abydus, where there was an oracle of the god Bess, one of the most ancient in Egypt, and which was still famous in the time of Constantius; and hence some have derived the appellation just mentioned, the neighbouring people coming in crowds to consult the oracle.

The ruins of the gates are the most beautiful pieces of architecture to be met with in this place. The handsomest has three vaulted entries; the middle one being 40 feet in height, 22 wide, and 20 thick; the other two smaller. Each of the façades of this edifice is ornamented with four pilasters in bas relief, with Corinthian capitals, the acanthus leaves of which have a considerable projection. It was surrounded by eight Corinthian columns, of which only one now remains, but the pedestals of the rest are still entire. Besides these, there are heaps of rubbish in different parts of the town, apparently the remains of ancient temples or palaces. All these seem to have been bordered by a colonnade, forming a portico on each side, where the inhabitants might walk secure from the heat of the sun. One of the squares was ornamented with four large Corinthian pillars, three of which are destroyed all but the bases. The fourth is quite entire, about 50 feet high, and the shaft composed of several stones. The pedestal has a Greek inscription, pretty much defaced, dedicating it to the emperor Alexander Severus, to whom the senate of ALEXANDRIA had already dedicated the famous column mentioned under that article. These four other columns were therefore probably raised in honour of that emperor after his victories over the Persians; for the foliage of the oak, with which the first stone of the shaft is decorated, was a sign of victory among the Romans. Towards the end of the fourth century the city was peopled by Christians; and Palladius assures us, that there were at that place 12 convents of virgins, and several others inhabited by monks. In the convents there are still several Coptic monasteries possessed by monks equally miserable and ignorant. The Nubian geographer informs us, that the city was surrounded by a well cultivated country, abounding in fruits and harvests; but these have now given place to sands and barren deserts. The ruins of Abydus above mentioned are still to be seen near this place.

ENFRANCHISEMENT, in *Law*, the incorporating a person into any society or body-politic.

ENGASTRIMYTHI, in Pagan theology, the Pythias, or priestesses of Apollo, who delivered oracles from within, without any action of the mouth or lips.

The ancient philosophers, &c. are divided upon the subject of the engastrimythi. Hippocrates mentions it as a disease. Others will have it a kind of divination. Others attribute it to the operation or possession of an evil spirit. And others to art and mechanism. M. Scottus maintains that the engastrimythi of the ancients were poets, who, when the priests could not speak, supplied the defect by explaining in verse what Apollo dictated in the cavity of the bason on the sacred tripod.

ENGENDERING, a term sometimes used for the act of producing or forming any thing: thus meteors are said to be engendered in the middle region of the atmosphere, and worms in the belly.

ENGINE, in *Mechanics*, is a compound machine, made of one or more mechanical powers, as levers, pulleys, screws, &c. in order to raise, cast, or sustain any weight, or produce any effect which could not be easily effected otherwise. The word is formed of the French *engin*, from the Latin *ingenium*, "wit;" by reason of the ingenuity required in the contrivance of engines to augment the effect of moving powers.

*ENGINE for Extinguishing Fires.* See HYDRODYNAMICS *Index*.

*Pile-ENGINE*, one contrived for driving piles. See *PILE-Engine*.

*Steam-ENGINE*, a machine to raise water by fire, or rather by the force of water turned into steam. See *STEAM-Engine*.

ENGINEER, in the military art, an able expert man, who, by a perfect knowledge in mathematics, delineates upon paper, or marks upon the ground, all sorts of forts, and other works proper for offence and defence. He should understand the art of fortification, so as to be able not only to discover the defects of a place, but to find a remedy proper for them; as also how to make an attack upon, as well as to defend, the place. Engineers, therefore, besides being ingenious, should be brave in proportion. When at a siege, the engineers have narrowly surveyed the place, they are to make their report to the general, by acquainting him which part they judge the weakest, and where approaches may be made with most success.

# ENGLAND.

ENGLAND, the southern division of the island of Great Britain. Including Wales, it is of a triangular form, and lies between the 50th and 55th degrees of north latitude, extending about 400 miles in length from south to north, and in some places it is 300 miles in breadth. It is bounded by Scotland on the north; by the English channel on the south, dividing it from France; by the German sea on the east; and on the west by St George's or the Irish channel.

1
Whence peopled.

At what time the island of Britain was peopled is uncertain; nor do we know whether the southern or northern parts were first inhabited. We have no accounts that can be depended upon before the arrival of Julius Cæsar, and it is certain he found the southern parts full of people of a very warlike disposition. These people, according to Cæsar, were a colony of the Gauls; and this opinion is embraced by most of the ancient as well as modern writers. It is chiefly founded on the agreement observed by the Romans between the two nations in their customs, manners, language, religion, government, way of fighting, &c. The more northern inhabitants, according to Tacitus, came from Germany. This he infers from the make of their limbs; but Cæsar simply calls them *Aborigenes*.

2 Inhabited by 17 different nations.

England, including the principality of Wales, when first invaded by the Romans, was divided into 17 petty states. 1. The Danmonii, called also *Dunmonii* and *Donmonii*, inhabiting the counties of Cornwall and Devonshire. 2. The Durotriges, who inhabited the tract now called *Dorsetshire*. 3. The Belgæ possessed Somersetshire, Wiltshire, and Hampshire. 4. The Attrebatii, or inhabitants of Berkshire. 5. The Regni, whose country bordered on that of the Attrebatii, and comprehended Surrey, Sussex, and part of the sea-coast of Hampshire. 6. The Cantii, inhabiting the county now called *Kent*. 7. The Dobuni are placed by Ptolemy on the north side of the Thames, near its head, in the counties of Gloucestershire and Oxfordshire. 8. The Cattieuchlani, *Calyeuchlani*, *Cattidudani*, or *Cathicludani*, inhabited Buckinghamshire, Bedfordshire, and Hertfordshire. 9. The Trinobantes, who possessed the counties of Essex and Middlesex. 10. The Iceni, whose country comprehended Suffolk, Norfolk, Cambridge, and Huntingdonshire. These are by Ptolemy called *Simeni*, and by others *Tigeni*. Camden is of opinion, that they were the same whom Cæsar calls *Cenomagni*. 11. The Coritani, whose country comprehended Northamptonshire, Leicestershire, Rutlandshire, Lincolnshire, Nottinghamshire, and Derbyshire. 12. The Cornavii possessed Warwickshire, Worcestershire, Staffordshire, Shropshire, and Cheshire. 13. The Silures inhabited the counties of Radnorshire, Brecknockshire, Glamorganshire, with Herefordshire and Monmouthshire. 14. The Demetæ inhabited part of Caermarthenshire, Pembrokeshire, and Cardiganshire. 15. The country of the Ordovices comprehended Montgomeryshire, Merionethshire, Caernarvonshire, Denbighshire, and Flintshire. 16. The Brigantes possessed the counties of Yorkshire, the bishopric of Durham, Lancashire, Westmoreland, and Cumberland. 17. The county of Northumberland was held by the Ottadini, Ottadeni, or Ottalini. Their country, according to some, reached from the Tyne to the river Forth; though the most common opinion is, that it reached only to the Tweed.

The above-mentioned names of these nations are plainly Roman, but the etymology of them is not easily ascertained. Some attempt to derive them from words in the old British language; but as this subject at best must be very obscure and uncertain, we shall not enter into it.

3 Julius Cæsar undertakes an expedition into Britain.

Before the time of Julius Cæsar, the Romans had scarcely any knowledge of Britain; but that conqueror having subdued most of the Gallic nations on the opposite side of the channel, began to think of extending his conquests by the reduction of Britain. The motive for this expedition, ascribed to him by Seutonius, was a desire of enriching himself with the British pearls, which were then very much esteemed. The pretence, however, which he made use of in order to justify his invasion was, that the Britons had sent assistance to the Gauls during his wars with them.

Cæsar undertook his first expedition against Britain when the summer was already far spent, and therefore he did not expect to finish the conquest of the country that campaign. He thought, however, that it would be a considerable advantage to view the island, and learn something of the manners and customs of the natives; after which he could more easily take such measures as would ensure a permanent conquest on his return. Having marched all his forces into the country of the Morini, now the province of Picardy, from whence was the shortest passage into Britain; he ordered at the same time all the vessels that lay in the neighbouring ports, and a fleet which he had built the year before for an expedition against the Morini, to attend him. The Britons, alarmed at his preparations, sent ambassadors with offers of submission; but Cæsar, though he received them with great kindness, did not abandon his intended scheme of an invasion. He waited till the arrival of C. Volusenus, whom he had sent out with a single galley to make discoveries on the coast. Volusenus did not think proper to land; but, having made what observations he could, returned after five days absence, and Cæsar immediately set sail for Britain. His force consisted of two legions, embarked on board 80 transports; and he appointed 18 more which lay wind-bound about eight miles off, to convey over the cavalry; but these last orders were too slowly executed, which occasioned some difficulty in his landing.

4 Manners, customs, &c. of the Britons.

The Britons at this time, according to Cæsar and other Roman historians, were very numerous, and had their country well stocked with cattle. Their houses resembled those of the Gauls; and they used copper or iron plates weighed by a certain standard instead of money. Their towns were a confused parcels of huts placed at a small distance from one another, generally in the middle of a wood, to which all the avenues were slightly guarded with ramparts of earth, or with trees. All the nations were in a state of the most wretched barbarism, even when compared with the barbarous Gauls on the continent. The use of clothes was scarcely known in the island. Only the inhabitants of the southern coast covered their nakedness with the skins of wild beasts; and this rather to avoid giving offence to the strangers who came to trade with them, than out of any principle of decency. It was a general custom among the Britons to paint their bodies with the juice of woad: but whether this was designed as ornament, or for any other purpose, is not known. They shaved their beards all except their upper lip, and wore long hair. They also had their wives in common, a custom which made them detestable to all other nations.

The arms of the Britons were a sword, a short lance, and a shield. Breast-plates and helmets they looked upon rather to be incumbrances, and therefore made no use of them. They usually fought in chariots, some of which were armed with scythes at the wheels; they were fierce and cruel, and exceedingly bloodthirsty. When driven to distress, they could subsist themselves even on the bark and roots of trees; and Dio Cassius tells us, that they had ready, on all occasions, a certain kind of food, of which, if they took but the quantity of a bean, they were not troubled with hunger or thirst for a considerable time after. The southern nations, however, were somewhat more civilized; and the Cantii, or inhabitants of Kent, more so than any of the rest.

All the British nations at this time were very brave and resolute, owing to the continual dissensions among themselves. They proved therefore very formidable enemies to the Romans; but the same dissensions which

5 They oppose Cæsar's landing.

had taught them the art of war, also prevented them from uniting in the defence of their country. As soon as they perceived Cæsar's fleet approaching, a number of cavalry and chariots were dispatched to oppose his landing, while a considerable body of infantry hastened after. What chiefly embarrassed the Romans in their attempt to land, was the largeness of their ships, which required a considerable depth of water. The soldiers, therefore, were obliged to leap into the sea while loaded with their armour; and at the same time to encounter the enemy, who were quite disengaged, as they either stood on dry ground, or waded but a little way into the water. Cæsar perceiving this disadvantage, ordered his galleys to advance, with their broadsides towards the shore, in order to drive the Britons from the water-side with their slings and arrows. On this the Britons, surprised at the galleys, a sort of shipping they had never before seen, began to give ground. The fight, however, continued for some time, greatly to the disadvantage of the Romans; till at last Cæsar, observing the distress of his men, caused several boats to be manned, and sent them to the assistance of those who were most exposed to the enemy's assault. The Romans then soon got the better of the undisciplined barbarians, however brave, and made good their landing; but they were unable to pursue the enemy for want of cavalry, which had not yet arrived.

6 They are defeated and sue for peace.

7 Their treachery.

The Britons were so disheartened with this bad success, that they immediately sent ambassadors to sue for peace; which was granted, on condition of their delivering a certain number of hostages for their fidelity. Part of these they brought immediately; and promised to return in a few days with the rest, who, they said, lived at some distance. But, in the mean time, the 18 transports which carried Cæsar's cavalry, being driven back by a violent storm, and the fleet which lay in the road being greatly damaged by the same, the Britons thought proper to break their engagements. Having therefore privately assembled their forces, they fell unexpectedly on the seventh legion while at a distance from the rest and busied in foraging. Cæsar being apprised of their danger, hastened to their assistance with two cohorts, and at last repulsed the enemy. This, however, proved only a temporary deliverance; for the Britons, thinking it would be possible for them to cut off all the Romans at once, dispatched messengers to inform several of the neighbouring nations of the weakness of the enemy's forces, and the happy opportunity that offered itself of destroying all these invaders at one blow. On this, they drew together a great body of horse and foot, which boldly advanced to the Roman entrenchments. But Cæsar came out to meet them; and the undisciplined Britons being by no means able to cope with the Romans, were put to flight with great slaughter. Having burnt several towns and villages, the victors returned to their camp, where they were soon followed by new deputies from the Britons. Cæsar being in want of horse, and afraid lest another storm should destroy the remainder of his fleet, granted them peace on condition of their sending him double the number of hostages into Gaul which they had before promised. The same night he set sail, and soon arrived safe in Gaul.

8 Cæsar returns.

9 Defeats the Britons.

The Britons no sooner perceived the Romans gone, than, as before, they broke through their engagements. Of all the states who had promised to send hostages, only two performed their promises; and this neglect so provoked Cæsar, that he determined to return the year following with a far greater force. Having, therefore, caused his old vessels to be refitted, and a great many new ones to be built, he arrived off the coast of Britain with a fleet of 600 ships and 28 galleys. The Britons made no opposition to his landing; but Cæsar, getting intelligence that an army was assembled at no great distance, marched in quest of them. He found them encamped on the banks of a river, supposed to be the *Stour*, about 12 miles distant from the place where he had landed. They attempted to oppose his passage; but being briskly attacked by the Roman cavalry, they were obliged to retire into a wood, all the avenues of which were blocked up by trees cut down for that purpose. This fortification, however, proved insufficient to protect them. The seventh legion having cast themselves into a testudo, and thrown up a mount against their works, drove them from their asylum; but as the day was far spent, a pursuit was not thought advisable.

Next morning Cæsar, with the greatest part of his army, which he divided into three bodies, marched out in quest of the enemy. But when he was already come in sight of their rear, he was overtaken by messengers, who informed him, that his fleet was greatly damaged by a violent storm which had happened the preceding night. This put an end to the pursuit for that time; but Cæsar having employed all the carpenters he had with him, and sent for others from Gaul, in order to repair the damage, resolved to prevent misfortunes of this kind for the future. He therefore drew all his ships ashore, and enclosed them within the fortifications of his camp. This arduous undertaking employed his whole camp for 10 days; after which he again set out in quest of the enemy.

The Britons had made the best use they could of the respite afforded them by the storm. They were headed by Cassibelaunus king of the Trinobantes. He had formerly made war upon his neighbours; and having rendered himself terrible to them, was looked upon to be the most proper person for leading them on against the common enemy; and as several states had now joined their forces, the British army was very numerous. Their cavalry and chariots attacked the Roman army while on their march; but were repulsed with loss, and driven into the woods. The Romans pursued them too eagerly, and thus lost some of their own men; which encouraged the Britons to make another fierce attack; but in this also they were finally unsuccessful, and obliged to retire, though their loss seems not to have been great.

Next day the Britons suddenly attacked the Roman legions as they were foraging; but meeting with a vigorous resistance, they soon betook themselves to flight. The Romans pursued them so closely, that having neither time to rally nor get down from their chariots according to custom, great numbers of them were cut in pieces; and this overthrow had such an effect upon the auxiliaries of Cassibelaunus, that all of them abandoned him; nor did the Britons ever afterwards engage Cæsar with united forces. Cæsar, pursuing his victory, marched

10 Cæsar crosses the Thames.

marched towards the Thames, with a design to cross that river, and enter the territories of the Trinobantes. The river was fordable only at one place, and that not without great difficulty; but when he came to it, he found the enemy's forces drawn up in a considerable body on the opposite bank, which was fortified with sharp stakes. They had likewise driven many stakes of the same kind into the bottom of the river, the tops of which were covered with water. These stakes are visible to this day at a place called *Walton* in Surry. They are made of oak; and though they have been so long in the water, are as hard as Brazil, and as black as jet; and have sometimes been pulled out in order to make knife handles of them.

11 Gives the Britons frequent overthrows.

Cæsar was not at all dismayed at these difficulties, which he had intelligence of by prisoners and deserters. He ordered the cavalry to enter first, and the foot to follow. His orders were obeyed, and the soldiers advanced with such resolution, that though the infantry were up to the chin in water, the enemy, unable to sustain their assault, abandoned the bank and fled. After this defeat, Cassibelaunus himself despaired of success, and therefore dismissed all his forces except about 4000 chariots, with which he observed the motions of the Romans, harassing them by cutting off straggling parties, &c. This, however, was not sufficient to keep up the spirits of his countrymen. On the contrary, they deposed him from the kingdom, and chose Mandubratius, whose father had been murdered by Cassibelaunus, who thereupon usurped the kingdom. The young prince had fled to Cæsar, who gave him protection; and the Trinobantes now offered to submit to the conqueror, provided he would give them Mandubratius for their king.

Cæsar readily complied with the request of the Trinobantes upon their sending him 40 hostages; and the submission of the Trinobantes was soon followed by that of other states and tribes; for each of the 17 nations already mentioned was composed of several different tribes, of which no particular account can be given.—Cæsar next marched to Verulamium, or Canterbury, which was Cassibelaunus's capital, and which he still kept possession of; but though the place was strongly fortified both by nature and art, the Britons were unable to bear the assault of the Romans, and therefore soon fled out at one of the avenues. Many were taken as they attempted to make their escape, and many more cut in pieces.

After this loss, Cassibelaunus, as his last resource, found means to draw into confederacy with him four kings of the Cantii. But though Cæsar gives them the title of kings, it is probable that they were only petty princes, tributary to the king of that nation. Their names were Cingetorix, Corvilius, Taximagulus, and Segonax. These, having raised what forces they could, attacked the camp where the ships were laid up: but the Romans having made a sally, repulsed them with great slaughter, and then returned to their trenches without any loss; after which, Cassibelaunus thought proper to submit to the conqueror. As the summer was already far spent, Cæsar hearkened to his proposals. A peace was concluded on the following terms, viz. that the Britons should pay an annual tribute to the Romans, that Cassibelaunus should leave Mandubratius in peaceable possession of his dominions, that he should not molest the Trinobantes, and that he should deliver a certain number of hostages.

12 He leaves the island altogether.

These terms being agreed to, Cæsar set sail with his whole fleet from Britain, to which he never returned.

Such is the account given by Cæsar himself of his two expeditions into Britain; but other authors have spoken very doubtfully of his victories in this island. Dio Cassius tells us, that the Britons utterly defeated the Roman infantry, but were at last put in disorder by their cavalry. Horace and Tibullus, in many parts of their works, speak of the Britons as a people not yet conquered. Tacitus says, that Cæsar rather showed the Romans the way to Britain, than put them in possession of it; and Lucan tells us plainly, that Cæsar turned his back to the Britons and fled. This last, however, considering the consummate military genius of Cæsar, is by no means probable. That he left Britain, during the winter, was, in all probability, to prevent insurrections among the Gauls, which might very readily have happened: and that he did not return to finish his conquest can be no wonder, seeing his ambition would certainly be more gratified by being called emperor of Rome, than conqueror of Britain.

The departure of Julius Cæsar, which happened about 53 years before Christ, left the Britons without any fear of a foreign enemy. We are not, therefore, to imagine, that they would regard their promises of paying tribute; nor was it probably demanded for a good number of years afterwards. Augustus, however, when he had got himself fully established on the throne, had twice a design of invading Britain and forcing the inhabitants to pay the tribute promised to Julius Cæsar. Both times, however, he was prevented by revolts in different provinces in the empire, so that the Britons still continued to enjoy their liberty. They thought proper, however, to court the favour of the Romans as much as they could by pretended submissions; but, in the reign of Claudius, the Romans set about reducing them to subjection in good earnest.

13 Why the war with the Romans was renewed.

The occasion of this war is related by Dio Cassius as follows. "Cunobellinus, the third in succession from Cassibelaunus, being dead, his two sons, Togodumnus and Caractacus, succeeded to the throne; but whether they reigned jointly or separately, is not known. In their reign one Bercius, of whom we also know very little, being driven out of the island for attempting to raise a sedition, fled with some of his partisans to Rome, and persuaded Claudius to make war on his countrymen. The Britons, on the other hand, resented the behaviour of Claudius in receiving these vagabonds, and therefore prohibited all intercourse with the Romans. A much smaller offence than this would have been sufficient at any time to provoke that haughty nation to declare war. An army was therefore immediately ordered into Britain, under the command of Plautius prætor in Gaul. The soldiers at first refused to embark, from a superstitious notion, that they were going to be sent without the compass of the world; and this mutiny being related to the Britons, they did not make the necessary preparations for their own defence. The Roman soldiers were soon brought to a sense of their duty; and set out from three different ports, in order to land in three different places of Britain at once.

Being driven back by contrary winds, their fears began to return; but they resumed their courage on the appearance of a meteor shooting from the east, which they imagined was sent from heaven to direct their course. They landed without opposition; and the Britons, not having drawn together a sufficient army, kept in small bodies behind their marshes, and in woods, in order to spin out the war till winter; which they thought Plautius, as Cæsar had done, would pass in Gaul.

14 The Britons defeated.

The Roman general marched first in quest of the two kings Togodumnus and Caractacus; both of whom he found out, and defeated one after another. He then reduced part of the Dobuni, at that time subject to the Cattieuchlani; and leaving a garrison to keep them in awe, he advanced to a river where the Britons lay carelessly encamped, supposing that the Romans could not pass it without a bridge. But the Germans in the Roman army had been accustomed to swim across the strongest currents with their heavy armoour. They therefore passed the river first; and having, according to their orders, fallen only upon the enemy's horses which drew their chariots, these formidable machines were rendered entirely useless; and the Britons were put to flight as soon as another part of the forces could pass the river.

The Britons were not disheartened with this defeat, but engaged the Romans next day with great bravery. Victory continued long doubtful; but at length the Romans prevailed, and the Britons were forced to betake themselves to flight. This battle is thought to have been fought on the banks of the Severn. From thence the Britons fled to the mouth of the Thames. They were closely pursued by the Romans; but the latter being unacquainted with the flats and shallows of the river, were often in great danger. The Germans, however, crossed by swimming as before, and the rest on a bridge somewhat farther up the river; so that the Britons were in a short time surrounded on all sides, and great numbers of them cut in pieces. Many of the Romans, also, pursuing the fugitives with too great eagerness, were lost in the marshes.—In one of these battles Togodumnus was killed; but the Britons were so far from being disheartened, that they showed more eagerness than ever to oppose the Romans, in order to revenge his death. Plautius, therefore, did not think proper to penetrate farther into the country, but contented himself with putting garrisons in the places he had already conquered. He then wrote to the emperor himself; who no sooner received an account of his success, than he set out for Britain; where, having landed after a short voyage, he joined Plautius on the banks of the Thames.

15 Claudius arrives in Britain.

Soon after the arrival of Claudius, the Romans passed the Thames, attacked the British army, and totally defeated it. The consequence of this was the taking of Cunobelinus's capital, and the submission of several of the neighbouring states. The emperor, however, did not make a long stay in the island, but left Plautius to pursue his conquests. This he did with such success, that on his return to Rome, he was met without the gates by the emperor himself, who, at his solemn entry, gave him the right hand.—The Britons seem to have made a very obstinate resistance to the Roman arms about this time. Vespasian, who was afterwards emperor, is said to have fought 30 battles with them; and the exploits of Titus his son are also much celebrated by the Roman historians.

In the ninth year of Claudius, P. Ostorius Scapula was sent into Britain. By far the greater part of the 17 nations formerly mentioned were at this time unconquered. Some of these had broken into the Roman territories; but Ostorius falling unexpectedly upon them, put great numbers to the sword, and dispersed the rest. To prevent them for the future from making inroads into the territories of the Romans or their allies, he built several forts on the Severn, the Avon, and the Nen, reducing the country south of these rivers to a Roman province. This so highly offended the Iceni, that, being joined by the neighbouring nations, they raised a considerable army, and encamped in an advantageous situation, in order to prevent the Romans from penetrating farther into the island. Ostorius, however, soon advanced against them. The Romans, as usual, got the victory, and the enemy were pursued with great slaughter. The Roman general then, having quelled an insurrection among the Brigantes, led his army against the Silures.

16 Caractacus defeated and taken prisoner.

They were headed by their king Caractacus, a most renowned warrior. He showed his military talents by choosing a very advantageous place for engaging the enemy. Tacitus tells us, "it was on the ridge of an exceeding steep mountain; and where the sides of it were inclining and accessible, he reared walls of stone for a rampart. At the foot of the mountain flowed a river dangerous to be forded, and an army of men guarded his entrenchments." This hill is thought to be one called *Caer-Caradoc* in Shropshire, situated near the conflux of the rivers Colun and Teme, and where the remains of ancient entrenchments are still visible.—On the approach of the enemy, Caractacus drew up his troops in order of battle, animating them with the following speech, according to Tacitus. "That from this day, and this battle, they must date their liberty rescued, or their slavery for every established. He then invoked the shades of those heroes who had expelled Cæsar the dictator; those brave men by whose valour they still enjoyed freedom from Roman tribute and taxes, and by which their wives and children were as yet preserved from prostitution." The whole army then took a solemn oath either to conquer or die, and prepared for the charge with the most terrible shouts. Ostorius was somewhat dismayed when he considered the uncommon fierceness of the enemy, and the other difficulties which he had to encounter. He led on his men, however, to the charge; and the Romans were attended with their usual good fortune. The Britons were put to flight. Vast numbers fell on the field of battle and in the pursuit, and many more were taken prisoners. Among the latter were the wife, the daughter, and the brothers of Caractacus. The unfortunate prince himself fled to Cartismundua queen of the Brigantes, by whom he was delivered up to the Roman general, who sent him in chains to Rome. Caractacus bore his misfortunes with magnanimity; and when he came before the emperor, addressed him in the following terms.

17 His speech to the Roman emperor.

"If my moderation in prosperity, O Claudius! had been as conspicuous as my birth and fortune, I should now have entered this city as a friend, and not as a prisoner; nor would you have disdained the

the friendship of a prince descended from such illustrious ancestors, and governing so many nations. My present condition, I own, is to you honourable, to me humiliating. I was lately possessed of subjects, horses, arms, and riches. Can you be surprised that I endeavoured to preserve them? If you Romans have a desire to arrive at universal monarchy, must all nations, to gratify you, tamely submit to servitude? If I had submitted without a struggle, how much would it have diminished the lustre of my fall, and of your victory? And now, if you resolve to put me to death, my story will soon be buried in oblivion; but if you think proper to preserve my life, I shall remain a lasting monument of your clemency."—This speech had such an effect upon Claudius, that he immediately pardoned Caractacus and his whole family, and commanded them to be set at liberty.

18
General revolt of the Britons.

The Silures, notwithstanding this terrible blow, continued the war with great vigour, and gained considerable advantages over the Romans; which so much affected Ostorius, that he died of grief. He was succeeded by A. Didius, who restrained the incursions of the Silures, but was not able to restore Cartismundua queen of the Brigantes, who had been deposed by her subjects. Didius was succeeded by Veranius, and he by Suetonius Paulinus, who reduced the island of ANGLESEY, as related under that article. But while Paulinus was employed in the conquest of this island, he was alarmed by the news of an almost universal revolt among those nations which had submitted to the Romans. The Britons, though conquered, had still a desire of returning to their former state of independence; and the Roman yoke became every day more unsupportable to them, through the insolence and oppressions of the Roman soldiers. The Britons had been long discontented, and were already in a very proper disposition for a revolt, when an event happened which kindled these discontents into an open flame. Prasutagus king of the Iceni, a prince renowned for opulence and grandeur, had by his last will, left the Roman emperor, joint-heir with his two daughters, in hopes of obtaining his favour and protection by so great an obligation. But the event turned out very different. No sooner was he dead, than his houses and possessions were all plundered by the Roman soldiers. The queen Boadicea remonstrated against this injustice; but, instead of obtaining any redress, she herself was publicly whipped, her daughters ravished, and all the relations of the late king reduced to slavery. The whole country also was plundered, and all the chiefs of the Iceni deprived of their possessions.

Boadicea was a woman of too haughty a spirit tamely to bear such indignities. She therefore persuaded the Iceni to take up arms, which they very readily did. Then, being joined by the Trinobantes, and some other nations, they poured like a torrent on the Roman colonies. Every thing was destroyed with fire and sword. The ninth legion, which had been left for the defence of the country under Petilius Cerealis, was defeated, the infantry totally cut in pieces, and the commander himself with the cavalry escaped with the utmost difficulty. Suetonius, alarmed at this news, immediately left Anglesey, and marched with the greatest expedition to London. The inhabitants were overjoyed at his arrival, and used their utmost endeavours to detain him for their defence. But he refused to stay, and in a short time left the place, notwithstanding the intreaties of the inhabitants. The whole city lamented his departure; and they had reason. Suetonius was scarce gone, when Boadicea with her Britons entered, and put all they found in it to the sword. None were taken prisoners, nor was any sex or age spared, and many were tortured in the most cruel manner. Seventy thousand persons are said to have perished on this occasion at London and other Roman colonies.

19
They destroy 70,000 Romans.

20
They are utterly defeated.

The Britons, now elated with success, assembled from all quarters in great numbers, so that Boadicea's army soon amounted to 230,000 men. They despised the Romans; and became so confident of victory, that they brought their wives and children along with them in waggons to be spectators of the destruction of their enemies. The event was what might naturally have been expected from such ill-judged confidence. The Britons were overthrown with most terrible slaughter, no fewer than 80,000 being killed in the battle and pursuit; while the Romans had not above 400 killed, and not many more wounded. Boadicea, not able to survive so great a calamity, put an end to her life by poison.

By this overthrow the Britons, who had once been subdued, were thoroughly prevented from raising any more insurrections, and even those who had not yet submitted to the Roman yoke seemed to be intimidated from making incursions into their dominions. Nothing remarkable therefore happened for some time. In the time of Vespasian, Petilius Cerealis being appointed governor of Britain, attacked the Brigantes, defeated them in several battles, and reduced great part of their country. He was succeeded by Julius Frontinus; who not only maintained the conquests of his predecessor, but reduced entirely the warlike nation of the Silures. Frontinus was succeeded by the celebrated Cneius Julius Agricola, who completed the conquest of all the southern Britons.

21
Britain conquered by Agricola.

Just before the arrival of Agricola, the Ordovices had cut in pieces a band of horse stationed on their confines, after which the whole nation had taken arms. The summer was pretty far spent, and the Roman army was quite separated and dispersed, the soldiers having assured themselves of rest for the remaining part of the year. Agricola, however, was no sooner landed, than, having drawn together his legions, he marched against the enemy without delay. The Britons kept upon the ridges of the mountains; but Agricola led them in person up the ascents. The Romans were victorious; and such a terrible slaughter was made of the Britons, that almost the whole nation of Ordovices was cut off. Without giving the enemy time to recover from the terror which this overthrow had occasioned, Agricola resolved upon the immediate reduction of Anglesey, which had been lost by the revolt of Boadicea. Being destitute of ships, he detached a chosen body of auxiliaries who knew the fords, and were accustomed to manage their arms and horses in the water. The Britons, who had expected a fleet and transports, were so terrified by the appearance of the Roman forces on their island, that they immediately submitted, and Anglesey was once more restored to the Romans.

With the conquest of Anglesey ended the first campaign of Agricola; and he employed the winter in reconciling the Britons to the Roman yoke. In this he met with such success, through his wise and equitable conduct, that the Britons, barbarous as they were, began to prefer a life of security and peace, to that independency which they had formerly enjoyed, and which continually exposed them to the tumults and calamities of war. The succeeding campaigns of Agricola were attended with equal success; he not only subdued the 18 nations inhabiting England, but carried the Roman arms almost to the extremity of Scotland. He also caused his fleet to sail round the island, and discovered the Orcades, or Orkney islands, which had before been unknown to the rest of the world. His expedition took him up about six years, and was completed in the year of Christ 84.

Had this commander been continued in Britain, it is probable that both Scotland and England would have been permanently subdued; but he was recalled by Domitian in the year 85, and we are then almost totally in the dark about the British affairs till the reign of the emperor Adrian. During this interval the Caledonians had taken arms, and not only refused subjection to the Roman power themselves, but ravaged the territories of the Britons who continued faithful to them. Adrian, for what reason is not well known, abandoned to them the whole tract lying between the Tyne and the Forth. At the same time, in order to restrain them from making incursions into the Roman territories, he built a wall 80 miles in length from the river Eden in Cumberland to the Tyne in Northumberland *. He was succeeded by Antoninus Pius, in whose reign the Brigantes revolted; and the Caledonians, having in several places broken down the wall built by Adrian, began anew to ravage the Roman territories. Against them the emperor sent Lollius Urbicus, who reduced the Brigantes; and having defeated the northern nations, confined them within narrower bounds by a new wall †, extending probably between the friths of Forth and Clyde. From the time of Antoninus to that of Severus, the Roman dominions in Britain continued to be much infested by the inroads of the northern nations. That emperor divided Britain into two governments, the southern and northern; but the governor of the northern division was so harassed by continual incursions of the Caledonians, that he was at length obliged to purchase a peace with money. The Caledonians kept the treaty for 15 years; after which, breaking into the Roman territories anew, they committed terrible ravages. Virius Lupus the governor, not being in a condition to withstand them, acquainted the emperor with his distress, intreating him to send powerful and speedy supplies. Upon this Severus resolved to put an end to the perpetual incursions of the enemy, by making a complete conquest of their country; for which purpose he set out for Britain, together with his two sons Caracalla and Geta, at the head of a numerous army. The Caledonians no sooner heard of his arrival, than they sent ambassadors, offering to conclude a peace upon honourable terms. But these the emperor detained till he was ready to take the field, and then dismissed them without granting their request.

* See *Adrian*.

† See *Antoninus's Wall*.

22
Expedition of Severus into Britain.

As soon as the season was fit for action, Severus marched into the territories of the Caledonians, where he put all to fire and sword. He advanced even to the most northerly parts of the island; and though no battle was fought in this expedition, yet through the continual ambuscades of the enemy, and the inhospitable nature of the country, he is said to have lost 50,000 men. At last the Caledonians were obliged to sue for peace; which was granted them on condition of their yielding part of their country and delivering up their arms. After this the emperor returned to York, leaving his son Caracalla to command the army, and finish the new wall which had been begun between the friths of Forth and Clyde. But the emperor being taken ill at York, the Caledonians no sooner heard of his indisposition, than they again took up arms. This provoked Severus to such a degree, that he commanded his son Caracalla to enter their country anew with the whole army, and to put all he met to the sword without distinction of sex or age. Before these orders, however, could be put in execution, his two sons, having concluded a shameful peace with the Caledonians, returned to Rome.

A long chasm now takes place in the history of the Roman dominions in Britain. In the beginning of Dioclesian's reign, Carausius a native of Gaul, passing over into Britain, took upon him the title of *emperor*, and was acknowledged by all the troops quartered here. He was, however, killed in a battle with one of Constantius's officers, after he had enjoyed the sovereignty for six or seven years. Constantine the Great began his reign in this island; and returned soon after he had left it, probably with a design to put a stop to the daily incursions of the Caledonians. He altered the division of that part of Britain subject to the Romans. Severus had divided it only into two provinces; but Constantine increased the number to three, viz. Britannia Prima, Britannia Secunda, and Maxima Cæsariensis; and this last was afterwards divided into two, viz. Maxima Cæsariensis and Flavia Cæsariensis. The removal of the imperial seat from Rome to Constantinople, which happened in the reign of Constantine, gave the northern nations an opportunity of making frequent incursions into the Roman provinces; the emperor having carried with him, first into Gaul, and then into the East, not only most of the Roman troops, but likewise the flower of the British youth.

About the latter end of the reign of Constantius son to Constantine the Great, the government of the province of Britain, and other western parts of the empire, was committed to Julian, afterwards called the *apostate*. While he was in winter quarters at Paris, he was informed that the Scots and Picts, about this time first distinguished by these names, had broken into the Roman territories and committed everywhere dreadful ravages. Against them Julian dispatched a body of troops under the command of Lupicinius. He embarked from Boulogne in the depth of winter, but was no sooner arrived at London than he was recalled; the enemy having probably found means to appease Julian by their submissions. Till the reign of Valentinian I. these nations still continued to infest the Roman territories in Britain, and had now reduced the country to a most deplorable condition, by their continual ravages. Valentinian sent against them Theodosius, father to the emperor of that name. That general

ral having divided his forces into several bodies, advanced against the enemy, who were roving up and down the country. The Scots and Picts were obliged to yield to the superior valour and discipline of the Romans. Great numbers were cut in pieces; they were forced to abandon all the booty and prisoners they had taken, and to retire beyond the friths of Forth and Clyde. Theodosius then entered London in triumph, and restored that city to its former splendour, which had suffered greatly by the former incursions of the northern Britons. To restrain them from breaking anew into the provinces, Theodosius built several forts or castles between the two friths; and having thus recovered all the country between Adrian's wall and the friths of Forth and Clyde, he formed of it a fifth province, which he called *Valentia*.

23 The Britons choose an emperor of their own.

Though Britain was now reduced to a state of temporary tranquillity, yet as the Roman empire was daily declining, it is not to be supposed that sufficient care could be taken to secure such a distant province. In the reign of the emperor Honorius, the provincial Britons found themselves annoyed not only by the Scots and Picts, but also by the depredations of the Saxons, who began to commit ravages on the sea-coasts. By the care, however, of Stilicho, prime minister to Honorius, matters were once more settled, and a particular officer was appointed to guard the coast against the attempts of the Saxons, with the title of *Comes limitis Saxonici*. But, not long after, the empire being overrun by barbarians, most of the Roman troops quartered in Britain were recalled, and the country left quite open to the attacks of the Scots and Picts. Upon this the provincials expecting no more assistance from Honorius, resolved to set up an emperor of their own. Accordingly they invested with the imperial dignity one *Mark*, an officer of great credit among them. Him they murdered in a few days, and placed on the throne one Gratian a native of Britain. After a reign of four months, Gratian underwent the fate of his predecessor; and was succeeded by *Constantine*, a common soldier, who was chosen merely for the sake of his name. He seems, however, to have been a man of some knowledge and experience in war. He drove the Scots and Picts beyond the limits of the Roman territories; but being elated with this success, he would now be satisfied with nothing less than the conquest of the whole Roman empire. He therefore passed over into Gaul; and took with him not only the few Roman forces that had been left, but such of the provincial Britons as were most accustomed to arms. That unhappy people, being now left entirely defenceless, were harassed in the most cruel manner by their enemies; who broke into the country, and destroyed all with fire and sword. In this miserable situation they continued from the year 407, when the usurper Constantine passed over into Gaul, till the year 410. Having during the last three years frequently implored assistance from Rome without receiving any, they now resolved to withdraw their allegiance from an empire which was no longer able to protect them. Honorius himself applauded their conduct; and advised them by letters to provide for their own safety, which was in effect an implicit resignation of the sovereignty of the island.

24 Implore the assistance of the Romans.

The provincial Britons now regained their liberty; but they had lost the martial spirit which had at first rendered them so formidable to the Romans. They seem, however, to have met with some success in their first enterprises; for Zosimus tells us, that they delivered their cities from the insult of an haughty enemy. But being at last overpowered, they were again obliged to have recourse to the Roman emperor, to whom they promised a most perfect submission, provided they were delivered from the hands of their merciless and implacable enemies. Honorius, touched with compassion, sent a legion to their relief. The Roman forces landed in Britain unexpectedly; and having destroyed great numbers of the Scots and Picts, they drove them beyond the friths of Forth and Dunbritton. After this they advised the natives to build a wall on the isthmus from sea to sea, and to reassume their courage, and defend themselves from their enemies by their own valour. The Romans then quitted the country; being obliged to return, in order to repulse those barbarians who had broken into the empire from all quarters.

25 Send ambassadors a second time to Rome.

The Britons immediately set about building the wall, as they had been desired, with great alacrity. But as it was constructed only of turf, the Scots and Picts soon broke it down in several places; and, pouring in upon the defenceless and effeminate provincials, committed more cruel ravages than ever. At last, after very many and grievous calamities, the latter sent ambassadors once more to Rome. These appeared with their garments rent and dust on their heads; and at last prevailed on the emperor, by their earnest intreaties, to send another legion to their relief. The troops arrived in Britain before the enemy had the least knowledge of their having set sail. They were therefore quite unprepared for an attack, and roving up and down the country in the utmost disorder. The Romans made a terrible havock among them, and drove the remainder into their own country. As Honorius had sent them not with any ambitious view of retaining the island in subjection, but merely out of compassion to the unhappy provincials, the Romans told them, they had now no farther assistance to expect from them. They informed them, that the legion must immediately return to the continent, to protect the empire from the barbarians, who had extended their ravages almost to every part of it; and therefore, that they must now take their last farewel of Britain, and totally abandon the island. After this declaration Gallio, the commander of the Roman troops, exhorted the provincials to defend themselves, by fighting bravely for their country, wives, and children, and what ought to be dearer than life itself, their liberty; telling them, at the same time, that their enemies were no stronger than themselves, provided they would but lay aside their fears, and exert their ancient courage and resolution. That they might the better withstand the attacks of the enemy, he advised them to build a wall, not of turf, but of stone; offering to assist them with his soldiers, and to direct them himself in the execution. Upon this the Britons immediately fell to work; and with the assistance of the Romans, finished it in a short time, though it was no less than eight feet thick, and twelve feet in height. It is thought to have been built on the same place where Severus's wall formerly stood. Towers were also built at convenient distances on the east coast, to prevent the descents of the Saxons and other barbarians that came from Germany. Gallio employed the rest of his time in teaching the provincials the art of war. He left them patterns of the Roman weapons, which he also taught them to make; and after many encouraging exhortations, he took his last farewel of Britain, to which the Romans never returned. There is a great disagreement among chronologers as to the year in which the Romans finally abandoned Britain; some placing it in 422; others in 423, or 426; and some in 431, 435, or 437.

26 Briton finally abandoned by the Romans.

The final departure of the Romans was no sooner known to the Scots and Picts, than they poured in upon the provincial Britons from all quarters, like hungry wolves breaking into a sheep-fold. When the Scots approached the new-built wall, they found it completely finished, and guarded by great numbers of armed men. But so little had the provincial Britons profited by the military instructions of the Romans, that instead of placing proper guards and centinels, and relieving one another by turns, their whole number had staid several days and nights upon the ramparts without intermission. Being therefore quite benumbed and wearied out, they were able to make but very little resistance. Many were pulled down with hooks from the battlements and dashed in pieces. The rest were driven from their stations with showers of darts and arrows. They betook themselves to flight; but that could not save them. The Scots and Picts pursued them close, made a dreadful havock among the fugitives, and took possession of the frontier towns, which they found deserted by the inhabitants. As they now met with no more opposition, they overran the whole country, putting every thing to fire and sword. Their ravages soon occasioned a famine; and this was followed by a kind of civil war. The provincials, unable to support themselves, were obliged to plunder each other of the little the common enemy had left them. The whole country at last became so incapable of supporting those who were left in it, that many fled into the woods, in order to subsist themselves there by hunting. In this extremity of distress they had once more recourse to the Romans; and wrote in the most mournful style that can possibly be imagined to Aetius, who was then consul the third time. Their letter they directed thus: "The groans of the Britons to the consul Aetius." The contents of this letter were answerable to the direction. "The barbarians (say they) drive us to the sea; the sea drives us back to the barbarians; between which we have only the choice of two deaths, either to be swallowed up by the waves, or to be cruelly massacred by the enemy."

27 Britons miserably harassed by the Scots and Picts.

28 Implore the assistance of the Romans.

To this letter the Roman general gave no satisfactory answer, and the provincials were thereupon reduced to despair. Great numbers of them fled over to Armorica, where they settled along with others who had formerly gone over with an usurper called *Maximus*; while others submitted to the Scots and Picts. Some, however, more resolute than the rest, had once more recourse to arms. They sallied out in parties from the woods and caves where they had been obliged to hide themselves, and, falling unexpectedly on the enemy, cut great numbers of them in pieces, and obliged the rest to retire. Having thus obtained some respite, they began again to cultivate their lands; which, having lain fallow for a long time, now produced all sorts of corn in the greatest plenty. This plenty, according to the historian Gildas, occasioned the most consummate wickedness and corruption of manners among all ranks of men. The clergy, says he, who should have reclaimed the laity by their example, proved the ringleaders in every vice; being addicted to drunkenness, contention, envy, &c.—It is possible, however, that this description might be exaggerated by Gildas, who was himself a monk. But, however this was, the Britons had not long enjoyed peace, when they were alarmed by a report that the Scots and Picts were about to return with a far greater force than before, utterly to extirpate the name of their southern neighbours, and seize upon the country for themselves. This report threw them into a terrible consternation; and to add to the rest of their misfortunes, they were now visited by a dreadful plague, which raged with such violence, that the living were scarce sufficient to bury the dead. The contagion no sooner ceased, than they found their country invaded by the Scots and Picts, who destroyed every thing with fire and sword; so that the provincials were soon reduced to the same miserable state they had formerly been in.

29 They at last repulse their enemies.

30 Are again threatened with an invasion.

At this time the chief, if not the only, king of the southern division of Britain, was one *Vortigern*. He is said to have been a cruel, debauched tyrant, regardless of the public welfare, and totally incapable of promoting it. Being now roused from his insensibility, however, by a sense of his own danger, he summoned a council of the chief men of the nation, in order to deliberate about the proper means for delivering the country from those calamities under which it groaned. In this council the most pernicious measure was adopted that could possibly have been resolved on; namely, to invite to their assistance the *Saxons*, a people famous for their piracies and cruelty, and justly dreaded by the Britons themselves *. This fatal expedient being agreed upon, ambassadors were immediately dispatched into Germany with advantageous proposals to the Saxons in case they would come over to their assistance.

31 They resolve to call in the Saxons.

The British ambassadors soon arrived in Germany, and, according to Witichind, a Saxon historian of the ninth century, made the following speech before an assembly of the Saxons.—"Illustrious Saxons, the fame of your victories having reached our ears, the distressed Britons, harassed by the continual inroads of a neighbouring enemy, send us to implore your assistance. We have a fertile and spacious country, which we are commanded to submit to you. We have hitherto lived under the protection of the Roman empire; but our ancient masters having abandoned us, we know no nation more powerful than you, and better able to protect us. We therefore recur to your valour. Forsake us not in our distress, and we shall readily submit to what terms you yourselves shall think fit to prescribe to us."—If this abject and shameful speech was really made, it must give us a very strange idea of the national spirit of the provincial Britons at that time. It is, however, probable that the whole is a fiction, designed only to excuse the perfidious treatment which these Britons afterwards received from the Saxons.

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* See *Saxons*.

Saxons. The most respectable even of the Saxon historians make no mention of such a speech; and it is certain, that when the Saxons themselves wanted to quarrel with the Britons, they never insisted upon the promise made by the British ambassadors; which they most certainly would have done, had any such promise ever been made.

33 The Saxons arrive in Britain, and defeat the Scots and Picts.

The British ambassadors were very favourably received by the Saxons. The latter embraced their proposal with joy; and the rather, because their soothsayers foretold that they should plunder their British allies for 150 years, and reign over them for twice that time. Three long ships, in the Saxon language called *chiules*, were therefore fitted out, under the conduct of Hengist and Horsa. These were two brothers much celebrated both for their valour and nobility. They were sons of Witigifil, said to be great-grandson to the Saxon god Woden; a circumstance which added much to their authority. Having embarked about 1600 men on board their three vessels, the two brothers arrived in the isle of Thanet, in the year 449 or 450. They were received by the inhabitants with the greatest demonstrations of joy: the isle in which they had landed was immediately appointed for their habitation; and a league was concluded, in virtue of which the Saxons were to defend the provincial Britons against all foreign enemies, and the provincials were to allow the Saxons pay and maintenance, besides the place allotted them for their abode. Soon after their arrival, King Vortigern led them against the northern nations, who had lately broke into the kingdom, and advanced as far as Stanford in the county of Lincolnshire. Here a battle was fought, in which the Scots and Picts were utterly defeated, and obliged to relinquish their booty.

Vortigern was so highly pleased with the behaviour of his new allies, that he bestowed large possessions in the country they had newly delivered, upon the two commanders Hengist and Horsa. It is said, that, even at this time, Hengist was taken with the wealth and fertility of the country; and at the same time observing the inhabitants to be quite enervated with luxury, began to entertain hopes of conquering part of it. He therefore, with Vortigern's consent, invited over some more of his countrymen; giving them notice at the same time of the fruitfulness of the country, the effeminacy of the inhabitants, and how easily a conquest might be effected.

34 New supplies of Saxons arrive.

The Saxons readily complied with the invitation; and, in 452, as many more arrived in 17 vessels, as, with those already in Britain, made up an army of 5000 men. Along with these, according to Nennius, came over Rowena the daughter of Hengist. Vortigern fell in love with this lady; and in order to obtain her in marriage, divorced his lawful wife. Hengist pretended to be averse to the match; but Vortigern obtained his consent by investing him with the sovereignty of Kent. The Saxon historians, indeed, make no mention of Rowena; but rather insinuate, that their countrymen made themselves masters of Kent by force of arms. It seems most probable, however, that Vortigern had as yet continued in friendship with the Saxons, and even put more confidence in them than in his own subjects. For, not long after the arrival of this first reinforcement, Hengist obtained leave to send for a second, in order, as was pretended, to defend the king from the attempts of his rebellious subjects, as well as of the Scots and Picts. Those embarked in 40 ships, under the command of Octa and Ebusa, the son and nephew, or, according to some, the brother and nephew of Hengist. They landed at the Orkney islands; and having ravaged them, as well as all the northern coasts of Scotland, they conquered several places beyond the Frith, and at last obtained leave to settle in Northumberland.

34 They quarrel with the Britons.

The pretence made for this settlement was, that the Saxons under Octa and Ebusa might defend the northern frontiers of the kingdom, as those under Hengist and Horsa did the southern parts. Many more Saxons were, under various pretences, invited over; till at last the countries from which they came were in a manner depopulated. And now their numbers being greatly increased, the Saxons began to quarrel with the natives. They demanded larger allowances of corn and other provisions; threatening to lay waste the whole country if their demands were not complied with. The Britons, instead of complying with these demands, desired them to return home, since their numbers exceeded what they were able to maintain. Upon this the Saxons concluded a peace with the Scots and Picts; and, turning their arms against the unhappy provincials, overran the whole country. The Saxons committed everywhere the greatest cruelties. All buildings, whether public or private, they levelled with the ground. The cities were pillaged and burnt; and the people massacred without distinction of sex or age, and that in such numbers, that the living scarce sufficed to bury the dead. Some of those who escaped the general slaughter, took refuge among inaccessible rocks and mountains; but there great numbers perished with hunger, or were forced to surrender themselves as slaves to their enemies. Some crossed the sea, and settled either in Holland or in Armorica, now the province of Britanny in France.

35 They are defeated and driven out by Vortimer.

Vortigern, we are told by Nennius, was so far from being reclaimed by these calamities, that he added incest to his other crimes, and married his own daughter. At last, his own subjects, provoked at his enormous wickedness, and the partiality he showed to the Saxons, deposed him, and raised his son Vortimer to the throne. He was a young man of great valour, and willingly undertook the defence of his distressed country. He first fell upon the Saxons with what troops he could assemble, and drove them into the isle of Thanet. Here they were besieged, till, being reinforced by fresh supplies from Germany, they opened themselves a way through the British troops. Vortimer, however, was not yet disheartened. He engaged the Saxons on the banks of the Derwent in Kent, where he obtained a complete victory, and cut in pieces great numbers of the enemy. Another battle was fought at Aylesford in Kent. Some ascribe the victory at this time to the Saxons, and some to the Britons. It is certain, however, that Horsa the brother of Hengist was killed in this engagement. He is said to have been buried at a place in the neighbourhood, which from him obtained the name of *Horsted*.—A third battle was fought, in which the victory was uncertain, as is also the place where it happened. The fourth battle, however, according to Nennius proved decisive

decisive in favour of the Britons. Vortimer engaged his enemies, according to some, at Folkstone; according to others, at a place called *Stonar*, in the isle of Thanet. The Saxons were defeated with great slaughter, and driven back to their ships. So complete is the victory said to have been, that the Saxons quitted the island, without making any attempt upon it for five years afterwards. These battles, however, rest entirely upon the credit of Nennius, and the historians who have followed him. They are taken notice of neither by Gildas nor Bede. The former only acquaints us, that the Saxons retired. This, by most historians, is understood of their returning home; though it is possible he might mean no more, than that, after they had laid waste the country, they retired into the territories allotted them by Vortigern, in Kent and Northumberland.

36
They return and defeat the Britons, and erect a kingdom in Kent.

Vortimer is said to have died after a reign of six years. On his death-bed, he desired his servants to bury him near the place where the Saxons used to land; being persuaded, that the virtue of his bones would effectually prevent them from ever touching the British shore. This command, however, was neglected; and Vortimer was buried at Lincoln, according to some, or London, according to others. Hengist was no sooner informed of his death, than he invaded Britain anew with a numerous body of Saxons. He was opposed by Vortigern, who had been restored to the throne after the death of his son Vortimer. Several battles were fought on this occasion; but at last the provincials being overthrown at a place called *Crecanford*, with the loss of 4000 men, were obliged to abandon Kent to their enemies, and retire to London. This happened about the year 458 or 459; and from this time most historians date the erection of the first Saxon kingdom in Britain, viz. that of Kent. Hengist assumed the title of *king*, and chose Esk his son for his colleague.

37
Treachery of the Saxons.

The Britons under Vortigern still continued the war. Hengist finding himself unable to gain a decisive advantage over them in the field, had recourse to treachery. He pretended to be desirous of concluding a peace with the British monarch, and of renewing his ancient friendship with him; and therefore required an interview. To this Vortigern readily consented, and accepted of an entertainment prepared for him by Hengist. The king was attended by 300 nobility all unarmed; but the Saxons had concealed daggers below their garments. The British nobility were all treacherously massacred in the height of their mirth; Vortigern himself was taken and put in fetters; nor could his liberty be procured, but by ceding to the Saxons those provinces now called *Essex*, *Sussex*, and *Middlesex*. Thus the Saxons got such a footing in Britain, that they could never afterwards be expelled. Vortigern, after being set at liberty, is said to have retired to a vast wilderness near the fall of the Wye in Radnorshire, where he was some time after consumed by lightning, together with a city called *Kaer Gourtigern* which he had built in that place.

On the retreat of Vortigern, the command of the British forces devolved upon Aurelius Ambrosius, or as Gildas calls him, Ambrosius Aurelianus. He was a Roman, and perhaps the last that remained in the island. He is said to have gained several victories over the Saxons. Notwithstanding this, however, they still continued to gain ground; and in the year 491, the foundation of a second Saxon kingdom was laid in Britain. This at first comprehended only the county of Sussex, but soon after extended over most of the counties lying south of the Humber. It was called the *kingdom of the South Saxons*.

38
Second Saxon kingdom.

The German nations being now informed of the good success which had attended the Saxons in Britain, new adventurers daily flocked over to share the good fortune of the others. They were chiefly composed of three nations, the Saxons, Angles, and Jutes. All these passed under the common appellation sometimes of *Saxons*, sometimes of *Angles*. They spoke the same language, and agreed very much in their customs and institutions, so that all of them were naturally led to combine against the natives. The most active of these adventurers was Cerdic a Saxon, said to be the tenth in descent from Woden. He landed with his son Cenric, and as many men as he could convey in five ships, at Yarmouth in Norfolk. The provincials immediately attacked them with great vigour; but after a short engagement, they were totally defeated. Many other battles were fought, the event of which was always favourable to the Saxons, so that the Britons were forced to abandon their sea-coasts to them.

39
Nazaleod king of Britain defeated and killed.

In 497, *Porta*, another Saxon, with his two sons, *Bleda* and *Magla*, arrived at *Portsmouth*, so called, as some imagine, from this chieftain. The provincials, under the command of a young prince a native of the country, attempted to oppose the landing of the Saxons: but his army was defeated with great slaughter, and he himself killed in the engagement; after which Porta made himself master of all the neighbouring country. The progress of Cerdic, however, alarmed the Britons more than that of all the other Saxon princes. About the year 508, therefore, *Nuzaleod*, styled, by Henry of Huntingdon, *the greatest of all the British kings*, assembled almost the whole strength of the provincial Britons in order to drive him out of the island. Cerdic, on the other hand, took care to strengthen himself by procuring assistance from all the Saxons already in the island. He then advanced against the Britons, commanding the right wing himself, and his son Cenric the left. As the two armies drew near each other, Nazaleod perceived the enemy's right wing to be much stronger than the left. He therefore attacked it with the flower of his army; and after an obstinate resistance, obliged Cerdic to save himself by flight. Being too eager in the pursuit, however, Cenric fell upon his rear, and the battle was renewed with great vigour. The British army was at last entirely defeated; and 5000 men, among whom was Nazaleod himself, were left dead on the spot.

40
Whether such a person as King Arthur ever existed.

Who succeeded Nazaleod in the kingdom of Britain, is not known. The Welsh annals leave an interregnum of about six years, after which they place the beginning of the reign of Arthur, the most renowned British prince mentioned in history. The history of King Arthur is so much obscured by fables, and many absurd, romantic, and ridiculous stories, that some have supposed that no such person ever existed. On this subject Milton gives the following reasons against the existence of King Arthur: 1. He is not mentioned by Gildas,

Gildas, or any British historian except Nennius, who is allowed on all hands to have been a very credulous writer, and to have published a great many fables. 2. Though William of Malmesbury and Henry of Huntingdon have both related his exploits, yet the latter took all he wrote from Nennius; and the former, either from the same fabulous writer, or some monkish legends in the abbey of Glastenbury; for both these writers flourished several centuries after King Arthur. 3. In the pretended history of Geoffroy of Monmouth, such contradictions occur concerning this monarch's victories in France, Scotland, Ireland, Norway, Italy, &c. as must cause us to look upon him as a hero altogether fabulous and romantic.

In answer to this it has been said, 1. That his not being mentioned by Gildas cannot seem strange to us, seeing it was not that author's design to write an exact history of his country, but only to give a short account of the causes of its ruin by the Scots, Picts, and Saxons. He had also a particular system to support, namely, That the ruin of the Britons was owing to the judgements of God upon them for their wickedness. He lies therefore under a great temptation to conceal the successes of the Britons, and to relate only their misfortunes. 2. Though Nennius was a credulous writer, it is unreasonable to think that the whole history of King Arthur was an invention of his. It is more probable that he copied it from other more ancient authors, or took it from the common tradition of his countrymen. That the Saxon annals make no mention of this king is not to be wondered at, seeing it is natural to think that they would wish to conceal the many defeats he gave their nation. 3. The most convincing proof of the existence of King Arthur is, that this tomb was discovered at Glastenbury in Somersetshire, and his coffin dug up in the reign of Henry II. with the following inscription upon it in Gothic characters: "Hic jacet sepultus inclytus rex Arturius in insula Avalonia." We are told that on his body were plainly to be seen the marks of 10 wounds, only one of which seemed to be mortal.

41 His exploits.

This renowned prince is said to have defeated the Saxons under Cerdic in 12 pitched battles. The last of these was fought on Badon-hill, supposed to be Bansdown near Bath; in which the Saxons received such a terrible overthrow, that for many years they gave the Britons no further molestation. As new supplies of Saxons, however, were continually flocking over, a third and fourth kingdom of them were soon formed. The third kingdom comprehended the counties of Devon, Dorset, Somerset, Wiltshire, Hampshire, and Berkshire; to which was afterwards added Cornwall. This was called the *kingdom of the West Saxons.* The other kingdom, which was called the *kingdom of the East Saxons*, comprehended Essex, Middlesex, and part of Hertfordshire.

42 Two other Saxon kingdoms erected.

In the year 542, happened the death of the great King Arthur, said to have been killed in battle with a treacherous kinsman of his own. Five years afterwards was erected the Saxon kingdom of Northumberland. It extended, however, much farther than the present bounds of that country; for it comprehended all Yorkshire, Lancashire, Durham, Cumberland, Westmoreland, and Northumberland, with part of Scotland, as far as the frith of Forth. Between the Saxon kings frequent contentions now arose; by which means the Britons enjoyed an uninterrupted tranquillity for at least 44 years. This interval, however, according to Gildas, they employed only in corrupting their manners more and more, till at last they were roused from their security by the setting up of a sixth Saxon kingdom, called the kingdom of the *East Angles.* It was founded in 575, and comprehended the counties of Norfolk, Suffolk, Cambridgeshire, and the Isle of Ely. The Saxons once more attacked the Britons, and overthrew them in many battles. The war was continued for ten years; after which, another Saxon kingdom called *Mercia* was set up. It comprehended 17 counties; viz. Gloucester, Hereford, Worcester, Warwick, Leicester, Rutland, Northampton, Lincoln, Huntingdon, Bedford, Buckingham, Oxford, Stafford, Nottingham, Derby, Shropshire, Cheshire, and part of Hertfordshire.

43 The Britons defeat the Saxons, but are obliged to retire into Wales.

The provincial Britons were now confined within very narrow bounds. However, before they entirely gave up the best part of their country to their enemies, they once more resolved to try the event of a battle. At this time they were assisted by the Angles, who were jealous of the overgrown power of the West Saxons. The battle was fought in Wiltshire, at Woden's Bearth, a place near the ditch called *Wansdike* or *Wodensdike;* which runs through the middle of the county. The battle was very obstinate and bloody; but at last the Saxons were entirely defeated, and almost their whole army cut off. The victory, however, proved of little service to the Britons: for being greatly inferior in number to the Saxons, and harassed by them on the one side, and by the Scots and Picts on the other, they were daily more and more confined; and at last obliged to take refuge among the craggy and mountainous places in the west of the island, where their enemies could not pursue them. At first they possessed all that country beyond the rivers Dee and Severn, which anciently divided Cambria, or Wales, from England; the towns which stand on the eastern banks of these rivers having mostly been built in order to restrain the incursions of the Welsh. But the English, having passed the Severn, by degrees seized on the country lying between that river and the Wye. Nay, in former times, some parts of Flintshire and Denbighshire were subject to the kings of Mercia: for Uffa, the most powerful king of that country, caused a deep ditch to be drawn, and a high wall built, as a barrier between his dominions and the territories of the Welsh, from the mouth of the Dee, a little above Flint-castle, to the mouth of the Wye. This ditch is still to be seen in several places; and is called by the Welsh *Claudh Uffa*, or the Ditch of Uffa. The inhabitants of the towns on the east side of this ditch are called by the same people *Gwyr y Mers;* that is, the men of Mercia.

44 Account of the heptarchy.

Thus, after a violent contest of near 150 years, the Saxons entirely subdued the Britons whom they had come to defend, and had erected seven independent kingdoms in England, now commonly denominated the *Saxon Heptarchy.* By these conquerors the country was now reduced to a degree of barbarity almost as great as it had been in when first invaded by the Romans. The provincial Britons, during their subjection to that people, had made considerable advances in civilization.

vilization. They had built 28 considerable cities, besides a number of villages and country-seats; but now these were all levelled with the ground, the native inhabitants who remained in England were reduced to the most abject slavery, and every art and science totally extinguished among them.

Before these fierce conquerors could be civilized in any degree, it was necessary that all the seven kingdoms should be reduced under one head; for as long as they remained independent, their continual wars with each other still kept them in the same state of barbarity and ignorance.

The history of these seven kingdoms affords no event that can be in the least interesting. It consists only of a detail of their quarrels for the sovereignty. This was at last obtained by Egbert king of the West Saxons, or Wessex, in 827. Before this time, Christianity had been introduced in almost all the kingdoms of the heptarchy; and however much corrupted it might be by coming through the impure channel of the church of Rome, and misunderstood through the ignorance of those who received it, it had considerably softened the barbarous manners of the Saxons. It had also opened a communication between Britain and the more polite parts of Europe, so that there was now some hope of the introduction of arts and sciences into this country. Another effect was that, by the ridiculous notions of preserving inviolable chastity even between married people, the royal families of most of the kingdoms were totally extinct; and the people, being in a state of anarchy, were ready to submit to the first who assumed any authority over them.

All these things contributed to the success of Egbert in uniting the heptarchy under his own dominion. He was one of the royal family of Wessex; and a nearer heir than Brithric, who had been raised to the kingdom in 784. As Egbert was a prince of great accomplishments, Brithric, knowing that he had a better title to the crown than himself, began to look upon him with a very jealous eye. Young Egbert, sensible of his danger, privately withdrew to France; where he was well received by Charlemagne, the reigning monarch. The French were reckoned at this period the most valiant and polite people in Europe; so that this exile proved of great service to Egbert.

He continued at the court of France till he was recalled by the nobility to take possession of the kingdom of Wessex. This recal was occasioned by the following accident. Brithric the king of Wessex had married Eadburga, natural daughter of Offa king of Mercia; a woman infamous for cruelty and incontinence. Having great influence over her husband, she often persuaded him to destroy such of the nobility as were obnoxious to her; and where this expedient failed, she herself had not scrupled to become their executioner. She had mixed a cup of poison for a young nobleman, who had acquired a great share of her husband's friendship; but, unfortunately, the king drank of the fatal potion along with his favourite, and soon after expired. By this and other crimes Eadburga became so odious to the people, that she was forced to fly into France, while Egbert was at the same time recalled, as above mentioned.

Egbert ascended the throne of Wessex in the year 799. He was the sole descendant of those conquerors who first invaded Britain, and who derived their pedigree from the god Woden. But though this circumstance might have given him great advantages in attempting to subdue the neighbouring kingdoms, Egbert for some time gave them no disturbance; but turned his arms against the Britons, who had retired into Cornwall, whom he defeated in several battles. He was recalled from his conquests in that country, by hearing that Bernulf king of Mercia had invaded his dominions. Egbert quickly led his army against the invaders, whom he totally defeated at Ellendun in Wiltshire. He then entered their kingdom on the side of Oxfordshire with an army, and at the same time sent his eldest son Ethelwolf with another into Kent. The young prince expelled Baldred the tributary king of Kent, and soon made himself master of the country. The kingdom of Essex was conquered with equal ease; and the East Angles, who had been reduced under subjection by the Mercians, joyfully put themselves under the protection of Egbert. Bernulf himself marched against them, but was defeated and killed; and Ludecan his successor met with the same fate two years after.

These misfortunes greatly facilitated the reduction of Mercia. Egbert soon penetrated into the very heart of the Mercian territories, and gained an easy victory over a dispirited and divided people; but in order to engage them to submit with the less reluctance, he allowed Wiglef, their countryman, to retain the title of *king*, whilst he himself exercised the real power of a sovereign. Northumberland was at present in a state of anarchy: and this tempted Egbert to carry his victorious arms into that kingdom also. The inhabitants, being desirous of living under a settled form of government, readily submitted, and owned him for their sovereign. To them, however, he likewise allowed the power of electing a king; who paid him a tribute, and was dependent on him.

45 Egbert the first king of England.

Egbert became sole master of England about the year 827. A favourite opportunity was now offered to the Anglo-Saxons of becoming a civilized people, as they were at peace among themselves, and seemed free from any danger of a foreign invasion. But this flattering prospect was soon overcast. Five years after Egbert had established his new monarchy, the Danes landed in the isle of Shepey, plundered it, and then made their escape with safety. Encouraged by this success, next year they landed from a fleet of 35 ships. They were encountered by Egbert at Charmouth in Dorsetshire. The battle was obstinate and bloody. Great numbers of the Danes were killed, but the rest made good their retreat to their ships. They next entered into an alliance with the Britons of Cornwall; and landing two years after in that country, they made an irruption into Devonshire. Egbert met them at Hengesdown, and totally defeated them; but before he had time to form any regular plan for the defence of the kingdom, he died, and left the government to his son Ethelwolf.

46 Danish invasion.

47 Ethelwolf.

The new king was weak and superstitious. He began with dividing the kingdom, which had so lately been united, with his son Athelstan. To the young prince he gave the counties of Essex, Kent, and Sussex. But though this division might have been productive of

England. A. D. 852. of bad consequences at another time, the fear of the Danes kept every thing quiet for the present. These barbarians had some how or other conceived such hopes of enriching themselves by the plunder of England, that they scarce ever failed of paying it an annual visit. The English historians tell us, that they met with many severe repulses and defeats; but on the whole it appears that they had gained ground; for in 851 a body of them took up their winter-quarters in England. Next year they received a strong reinforcement of their countrymen in 350 vessels; and advancing from the isle of Thanet, where they had stationed themselves, they burnt the cities of London and Canterbury. Having next put to flight Brichtric the governor of Mercia, they marched into the heart of Surry, laying waste the whole country through which they passed.

Æthelwolf, though naturally little fitted for military enterprises, was now obliged to take the field. He marched against the Danes at the head of the West Saxons, and gained an indecisive and bloody victory over his enemies. The Danes still maintained their settlement in the isle of Thanet. They were attacked by Ealher and Huda, governors of Kent and Surry: both of whom they defeated and killed. Afterwards they removed to the isle of Shepey, where they took up their winter-quarters, with a design to extend their ravages the next year.

The deplorable state of the kingdom did not hinder Ethelwolf from making a pilgrimage to Rome, whither he carried his fourth and favourite son Alfred, then only six years of age. He passed a twelvemonth in that city; made presents to the principal ecclesiastics there; and made a grant of 300 mancuses (a silver coin about the weight of our half-crown) annually to the see of Rome. One-third of this was to support the lamps of St Peter's, another those of St Paul's, and the third was for the Pope himself. In his return to England, Ethelwolf married Judith, daughter of the emperor Charles the Bald; but when he landed, he found himself deprived of his kingdom by his son Ethelbald. That prince assumed the government of Athelstan's dominions, who was lately dead; and, with many of Ethelwolf's nobles, formed a design of excluding him from the throne altogether, on account of his weaknesses and superstitions. Ethelwolf, however, delivered the people from the calamities of a civil war, by dividing the kingdom with his son. He gave to Ethelbald the government of the western, and reserved to himself that of the eastern, part of the kingdom. Immediately after this, he summoned the states of the whole kingdom, and conferred on the clergy a perpetual donation of tithes, for which they had long contended, and which had been the subject of their sermons for several centuries.

This concession was deemed so meritorious by the English, that they now thought themselves sure of the favour of heaven; and therefore neglected to use the natural means for their safety which they might have done. They even agreed, that notwithstanding the desperate situation of affairs at present, the revenues of the church should be exempted from all burdens, though imposed for the immediate security and defence of the nation. Ethelwolf died two years after he had made the above-mentioned grant, and left the kingdom to his two eldest sons Ethelbald and Ethelbert. Both these princes died in a few years, and left the kingdom to Ethered their brother, in the year 866.

England. A. D. 866.

48 Ethered.

The whole course of Ethered's reign was disturbed by the irruptions of the Danes. The king defended himself against them with great bravery, being seconded in all his military enterprises by his younger brother Alfred, who afterwards ascended the throne. In this reign, the Danes first landed among the East Angles. That people treacherously entered into an alliance with the common enemy; and furnished them with horses, which enabled them to make an irruption into Northumberland. There they seized upon the city of York. Osbricht and Ælla, two Northumbrian princes who attempted to rescue the city, were defeated and killed. Encouraged by this success, the Danes penetrated into the kingdom of Mercia, took up their winter-quarters at Nottingham, and thus threatened the kingdom with a final subjection. From this post, however, they were dislodged by Ethered and Alfred, who forced them to retire into Northumberland. Their restless and savage disposition, however, did not suffer them to continue long in one place. They broke into East Anglia; defeated and took prisoner Edmund the tributary king of that country, whom they afterwards murdered; and committed everywhere the most barbarous ravages. In 871, they advanced to Reading, from whence they infested the neighbouring country by their incursions. The Mercians, desirous of recovering their independency, refused to join Ethered with their forces; so that he was obliged to march against the Danes, attended only by the West Saxons, who were his hereditary subjects. Several actions ensued, in which the Danes are said to have been unsuccessful; but being continually reinforced from their own country, they became every day more and more formidable to the English. During the confusion and distress in which the nation was now necessarily involved, King Ethered died of a wound he had received in an action with the Danes; and left to his brother Alfred the kingdom almost totally subdued by a foreign power.

49 Alfred the Great.

Alfred, who may properly be called the founder of the English monarchy, ascended the throne in the year 871, being then only 22 years of age. His great virtues and shining talents saved his country from ruin, which seemed almost unavoidable. His expoits against the Danes, his dangers and distresses, are related under the article ALFRED. Having settled the nation in a much better manner than could have been expected, he died in 901, leaving the kingdom to his second son Edward the Elder.

50 Edward the Elder.

The beginning of this monarch's reign was disturbed by those intestine commotions from which the wise and politic Alfred had taken so much pains to free the nation. Ethelwald, son to King Ethelbert, Alfred's elder brother, claimed a right to the throne. Having armed his partisans, he took possession of Winburne, where he seemed determined to hold out to the last extremity. On the approach of Edward, however, with a powerful army, he first fled into Normandy, and afterwards into Northumberland. He hoped to find the Northumbrians ready to join him, as most of them were Danes, lately subdued by Alfred, and very impatient of peace. The event did not disappoint his expectations.

pectations. The Northumbrians declared for him; and Ethelwald having thus connected himself with the Danish tribes, went beyond sea, whence he returned with a great body of these banditti. On his return, he was joined by the Danes of East Anglia and Mercia. Ethelwald, at the head of the rebels, made an irruption into the counties of Gloucester, Oxford, and Wilts; and having ravaged the country, retired with his booty before the king could approach him. Edward, however, took care to revenge himself, by conducting his forces into East Anglia, and ravaging it in like manner. He then gave orders to retire; but the Kentish men, greedy of more plunder, staid behind, and took up their quarters at Bury. Here they were assaulted by the Danes; but the Kentish men made such an obstinate defence, that though their enemies gained the victory, it was bought by the loss of their bravest men, and, among the rest, of the usurper Ethelwald himself.

The king, now freed from the attempts of so dangerous a rival, concluded an advantageous peace with the East Angles. He next set about reducing the Northumbrians; and for this purpose equipped a fleet, hoping that thus they would be induced to remain at home to defend their own country, without attempting to invade his territories. He was disappointed in his expectations. The Northumbrians were more eager to plunder their neighbours than to secure themselves. Imagining that the whole of Edward's forces were embarked on board his fleet, they entered his territories with all the troops they could raise. The king, however, was better prepared for them than they had expected. He attacked them on their return at Tetenhall in the county of Stafford, put them to flight, recovered all the booty, and pursued them with great slaughter into their own country.

The rest of Edward's reign was a scene of continued and successful action against the Northumbrians, East Angles, the Danes of Mercia, and those who came from their native country in order to invade England. He put his kingdom in a good posture of defence, by fortifying the towns of Chester, Eddesbury, Warwick, Cherbury, Buckingham, Towcester, Maldon, Huntingdon, and Colchester. He vanquished Thurketill a Danish chieftain, and obliged him to retire with his followers into France. He subdued the East Anglians, Northumbrians, and several tribes of the Britons; and even obliged the Scots to make submissions. He died in 925, and was succeeded by Athelstan his natural son.

51 Athelstan.

This prince, notwithstanding his illegitimate birth, ascended the throne without much opposition, as the legitimate children of Edward were too young to rule a nation so much liable both to foreign invasions and domestic troubles as England at present was. One Alfred, however, a nobleman of considerable power, entered into a conspiracy against him. It is said, that this nobleman was seized upon strong suspicions, but without any certain proof. He offered to swear to his innocence before the pope; and in those ages it was supposed that none could take a false oath in presence of such a sacred person, without being visited by an immediate judgment from God. Alfred was accordingly conducted to Rome, and took the oath required of him before Pope John. The words were no sooner pronounced, than he fell into convulsions, of which he expired in three days. The king, fully convinced of his guilt, confiscated his estate, and made a present of it to the monastery of Malmesbury.

This accident proved the means of establishing the authority of Athelstan in England. But finding the Northumbrians bore the English yoke with impatience, he gave Sithric, a Danish nobleman, the title of king of Northumberland; and in order to secure his friendship, gave him his own sister Editha in marriage. This was productive of bad consequences. Sithric died the year after his marriage with Editha; upon which Anlaf and Godfrid, Sithric's sons by a former marriage, assumed the sovereignty without waiting for Athelstan's consent. They were, however, soon obliged to yield to the superior power of that monarch. The former fled to Ireland; and the latter to Scotland, where he was protected by Constantine king of that country. The Scottish monarch was continually importuned by Athelstan to deliver up his guest, and even threatened with an invasion in case he did not comply. Constantine, detesting this treachery, advised Godfrid to make his escape. He did so, turned pirate, and died soon after. Athelstan, however, resenting this conduct of Constantine, invaded his kingdom, and reduced him, it is said, so low, that he was obliged to make the most humble submissions. This, however, is denied by all the Scottish historians.

Constantine, after the departure of Athelstan, entered into a confederacy with Anlaf, who subsisted by his piracies, and with some of the Welsh princes who were alarmed at the increase of Athelstan's power. All these confederates made an irruption into England at once; but Athelstan meeting them at Brumsbury in Northumberland, gave them a total overthrow. Anlaf and Constantine made their escape with difficulty, leaving the greatest part of their men dead on the field of battle. After this period, Athelstan enjoyed his crown with tranquillity. He died in 941, after a reign of 16 years. He passed a remarkable law, for the encouragement of commerce: viz. that a merchant, who had made three long sea voyages on his own account, should be admitted to the rank of a thane or gentleman.

52 Defeats his enemies.

53 Edmund.

Athelstan was succeeded by his brother Edmund. On his accession, he found the kingdom disturbed by the restless Northumbrians, who watched for every opportunity of rising in rebellion. They were, however, soon reduced; and Edmund took care to ensure the peace of the kingdom, by removing the Danes from the towns of Mercia where they had been allowed to settle, because it was found that they took every opportunity to introduce foreign Danes into the kingdom. He also conquered Cumberland from the Britons. This country, however, he bestowed upon Malcolm king of Scotland, upon condition that he should do homage for it, and protect the north of England from all future incursions of the Danes.

54 Murdered by Leolf.

Edmund was unfortunately murdered in Gloucester, by one Leolf a notorious robber. This man had been formerly sentenced to banishment; yet had the boldness to enter the hall where the king himself dined, and to sit at table with his attendants. Edmund immediately ordered him to leave the room. The villain refused to obey; upon which the king leaped upon him,

him, and seized him by the hair. Leolf then drew a dagger, and gave the king a wound, of which he instantly died, A. D. 946, being the sixth year of his reign.

**55 Edred.** As the children of Edmund were too young at the time of his decease, his brother Edred succeeded to the throne. The beginning of his reign, as well as those of his predecessors, was disturbed by the rebellions and incursions of the Northumbrian Danes, who looked upon the succession of every new king to be a favourable opportunity for shaking off the English yoke. On the appearance of Edred with an army, however, they immediately submitted: but before the king withdrew his forces, he laid waste their territories as a punishment for their offence. **56 Subdues the Northumbrians.** He was no sooner gone, than they rose in rebellion a second time. They were again subdued; and the king took effectual precautions against their future revolts, by placing English garrisons in all their towns, and appointing an English governor to watch their motions, and suppress their insurrections on the first appearance. **57 Celibacy of the clergy introduced.** In the reign of Edred, celibacy of the clergy began to be preached up under the patronage of St DUNSTAN. This man had obtained such an ascendant over Edred, who was naturally superstitious, that he not only directed him in affairs of conscience, but in the most important matters of state. He was placed at the head of the treasury; and being thus possessed of great power at court, he was enabled to accomplish the most arduous undertakings. He professed himself a partisan of the rigid monastic rules; and having introduced celibacy among the monks of Glastenbury and Abingdon, he endeavoured to render it universal among the clergy throughout the kingdom. The monks in a short time generally embraced the pretended reformation; after which they inveighed bitterly against the vices and luxury of the age. When other topics of defamation were wanting, the marriages of clergymen became a sure object of invective. Their wives received the appellation of *concubines* or some other more opprobrious names. The secular clergy, on the other hand, who were numerous and rich, defended themselves with vigour, and endeavoured to retaliate upon their adversaries. The people were thrown into the most violent ferments; but the monks, being patronised by King Edred, gained ground greatly upon their opponents. Their progress, however, was somewhat retarded by the king's death, which happened in 955, after a reign of nine years. He left children; but as they were infants, his nephew Edwy, son to Edmund, was placed on the throne.

**58 Edwy.** The new king was not above 16 or 17 years of age at the time of his accession. His reign is only remarkable for the tragical story of his queen Elgiva. She was a princess of the royal blood, with whom Edwy was deeply enamoured. She was his second or third cousin, and therefore within the degrees of affinity prohibited by the canon law. Edwy, however, hearkening only to the dictates of his passion, married her, contrary to the advice of the more dignified ecclesiastics. The monks on this occasion were particularly violent; and therefore Edwy determined not to second their ambitious projects. He soon found reason to repent his having provoked such dangerous enemies. On his coronation day, while his nobility were indulging themselves in riotous mirth in a great hall where they had assembled, Edwy withdrew to another apartment to enjoy the company of his beloved queen and her mother. Dunstan guessed the reason of his absence. With unparalleled impudence, he burst into the queen's apartment; and upbraiding Edwy with his lasciviousness, as he termed it, pushed him back to the hall where the nobles were assembled. The king determined to resent such a daring insult. He required from Dunstan an account of his administration of the treasury during the late reign. The monk, probably unable to give a just account, refused to give any; upon which Edwy accused him of malversation in his office, and banished him the kingdom.

This proved the worst step that could possibly have been taken. Dunstan was no sooner gone than the whole nation was in an uproar about his sanctity and the king's impiety. These clamours, as they had been begun by the clergy, so they were kept up and increased by them, till at last they proceeded to the most outrageous violence. **59 Tragical death of the queen.** Archbishop Odo sent a party of soldiers to the palace. They seized the queen, and burned her face with a red-hot iron, in order to destroy her beauty by which she had enticed her husband; after which they carried her by force into Ireland, there to remain in perpetual exile. The king, finding it in vain to resist, was obliged to consent to a divorce from her, which was pronounced by Archbishop Odo. A catastrophe still more dismal awaited Elgiva. She had been cured of her wounds, and had even found means to efface the scars with which her persecutors had hoped to destroy her beauty. She then came to England, with a design to return to the king, whom she still considered as her husband. Unfortunately, however, she was intercepted by a party of soldiers sent for that purpose by the primate. Nothing but her most cruel death could now satisfy that wretch and his accomplices. She was hamstringed at Gloucester, and expired in a few days.

The minds of the English were at this time so much sunk in superstition, that the monstrous inhumanity above mentioned was called a judgment from God upon Edwy and his spouse for their dissolute life, i. e. their love to each other. They even proceeded to rebellion against their sovereign; and having raised to the throne Edgar, the younger brother of Edwy, at that time only 13 years of age, they soon put him in possession of Mercia, Northumberland, and East Anglia. Edwy being thus confined to the southern counties, Dunstan returned, and took upon him the government of Edgar and his party; but the death of Edwy soon removed all difficulties, and gave Edgar peaceable possession of the government.

**60 Edgar.** The reign of Edgar proved one of the most fortunate mentioned in the ancient English history. He took the most effectual methods both for preventing tumults at home and invasions from abroad. He quartered a body of disciplined troops in the north, in order to repel the incursions of the Scots, and to keep the Northumbrians in awe. He built a powerful navy; and that he might keep the seamen in the practice of their duty, as well as present a formidable armament to his enemies, he commanded the fleet from time to time to make the circuit of his dominions.

The greatness of King Edgar, which is very much celebrated by the English historians, was owing to the harmony which reigned between him and his subjects; and the reason of this good agreement was, that the king sided with Dunstan and the monks, who had acquired a great ascendant over the people. He enabled them to accomplish their favourite scheme of dispossessing the secular canons of all the monasteries; and he consulted them not only in ecclesiastical but also in civil affairs. On these accounts, he is celebrated by the monkish writers with the highest praises; though it is plain, from some of his actions, that he was a man who could be bound neither by the ties of religion nor humanity. He broke into a convent, and carried off by force, and ravished, a nun called *Editha*. His spiritual instructor, Dunstan, for this offence, obliged the king, not to separate from his mistress, but to abstain from wearing his crown for seven years!

61 His licentious amours.

Edgar, however, was not to be satisfied with one mistress. He happened once to lodge at the house of a nobleman who had a very beautiful daughter. Edgar, inflamed with desire at the sight of the young lady, without ceremony asked her mother to allow her to pass a night with him. She promised compliance; but secretly ordered a waiting-maid, named *Elfleda*, to steal into the king's bed when the company were gone, and to retire before day-break. Edgar, however, detained her by force, till day-light discovered the deceit. His love was now transferred to the waiting-maid; who became his favourite mistress, and maintained a great ascendant over him till his marriage with Elfrida.

62 His marriage with Elfrida.

The circumstances of this marriage were still more singular and criminal than those above mentioned. Elfrida was daughter and heiress to Olgar earl of Devonshire. She was a person of such exquisite beauty, that her fame was spread all over England, though she had never been at court. Edgar's curiosity was excited by the accounts he had heard of her, and therefore formed a design of marrying her. He communicated his intention to Earl Athelwold his favourite; and ordered him, on some pretence or other, to visit the earl of Devonshire, and bring him a certain account concerning Elfrida. Athelwold went as he was desired; but fell so deeply in love with the lady himself, that he resolved to sacrifice his fidelity to his passion. He returned to Edgar, and told him that Elfrida's charms were by no means extraordinary, and would have been totally overlooked in a woman of inferior station. After some time, however, turning the conversation again upon Elfrida, he told the king that he thought her parentage and fortune made her a very advantageous match; and therefore, if the king gave his consent, he would make proposals to the earl of Devonshire on his own behalf. Edgar consented, and Athelwold was married to Elfrida. After his marriage, he used his utmost endeavours to keep his wife from court, that Edgar might have no opportunity of observing her beauty. The king, however, was soon informed of the truth; and told Athelwold, that he intended to pay him a visit in his castle, and be made acquainted with his new-married wife. The earl could make no objections; only he desired a few hours to prepare for the visit. He then confessed the whole to Elfrida, and begged of her to appear before the king as much to the disadvantage as possible. Instead of this, she dressed herself to the greatest advantage. Edgar immediately conceived a violent passion for her; and in order to gratify it, seduced Athelwold into a wood under pretence of hunting, where he stabbed him with his own hand, and afterwards married his widow.

The reign of Edgar is remarkable among historians for the encouragement he gave to foreigners to reside at his court and throughout the kingdom. These foreigners, it is said, corrupted the former simple manners of the nation. Of this simplicity, however, there seems to be no great reason to boast; seeing it could not preserve them from treachery and cruelty, the greatest of all vices: so that their acquaintance with foreigners was certainly an advantage to the people, as it tended to enlarge their views, and cure them of those illiberal prejudices and rustic manners to which islanders are often subject. Another remarkable incident is the extirpation of wolves from England. The king took great pleasure in hunting and destroying these animals himself. At last he found that they had all taken shelter in the mountains and forests of Wales. Upon this he changed the tribute imposed upon the Welsh princes by Athelstan, into an annual tribute of 300 wolves heads; and thus produced such diligence in hunting them, that the animal has never since appeared in England.

63 Wolves extirpated from England.

64 Edward the martyr.

Edgar died in 957, after a reign of 16 years. He left a son named *Edward*, whom he had by his first wife the daughter of Earl Ordmer; and another, named *Ethelred*, by Elfrida. The mental qualifications of this lady were by no means answerable to the beauty of her person. She was ambitious, haughty, treacherous, and cruel. The principal nobility, therefore, were greatly averse from the succession of her son Ethelred, which would unavoidably throw too much power into the hands of his mother, as he himself was only seven years of age. Edward, afterwards surnamed the *Martyr*, was therefore pitched upon: and was certainly the most proper person, as he was 15 years of age, and might soon be able to take the government into his own hands. Elfrida opposed his advancement with all her might: but Dunstan overcame every obstacle, by anointing and crowning the young prince at Kingston; upon which the whole kingdom submitted without farther opposition.

The only remarkable occurrence in this reign was the complete victory gained by the monks over the secular clergy, who were now totally expelled from the convents. Though this had been pretty nearly accomplished by Edgar, the secular clergy still had partisans in England who made considerable opposition: but these were all silenced by the following miracles: In one synod, Dunstan, finding the majority of votes against him, rose up, and declared that he had that instant received from heaven a revelation in favour of the monks. The whole assembly were so much overawed by this intelligence, that they proceeded no farther in their deliberations. In another synod, a voice issued from the crucifix, acquainting the members, that the establishment of the monks was founded on the will of heaven, and could not be opposed without impiety. But the third miracle was still more alarming. In another

65 Miracles of St Dunstan.

other synod the floor of the hall sunk, and great numbers of the members were killed or bruised by their fall. It was remarked that Dunstan had that day prevented the king from attending the synod, and that the beam on which his own chair stood was the only one which did not sink. These circumstances, instead of making him suspected as the author of the miracle, were regarded as proofs of the interposition of Providence in his favour.

66 **The king murdered.**

Edward lived four years after he was raised to the throne, in perfect innocence and simplicity. Being incapable of any treacherous intention himself, he suspected none in others. Though his stepmother had opposed his succession, he had always behaved towards her with the greatest respect; and expressed on all occasions the most tender affection for his brother Ethelred. Being one day hunting in the neighbourhood of the castle where Elfrida resided, he paid her a visit unattended by any of his retinue. After mounting his horse with a design to return, he desired some liquor to be brought him. But while he was holding the cup to his head, a servant of Elfrida stabbed him behind. The king, finding himself wounded, clapped spurs to his horse; but soon becoming faint by the loss of blood, he fell from the saddle, and his foot being entangled in the stirrup, he was dragged along till he expired. His body was found and privately interred at Wereham by his servants. The English had such compassion for this amiable prince, that they bestowed on him the appellation of *Martyr*, and even fancied that miracles were wrought at his tomb. Elfrida built monasteries, and submitted to many penances, in order to atone for her guilt; but, even in that barbarous age, she could never regain the good opinion of the public.

67 **Ethelred.**

68 **England invaded and ruined by the Danes.**

After the murder of Edward, his brother Ethelred succeeded to the throne without opposition. As he was a minor when he was raised to the throne, and, even when he came to man's estate, never discovered any vigour or capacity of defending the kingdom against invaders, the Danes began to renew their incursions. Before they durst attempt any thing of importance, however, they first made a small incursion by way of trial. In the year 981, they landed in Southampton from seven vessels; and having ravaged the country, they retired with impunity, carrying a great booty along with them. In 987, they made a similar attempt on the west coast, and were attended with the like success. Finding that matters were now in a favourable situation for their enterprises, they landed in Essex under the command of two chieftains; and, having defeated and killed Brithnot duke of that county, laid waste all the neighbouring provinces. In this extremity, Ethelred, surnamed, on account of his preposterous conduct, the *Unready*, bribed the enemy with 10,000l. to depart the kingdom. This advice was given by Siricius archbishop of Canterbury, and some of the degenerate nobility; and was attended with the success that might have been expected. The Danes appeared next year off the eastern coast. But, in the mean time, the English had determined to assemble at London a fleet capable of repulsing the enemy. This failed of success through the treachery of Alfrie duke of Mercia. Having been formerly banished the kingdom, and found great difficulty in getting himself restored to his former dignity, he trusted thenceforth, not to his services or the affections of his countrymen, but to the influence he had over his vassals, and to the public calamities. These last he determined always to promote as far as he could: because in every revolution his assistance would be necessary, and consequently he must have received a continual accession of power. The English had formed a plan for surrounding and destroying the Danish fleet in the harbour; but Alfric not only gave the enemy notice of this design, but also deserted with his squadron the night before the engagement. The English by this means proved unsuccessful; and Ethelred, in revenge, took Alfgar, Alfric's son, and ordered his eyes to be put out. This piece of cruelty could be productive of no good effect. Alfric had become so powerful, that, notwithstanding his treachery, it was found impossible to deprive him of the government of Mercia.

In 993, the Danes under the command of Sweyn their king, and the Norwegians conducted by Olave king of that country, sailed up the Humber, and destroyed all around them. A powerful army was assembled to oppose these invaders; but through the treachery of the three leaders, all men of Danish extraction, the English were totally defeated. Encouraged by this success, the Danes entered the Thames in 94 vessels, and laid siege to London. The inhabitants, however, made such a brave defence, that the besiegers were finally obliged to give over the attempt. Out of revenge for this disappointment, they laid waste Essex, Sussex, and Hampshire. In these counties they procured horses; by which means they were enabled to penetrate into the more inland parts, and threatened the kingdom with total subjection. Ethelred and his nobles had now recourse to their former expedient. They sent ambassadors to the two northern kings, to whom they promised subsistence and tribute, provided they would, for the present, put an end to their ravages, and soon after depart the kingdom. They agreed to the terms, and peaceably took up their quarters at Southampton. Olave even paid a visit to Ethelred, and received the rite of confirmation from the English bishops. The king also made him many presents; and Olave promised never more to infest the English territories; which promise it is said he afterwards religiously observed.

After the departure of Olave with his Norwegians, Sweyn, though less scrupulous than the king of Norway, was obliged to leave the kingdom also. But this shameful composition procured only a short relief to the nation. The Danes soon after appeared in the Severn; and having ravaged Wales as well as Cornwall and Devon, they sailed round, and, entering the mouth of the Tamar, completed the ruin of these two counties. Then, returning to the Bristol channel, and penetrating into the country by the Avon, they overran all that country, and carried fire and sword even into Dorsetshire. In 998, they changed the seat of war; and, after ravaging the isle of Wight, they entered the Thames and Medway, where they laid siege to Rochester, and defeated the Kentish men in a great battle. After this victory, the whole province of Kent was made a scene of slaughter and devastation. The extremity of these miseries forced the English into counsels for common defence both by sea and land: but the weakness of the king, the divisions among the nobility, the treachery of some, the cowardice of others,

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the want of concert in all, frustrated every endeavour; and their fleets and armies either came too late to attack the enemy, or were repulsed with dishonour. The English, therefore, devoid both of prudence and unanimity in council, had recourse to the expedient which by experience they had found to be ineffectual. They offered the Danes a large sum if they would conclude a peace and depart the kingdom. These ravagers continually rose in their demands; and now required the payment of 24,000l. which the English submitted to give. The departure of the Danes procured them a temporary relief; which they enjoyed as if it was to be perpetual, without making any effectual preparations for giving them a more vigorous reception upon their next return.

69 Marriage of the king with the princess of Normandy.

Besides the receiving this sum, the Danes were at present engaged by another motive to depart from England. They were invited over by their countrymen in Normandy, who at that time were hard pressed by Robert king of France, and who found it difficult to defend their settlements against him. It is probable also, that Ethelred, observing the close connection of all the Danes with one another, however they might be divided in government or situation, was desirous of procuring an alliance with that formidable people. For this purpose, being at present a widower, he made his addresses to Emma, sister to Richard II. duke of Normandy. He soon succeeded in his negotiations; the princess came over to England, and was married to the king in the year 1001.

Though the Danes had been for a long time established in England, and though the similarity of their language with the Saxon had invited them to an early coalition with the natives; they had as yet found so little example of civilized manners among the English, that they retained all their ancient ferocity, and valued themselves only on their national character of military bravery. The English princes had been so well acquainted with their superiority in this respect, that Athelstan and Edgar had been accustomed to keep in pay large bodies of Danish troops, who were quartered about the country, and committed many violences upon the inhabitants. These mercenaries had attained to such a height in luxury, according to the old English writers, that they combed their hair once a-day, bathed themselves once a-week, changed their clothes frequently; and by all these arts of effeminacy, as well as by their military character, had rendered themselves so agreeable to the fair sex, that they debauched the wives and daughters of the English, and had dishonoured many families. But what most provoked the inhabitants was, that, instead of defending them against invaders, they were always ready to betray them to the foreign Danes, and to associate themselves with every straggling party which came from that nation.

70 Danes massacred.

The animosities between the native English and the Danes, who inhabited among them, had from these causes risen to a great height; when Ethelred, from a policy commonly adopted by weak princes, took the cruel resolution of massacring the Danes throughout the kingdom. On the 13th of November 1002, secret orders were dispatched to commence the execution everywhere on the same day; and the festival of St Brice, which fell on a Sunday, the day on which the Danes usually bathed themselves, was chosen for this purpose. These cruel orders were executed with the utmost exactness. No distinction was made betwixt the innocent and the guilty; neither sex nor age was spared; nor were the cruel executioners satisfied without the tortures, as well as death of the unhappy victims. Even Gunilda, sister to the king of Denmark, who had married Earl Paling, and had embraced Christianity, was, by the advice of Edric earl of Wilts, seized and condemned to death by Ethelred, after seeing her husband and children butchered before her face. This unhappy princess foretold, in the agonies of despair, that her murder would soon be avenged by the total ruin of the English nation (A).

71 New invasion by Sweyn.

The prophecy of Gunilda was exactly fulfilled. In 1003, Sweyn and his Danes, who wanted only a pretence to renew their invasions, appeared off the western coast, and threatened revenge for the slaughter of their countrymen. The English took measures for repulsing the enemy; but these were defeated through the treachery first of Alfric, and then of Edric, a still greater traitor, who had married the king's daughter, and succeeded Alfric in the command of the British armies. The Danes therefore ravaged the whole country. Agriculture was neglected, a famine ensued, and the kingdom was reduced to the utmost degree of misery. At last the infamous expedient of buying a peace was recurred to; and the departure of the Danes was purchased, in 1007, at the expence of 30,000l.

The English endeavoured to employ this interval in making preparations against the return of the Danes, which they had reason soon to expect. A law was made, ordering the proprietors of eight hides of land to provide themselves of a horseman and a complete suit of armour; and those of 310 hides to equip a ship for the defence of the kingdom. By this means a formidable armament was raised. There were 243,600 hides in England; consequently the ships equipped must be 785. The cavalry was 30,450 men. All hopes of success from this equipment, however, were disappointed by the factions, animosities, and dissensions

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(A) On the subject of this massacre, Mr Hume has the following observations: "Almost all the ancient historians speak of this massacre of the Danes as if it had been universal, and as if every individual of that nation throughout England had been put to death. But the Danes were almost the sole inhabitants in the kingdoms of Northumberland and East Anglia, and were very numerous in Mercia. This representation of the matter was absolutely impossible. Great resistance must have been made, and violent wars ensued: which was not the case. This account given by Wallingford, though he stands single, must be admitted as the only true one. We are told that the name of *lurdane*, *lord Dane*, for an idle lazy fellow who lives at other people's expence, came from the conduct of the Danes who were put to death. But the English princes had been entirely masters for several generations; and only supported a military corps of that nation. It seems probable, therefore, that these Danes only were put to death."

sions of the nobility. Edric had caused his brother Brightric to advance an accusation of treason against Wolfnoth governor of Sussex, the father of the famous Earl Godwin; and that nobleman, knowing the power and malice of his enemy, consulted his own safety by deserting with 20 ships to the Danes. Brightric pursued him with a fleet of 80 sail; but his ships being shattered in a tempest, and stranded on the coast, he was suddenly attacked by Wolfnoth, and all his vessels were burnt or otherwise destroyed. The treachery of Edric frustrated every plan of future defence; and the whole navy was at last scattered into the several harbours.

72 Ethelred flies to Normandy.

By these fatal miscarriages, the enemy had leisure to overrun the whole kingdom. They had now got such a footing, indeed, that they could hardly have been expelled though the nation had been ever so unanimous. But so far did mutual diffidence and dissension prevail, that the governors of one province refused to march to the assistance of another; and were at last terrified from assembling their forces for the defence of their own. At last the usual expedient was tried. A peace was bought with 48,000l.; but this did not procure even the usual temporary relief. The Danes, knowing that they were now masters of the kingdom, took the money, and continued their devastations. They levied a new contribution of 8000l. on the county of Kent alone; murdered the archbishop of Canterbury, who had refused to countenance this exaction; and the English nobility submitted everywhere to the Danish monarch, swearing allegiance to him, and giving hostages for their good behaviour. At last, Ethelred himself, dreading equally the violence of the enemy and the treachery of his own subjects, fled into Normandy, whither he had already sent Queen Emma and her two sons Alfred and Edward. The duke received his unhappy guests with a generosity which does honour to his memory.

73 Returns, but behaves as ill as ever.

The flight of King Ethelred happened in the end of the year 1013. He had not been above six weeks in Normandy, when he heard of the death of Sweyn, which happened at Gainsborough before he had time to establish himself in his new dominions. At the same time he received an invitation from the prelates and nobility to resume the kingdom; expressing also their hopes, that, being now better taught by experience, he would avoid those errors which had been so fatal to himself and his people. But the misconduct of Ethelred was incurable; and, on his resuming the government, he behaved in the very same manner that he had done before. His son-in-law Edric, notwithstanding his repeated treasons, retained such influence at court, that he instilled into the king jealousies of Sigefert and Morcar, two of the chief nobles of Mercia. Edric enticed them into his house, where he murdered them; while Ethelred partook of the infamy of this action, by confiscating their estates, and confining the widow of Sigefert in a convent. She was a woman of singular beauty and merit; and in a visit which was paid her, during her confinement, by Prince Edmund the king's eldest son, she inspired him with so violent an affection, that he released her from the convent, and soon after married her without his father's consent.

In the mean time, Canute, the son and successor of Sweyn, proved an enemy no less terrible to the English than his father had been. He ravaged the eastern coast with merciless fury; and put ashore all the English hostages at Sandwich, after having cut off their hands and noses. He was at last obliged, by the necessity of his affairs, to return to Denmark. In a short time, however, he returned, and continued his depredations along the southern coast. He then broke into the counties of Dorset, Wilts, and Somerset; where an army was assembled against him under the command of Prince Edmund and Duke Edric. The latter still continued his perfidious machinations; and after endeavouring in vain to get the prince into his power, found means to dissipate the army, and then deserted to Canute with 40 vessels.

Edmund was not disheartened by this treachery. He again assembled his forces, and was in a condition to give the enemy battle. Ethelred, however, had now such frequent experience of the treachery of his subjects, that he had lost all confidence in them. He remained in London, pretending sickness, but in reality from an apprehension that they intended to buy their peace by delivering him into the hands of his enemies. The army called aloud for their sovereign to march at their head against the Danes; and on his refusal to take the field, they were so discouraged, that all the preparations which had been made became ineffectual for the defence of the kingdom. Edmund, deprived of all regular resources for the maintenance of the soldiers, was obliged to commit similar ravages to those practised by the Danes; and after making some fruitless expeditions into the north, which had submitted entirely to Canute's power, he returned to London, where he found every thing in confusion by the death of the king.

74 Edmund Ironside divides the kingdom with the Danes.

Ethelred died in 1016, after an unhappy reign of 35 years; and was succeeded by his eldest son Edmund, surnamed *Ironside* on account of his great strength and valour. He possessed abilities sufficient to have saved his country from ruin, had he come sooner to the throne; but it was now too late. He bravely opposed the Danes, however, notwithstanding every disadvantage; till at last the nobility of both nations obliged their kings to come to a compromise, and divide the kingdom between them by treaty. Canute reserved to himself, Mercia, East Anglia, and Northumberland, which he had entirely subdued. The southern parts were left to Edmund. This prince survived the treaty only about a month; being murdered at Oxford by two of his chamberlains, accomplices of Edric.

75 Canute.

After the death of Edmund, nothing was left for the English but submission to Canute. The least scrupulous of mankind, however, dare not at all times openly commit injustice. Canute, therefore, before he seized the dominions of Edwin and Edward, the two sons of Edmund, suborned some of the nobility to depose, that, in the last treaty with Edmund, it had been verbally agreed, that, in case of Edmund's death, Canute should either be successor to his dominions, or tutor to his children; for historians differ with regard to this particular. This evidence, supported by the great power of Canute, was sufficient to get him elected king of England. Immediately after his accession to the throne, he sent the two sons of Edmund to the court of Sweden, on pretence of being there educated; but

but charged the king to put them to death as soon as they arrived. The Swedish monarch did not comply with this request; but sent them to Solomon king of Hungary, to be educated in his court. The elder, Edwin, was afterwards married to Solomon's sister: but he dying without issue, that prince gave his sister-in-law, Agatha, daughter of the emperor Henry II. in marriage to Edward, the younger brother; and she bore him Edgar Atheling; Margaret, afterwards queen of Scotland; and Christina, who retired into a convent.

Canute was obliged at first to make great concessions to the nobility: but he afterwards put to death many of those in whom he could not put confidence; and, among the rest, the traitor Edric himself, who was publicly executed, and his body thrown into the Thames. In order to prevent any danger from the Normans, who had threatened him with an invasion, he married Emma the widow of Ethelred, and who now came over from Normandy; promising that he would leave the children he should have by that marrige heirs to the crown after his decease. The English were at first displeased with Emma for marrying the mortal enemy of her former husband; but at the same time were glad to find at court a sovereign to whom they were accustomed, and who had already formed connections with them: and thus Canute, besides securing by his marriage the alliance with Normandy, gradually acquired by the same means the confidence of his own people.

76 Marries Ethelred's widow.

The most remarkable transaction in this prince's reign, besides those mentioned under the article CANUTE, is his expedition to Scotland against Malcolm king of that country, whom he forced to do homage for the county of Cumberland, which the Scots at that time possessed. After this enterprise, Canute passed four years in peace, and died at Shaftsbury; leaving three sons, Sweyn, Harold, and Hardicanute. Sweyn, whom he had by his first marriage with Alfwen, daughter of the earl of Hampshire, was crowned in Norway; Hardicanute, whom Emma had born, was in possession of Denmark; and Harold, who was of the same marriage with Sweyn, was at that time in England.

77 Harold.

Harold succeeded to the crown of England; though it had been stipulated that Emma's son, Hardicanute, should be heir to that kingdom. This advantage Harold obtained by being on the spot, and getting possession of his father's treasures, while Hardicanute was at a distance. As Hardicanute, however, was supported by Earl Godwin, a civil war was likely to ensue, when a compromise was made; by which it was agreed, that Harold should enjoy London, and all the provinces north of the Thames, while the possession of the south should remain to Hardicanute: and till that prince should appear and take possession of his dominions, Emma fixed her residence at Winchester, and ruled her son's part. Harold reigned four years; during which time the only memorable action he performed was a most infamous piece of treachery.—Alfred and Edward, the two sons of Emma by Ethelred, paid a visit to their mother in England. But, in the mean time, Earl Godwin being gained over by Harold, a plan was laid for the destruction of the two princes. Alfred was accordingly invited to London by Harold, with many professions of friendship; but when he had reached Guildford, he was set upon by Godwin's vassals: about 600 of his train were murdered in the most cruel manner; he himself was taken prisoner, his eyes were put out, and he was conducted to the monastery of Ely, where he died soon after. Edward and Emma, apprised of the fate which awaited them, fled beyond sea, the former into Normandy, the latter into Flanders; while Harold took possession of all his brother's dominions without opposition. He died in April 1039.

78 His treachery and cruelty.

Hardicanute succeeded his brother Harold without opposition. His government was extremely violent and tyrannical. However, it was but of short duration. He died, in 1041, of a debauch at the marriage of a Danish lord. After his death, a favourable opportunity was offered to the English for shaking off the Danish yoke. Sweyn, king of Norway, the eldest son of Canute, was absent; and as the two last kings had died without issue, there appeared none of that race whom the Danes could support as successor to the throne. For this reason, the eyes of the nation were naturally drawn towards Prince Edward, who happened to be at court when the king died. There were some reasons, however, to fear, that Edward's succession would be opposed by Earl Godwin, who was by far the most powerful nobleman in the kingdom. A declared animosity subsisted between Edward and Godwin, on account of the hand which the latter had in the murder of his brother Alfred; and this was thought to be an offence of so grievous a nature, that Edward could never forgive it. But here their common friends interposed; and representing the necessity of their good correspondence, obliged them to lay aside their animosities, and to concur in restoring liberty to their native country. Godwin only stipulated, that Edward, as a pledge of his sincere reconciliation, should promise to marry his daughter Editha. This proposal was agreed to; Edward was crowned king of England, and married Editha as he had promised. The marriage, however, proved rather a source of discord than otherwise between the king and Godwin. Editha, though a very amiable woman, could never obtain the confidence and affection of her husband. It is even said that during the whole course of her life he abstained from all matrimonial converse with her; and this ridiculous behaviour was highly celebrated by the monkish writers of the age, and contributed to the king's acquiring the title of Saint and Confessor.

79 Edward the Confessor.

Though the neglect of his daughter could not fail to awaken Godwin's former enmity against King Edward, it was necessary to choose a more popular ground before he could vent his complaints against the king in a public manner. He therefore chose for his theme the influence which the Normans had on the affairs of government; and declared opposition took place between him and these favourites. In a short time, this animosity openly broke out with great violence. Eustace count of Boulogne having paid a visit to the king, passed by Dover on his return. One of his train being refused access to a lodging which had been appointed for him, attempted to make his way by force, and wounded the master of the house in the contest. The townsmen revenged this insult by the death of the stranger; the count and his train took arms, and murdered

80 Variance of the king and earl Godwin.

murdered the townsmen in his own house. A tumult ensued; near 20 persons were killed on each side; and Eustace being overpowered with numbers, was at last obliged to fly. He complained to the king; who gave orders to Earl Godwin, in whose government Dover lay, to punish the inhabitants. But this nobleman refused to obey the command, and endeavoured to throw the whole blame on Count Eustace and his followers. The king was displeased; and threatened to make him feel the utmost effects of his resentment, in case he finally refused to comply. Upon this, Godwin assembled a powerful army, on pretence of repressing some disorders on the frontiers of Wales; but, instead of this, marched directly to Gloucester, where the king at that time was without any military force, as suspecting no danger.

Edward, perceiving his danger, applied to Siward duke of Northumberland, and Leofric duke of Mercia, two very powerful noblemen. They hastened to him with such followers as they could assemble, issuing orders at the same time for all the forces under their respective governments to march without delay to the defence of the king. Godwin, in the mean time, suffered himself to be deceived by negotiations, till the king's army became so powerful, that he was not able to cope with it. He was therefore obliged to fly with his family to Flanders. Here he was protected by Baldwin earl of that country, together with his three sons, Gurth, Sweyn, and Tosti; the last of whom had married Baldwin's daughter. Harold and Leofwin, two other sons of Godwin, took shelter in Ireland.

81
Godwin flies to Flanders.

After the flight of Earl Godwin, he was proceeded against as a traitor by King Edward. His estates, and those of his sons, were confiscated; his governments given to others; Queen Editha was confined in a monastery; and the great power of this family, which had become formidable to the crown itself, seemed to be totally overthrown. Godwin, however, soon found means to retrieve his affairs. Having hired some ships, and manned them with his followers, he attempted to make a descent at Sandwich. The king, informed of his preparations, equipped a fleet which Godwin could not resist, and he therefore retreated into the Flemish harbours. On his departure, the English dismissed their armament. This Godwin had expected, and therefore kept himself in readiness for the favourable opportunity. He immediately put to sea, and sailed to the isle of Wight, where he was joined by Harold with a squadron which he had collected in Ireland. Being thus master of the sea, Godwin entered the harbours on the southern coast; seized all the ships; and being joined by great numbers of his former vassals, he sailed up the Thames, and appeared before London.

82
Returns, and is reconciled with the king.

The approach of such a formidable enemy threw every thing into confusion. The king alone seemed resolute to defend himself to the last extremity; but the interposition of many of the nobility, together with the submissions of Godwin himself, at last produced an accommodation. It was stipulated, that Godwin should give hostages for his good behaviour, and that all the foreigners should be banished the kingdom; after which, Edward, sensible that he had not power sufficient to detain the earl's hostages in England, sent them over to his kinsman the young duke of Normandy.

Soon after this reconciliation, Godwin died as he was sitting at table with the king. He was succeeded in the government of Wessex, Sussex, Kent, and Essex, and the office of steward of the household, a place of great power, by his son Harold. The son was no less ambitious than his father had been; and as he was a man of much greater abilities, he became a more dangerous enemy to Edward than even Godwin had been. Edward knew no better expedient to prevent the increase of Harold's power, than by giving him a rival. This was Algar son of Leofric duke of Mercia, whom he invested with the government of East Anglia, which had formerly belonged to Harold. The latter, however, after some broils, finally got the better of his rival, and banished him the kingdom. Algar returned soon after, with an army of Norwegians, with whom he invaded East Anglia; but his death in a short time freed Harold from all further apprehensions from that quarter. His power was still further increased in a short time after by the accession of his brother Tosti to the government of Northumberland; and Edward now declining in years, and apprehensive that Harold would attempt to usurp the crown after his death, resolved to appoint a successor. He therefore sent a deputation into Hungary, to invite over his nephew, Edward, son to his elder brother, who was the only remaining heir of the Saxon line. That prince accordingly came over with his children, Edgar Atheling, Margaret, and Christina; but died a few days after his arrival. His death threw the king into greater perplexity than ever. Being resolved to exclude Harold if possible, he secretly cast his eye on his kinsman William duke of Normandy; a person of whose power, character, and capacity, he had justly a very high opinion. This advice had formerly been given him by Robert archbishop of Canterbury, who was himself a Norman, and had been banished along with the rest upon the return of Earl Godwin. But Edward finding that the English would more easily acquiesce in the restoration of the Saxon line, had in the mean time invited his brother's descendants from Hungary, as already mentioned. The death of his nephew, and the inexperience and unpromising qualities of young Edgar, made him resume his former intentions in favour of the duke of Normandy, though his aversion to hazardous enterprises engaged him to postpone the execution, and even to keep his purpose concealed from all his ministers.

83
His son Harold aspires to the crown.

Harold in the mean time increased his popularity by all possible means, in order to prepare his way for being advanced to the throne after the death of Edward, which now seemed to be fast approaching. He had no suspicion of the duke of Normandy as a rival; but as he knew that a son and grandson of the Earl Godwin were in the hands of that prince as hostages, he feared that they might be made use of as checks upon his ambition, in case he attempted afterwards to ascend the throne. He therefore prevailed upon Edward to release these hostages unconditionally; and having obtained his consent, he set out for Normandy himself, attended by a numerous retinue. He was driven by a tempest on the territory of Guy count of Ponthieu,

Ponthieu, who detained him prisoner, and demanded an exorbitant sum for his ransom. Harold found means to acquaint William with his situation. The duke of Normandy, desirous of gaining Harold over to his party, commanded Guy to restore his prisoner to his liberty. Upon this Harold was immediately put into the hands of the Norman ambassador, who conducted him to Rouen. William received him with great demonstrations of respect and friendship; but soon took an opportunity of acquainting him with his pretensions to the crown of England, and asked his assistance in the execution of his scheme. Harold was surprised with this declaration of the duke; but being entirely in his power, he feigned a compliance with his desires, and promised to second to the utmost of his ability the will of King Edward. William, to secure him as much as possible to his interest, promised him his daughter in marriage, and required him to take an oath that he would fulfil his promises. Harold readily complied; but to make the oath more binding, William privately conveyed under the altar where the oath was taken relicks of some of the most revered martyrs; and when Harold had taken the oath, he showed him the relicks, and admonished him to observe religiously such a solemn engagement.

Harold was no sooner set at liberty, than he found himself master of casuistry sufficient to excuse the breaking of his oath, which had been extorted from him, and which, if kept, might be attended with the subjugation of his country to a foreign power. He continued to practise every art to increase his popularity; and about this time, two accidents enabled him to add much to that character which he had already so well established. The Welsh had for some time made incursions into the English territories, and had lately become so troublesome, that Harold thought he could not do a more acceptable piece of service to the public, than undertake an expedition against these invaders. Having therefore prepared some light-armed foot to pursue the natives into their fortresses, some cavalry to scour the open country, and a squadron of ships to attack the sea-coasts, he employed all these forces against the enemy at once; and thus reduced them to such distress, that they were obliged to purchase peace by sending their prince's head to Harold, and submitting to the government of two Welsh noblemen appointed by Edward.

The other incident was no less honourable to Harold. Tosti his brother had been created duke of Northumberland; but being of a violent tyrannical temper, he treated the inhabitants with such cruelty, that they rose in rebellion against him, and drove him from his government. Morcar and Edwin, two brothers, grandsons of the great Duke Leofric, joined in the insurrection; and the former being elected duke, advanced with an army to oppose Harold, who had been commissioned by the king to reduce and punish the Northumbrians. Before the armies engaged, Morcar endeavoured to justify his conduct, and represented to Harold, that Tosti had behaved in such a manner, that no one, not even a brother, could defend him without participating of the infamy of his conduct: that the Northumbrians were willing to submit to the king, but required a governor that would pay some attention to their privileges; and they trusted that Harold would not defend in another that violent conduct from which his own government had always kept at so great a distance. This speech was accompanied by such a detail of well supported facts, that Harold abandoned his brother's cause; and returning to Edward, persuaded him to pardon the Northumbrians, and confirm Morcar in his government. He even married the sister of that nobleman; and by his interest procured Edwin the younger brother to be chosen governor of Mercia. Tosti, in a rage, departed the kingdom, and took shelter in Flanders with Baldwin his father-in-law; while William of Normandy saw that now he had nothing to expect from Harold, who plainly intended to secure the crown for himself.

84
Harold succeeds Edward the Confessor.

Edward died in 1066, and was succeeded by Harold with as little opposition as though he had been the lawful heir. The very day after Edward's death, he was anointed and crowned by the archbishop of York. The whole nation seemed joyfully to swear allegiance to him. But he did not long enjoy the crown, to obtain which he had taken so much pains, and which he seemed to have such capacity for wearing. His brother Tosti, provoked at his success, stirred up against him every enemy he could have any influence with. The duke of Normandy also was enraged to the last degree at the perfidy of Harold; but before he commenced hostilities, he sent an embassy to England, upbraiding the king with his breach of faith, and summoning him to resign the kingdom immediately. Harold replied, that the oath, with which he was reproached, had been extorted, by the well grounded fear of violence, and for that reason could never be regarded as obligatory: that he never had any commission either from the late king or the states of England, who alone could dispose of the crown, to make any tender of the succession to the duke of Normandy; and if he, a private person, had assumed so much authority, and had even voluntarily sworn to support the duke's pretensions, the oath was unlawful, and it was his duty to take the first opportunity of breaking it: that he had obtained the crown by the unanimous suffrages of the people; and should show himself totally unworthy of their favour, did he not strenuously maintain those liberties with which they had entrusted him; and that the duke, if he made any attempt by force of arms, should experience the power of an united nation, conducted by a prince, who, sensible of the obligations imposed on him by his royal dignity, was determined, that the same moment should put a period to his life and to his government.

This answer was according to William's expectations; and therefore he had already made preparations for invading England. He was encouraged and assisted in this enterprise by Howel count of Brittany, Baldwin earl of Flanders, the emperor Henry IV. and Pope Alexander II. The latter declared Harold a perjured usurper; denounced excommunication against him and his adherents; and the more to encourage William in his enterprises, sent him a consecrated banner, and a ring with one of St Peter's hairs in it. Thus he was enabled to assemble a fleet of 3000 vessels, on board of which were embarked 60,000 men, chosen from among those numerous supplies which were sent him from all quarters. Many eminent personages were enlisted under

der his banners. The most celebrated were Eustace count of Boulogne, Aimeri de Thouars, Hugh d'Estaples, William d'Evreux, Geoffroy de Rotrou, Roger de Beaumont, William de Warenne, Roger de Montgomeri, Hugh de Grantmesnil, Charles Martel, and Geoffroy Gifford.

In order to embarrass the affairs of Harold the more effectually, William also excited Tosti, in concert with Halfager king of Norway, to infest the English coasts. These two having collected a fleet of 350 ships, sailed up the Humber, and disembarked their troops, who began to commit great depredations. They were opposed by Morcar earl or duke (B) of Northumberland, and Edwin earl of Mercia, who were defeated. Harold, on the news of this invasion, assembled a considerable army, engaged the enemy at Standford, and after a bloody battle entirely defeated them. Tosti and Halfager were killed in the action, and all the fleet fell into the hands of the victors; but Harold generously allowed Olave the son of Halfager to depart with 20 vessels.

85 Defeats the Danes.

The king of England had scarce time to rejoice on account of the victory, when news were brought him that the Normans were landed in Sussex. Harold's victory had considerably weakened his army. He lost many of his bravest officers and soldiers in the action; and he disgusted the rest, by refusing to distribute the Danish spoils among them. He hastened, however, by quick marches, to repel this new invader; but though he was reinforced at London and other places with fresh troops, he found himself weakened by the desertion of his old soldiers, who, from fatigue and discontent, secretly withdrew from their colours. Gurth, the brother of Harold, a man of great conduct as well as bravery, became apprehensive of the event; and entreated the king to avoid a general engagement for some time, or at least not to hazard his person. But though this advice was in itself evidently proper, and enforced by all the arguments which Gurth could suggest, Harold continued deaf to every thing that could be said. Accordingly, on the 14th of October 1066, the two armies engaged near Hastings, a town of Sussex. After a most obstinate and bloody battle †, the English were entirely defeated, Harold and his two brothers killed, and William left master of the kingdom of England.

86 Is defeated and killed by William of Normandy.

† See *Hastings*.

Nothing could exceed the terror of the English upon the news of the defeat and death of Harold. As soon as William passed the Thames at Wallingford, Stigand, the primate, made submissions to him in the name of the clergy; and before he became within sight of London, all the chief nobility, and even Edgar Atheling himself, who, being the rightful heir to the throne, had just before been declared king, came and submitted to the conqueror. William very readily accepted of the crown upon the terms that were offered him; which were, that he should govern according to the established customs of the country. He could indeed have made what terms he pleased; but, though really a conqueror, he chose rather to be thought an elected king. For this reason he was crowned at Westminster by the archbishop of York, and took the oath administered to the former kings of England; namely, that he would protect and defend the church, observe the laws of the realm, and govern the kingdom with impartiality.

87 William the Conqueror.

The English historians complain of the most grievous oppression by William and his Normans. Whether by his conduct the conqueror willingly gave the English opportunities of rebelling against him, in order to have a pretence for oppressing them afterwards, is not easy to say; but it is certain that the beginning of his reign cannot justly be blamed. The first disgust against his government was excited among the clergy. William could not avoid the rewarding of those numerous adventurers who had accompanied him in his expedition. He first divided the lands of the English barons who had opposed him, among his Norman barons; but as these were found insufficient, he quartered the rest on the rich abbeys, of which there were many in the kingdom, until some other opportunity of providing for them offered itself.

88 The English grievously oppressed.

Though this last step was highly resented by the clergy, it gave very little offence to the laity. The whole nation, however, was soon after disgusted, by seeing all the real power of the kingdom placed in the hands of the Normans. He disarmed the city of London, and other places which appeared most warlike and populous, and quartered Norman soldiers wherever he dreaded an insurrection. This was indeed acting as a conqueror, and not as an elected king; but the event showed the necessity of such precautions. The king having thus secured, as he imagined, England from any danger of a revolt, determined to pay a visit to his Norman dominions. He appointed his brother Odo, bishop of Bayeux, and William Fitz-Osborne, regents in his absence; and to secure himself yet farther, he resolved to carry along with him such of the English nobility as he put the least confidence in.

Having taken all these methods to ensure the tranquillity of his new kingdom, William set sail for Normandy in March 1067; but his absence produced the most fatal consequences. Discontents and murmurings were multiplied everywhere; secret conspiracies were entered into against the government; hostilities were commenced in many places; and every thing seemed to threaten a speedy revolution. William of Poictiers, a Norman historian, throws the blame entirely on the English. He calls them a fickle and mutinous race, while he celebrates with the highest encomiums the justice and lenity of Odo's and Fitz-Osborne's administration. On the other hand, the English historians tell us, that these governors took all opportunities of oppressing the people, either with a view to provoke them to rebellion, or in case they tamely submitted to their impositions, to grow rich by plundering them. Be this as it will, however, a secret conspiracy was formed among the English for a general massacre of the Normans, like what had formerly been made of the Danes. This was prosecuted with so much animosity, that the vassals of the earl Coxo put him to death because he refused to head them in the enterprise. The conspirators had already taken the resolution, and fixed the day for their intended massacre, which was to be on Ash-Wednesday, during the time of divine service,

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(B) Anciently these two titles were synonymous.

A. D. 1067.

vice, when all the Normans would be unarmed as penitents, according to the discipline of the times. But the presence of William disconcerted all their schemes. Having got intelligence of their bloody purpose, he hastened over to England. Such of the conspirators as had been more open in their rebellion, consulted their safety by flight; and this served to confirm the proofs of an accusation against those who remained. From this time the king not only lost all confidence in his English subjects, but regarded them as inveterate and irreconcileable enemies. He had already raised such a number of fortresses in the country, that he no longer dreaded the tumultuous or transient efforts of a discontented multitude. He determined therefore to treat them as a conquered nation. The first instance of this treatment was his revival of the tax of Danegelt, which had been imposed by the Danish conquerors, and was very odious to the people. This produced great discontents, and even insurrections. The inhabitants of Exeter and Cornwall revolted; but were soon reduced, and obliged to implore the mercy of the conqueror. A more dangerous rebellion happened in the north; but this was also soon quashed, and the English became sensible that their destruction was intended. Their easy submission after the battle of Hastings had inspired the Normans with contempt; their commotions afterwards had rendered them objects of hatred; and they were now deprived of every expedient which could make them either regarded or beloved by their sovereign. Many fled into foreign countries; and among the rest Edgar Atheling himself, who made his escape to Scotland, and carried thither his two sisters Margaret and Christina. They were well received by Malcolm, who soon after married Margaret the elder sister, and also received great numbers of other exiles with the utmost kindness.

The English, though unable to make any resistance openly, did not fail to gratify their resentment against the Normans in a private manner. Seldom a day passed, but the bodies of assassinated Normans were found in the woods or highways, without any possibility of bringing the perpetrators to justice. Thus, at length, the conquerors themselves began again to wish for tranquillity and security; and several of them, though entrusted with great commands, desired to be dismissed the service. In order to prevent these desertions, which William highly resented, he was obliged to allure others to stay by the largeness of his bounties. The consequences were, fresh exactions from the English, and new insurrections on their part against their cruel masters. The Norman power, however, was too well founded to be now removed, and every attempt of the English to regain their liberty served only to rivet their chains the more firmly. The county of Northumberland, which had been most active in these insurrections, now suffered most severely. The whole of it was laid waste, the houses were burned, the instruments of agriculture destroyed, and the inhabitants forced to seek new places of abode. On this occasion it is said, that above 100,000 persons perished either by the sword or famine; and the country is supposed, even to this day, to retain the marks of its ancient depopulation. The estates of all the English gentry were next confiscated, and bestowed on the Normans. By this means all the ancient and honourable families were reduced to beggary; and the English found themselves totally excluded from every road that led either to honour or preferment.

By proceeding in this manner, William at last broke the spirit of the English nation, and received no farther trouble from them. In 1076, however, he found that the latter part of his life was likely to be unhappy through dissensions in his own family. He had four sons, Robert, Richard, William, and Henry, besides several daughters. Robert, his eldest son, surnamed *Curthose*, from the shortness of his legs, was a prince who inherited all the bravery and ambition of his family. He had formerly been promised by his father the government of the province of Maine in France, and was also declared successor to the dukedom of Normandy. He demanded from his father the fulfilment of these promises; but William gave him a flat denial, observing, that "it was not his custom to throw off his clothes till he went to bed." Robert declared his resentment; and openly expressed his jealousy of his two brothers William and Henry, (for Richard was killed, in hunting, by a stag). An open rupture was soon commenced. The two young princes one day took it into their heads to throw water on their elder brother as he passed through the court after leaving their apartment. Robert construed this frolic into a studied indignity; and having these jealousies still farther inflamed by one of his favourites, he drew his sword, and ran up stairs with an intent to take revenge. The whole castle was quickly filled with tumult, and it was not without some difficulty that the king himself was able to appease it. But he could not allay the animosity which from that moment prevailed in his family. Robert, attended by several of his confederates, withdrew to Rouen that very night, hoping to surprise the castle; but his design was defeated by the governor. The popular character of the prince, however, engaged all the young nobility of Normandy, as well as of Anjou and Brittany, to espouse his quarrel; even his mother is supposed to have supported him in his rebellion by secret remittances. The unnatural contest continued for several years; and William was at last obliged to have recourse to England for support against his own son. Accordingly, he drew an army of Englishmen together; he led them over to Normandy, where he soon compelled Robert and his adherents to quit the field, and was quickly reinstated in all his dominions. Robert then took shelter in the castle of Gerberoy, which the king of France had provided for him, where he was shortly after besieged by his father. As the garrison was strong, and conscious of their treason, they made a gallant defence; and many skirmishes and duels were fought under its walls. In one of these the king and his son happened to meet; but being both concealed by their helmets, they attacked each other with mutual fury. The young prince wounded his father in the arm, and threw him from his horse. The next blow would probably have put an end to his life, had he not called for assistance. Robert instantly recollected his father's voice, leaped from his horse, and raised him from the ground. He prostrated himself in his presence, asked pardon for his offences, and promised for the future a strict adherence to his duty. The king was not so easily appeased; and perhaps his resentment was heightened by the disgrace of being overcome. He therefore gave his malediction to his son; and returned to his own camp on Robert's horse, which he had assisted him to mount. After some recollection, however, he was reconciled to Robert, and carried him with him into England.

William returned in 1081; and being now freed from his enemies both at home and abroad, began to have more leisure to attend to his own domestic affairs. For this purpose the *Doomsday-Book* was composed by his order, of which an account is given under that article. He reserved a very ample revenue for the crown; and in the general distribution of land among his followers, kept possession of no fewer than 1400 manors in different parts of the country. No king of England was ever so opulent; none was able to support the splendour and magnificence of a court to such a degree; none had so many places of trust and profit to bestow; and consequently none ever had such implicit obedience paid to his commands. He delighted greatly in hunting; and to indulge himself in this with the greater freedom, he depopulated the county of Hampshire for 30 miles, turning out the inhabitants, destroying all the villages, and making the wretched outcasts no compensation for such an injury. In the time of the Saxon kings, all noblemen without distinction had a right to hunt in the royal forests; but William appropriated all these to himself, and published very severe laws to prohibit his subjects from encroaching on this part of his prerogative. The killing of a boar, a deer, or even a hare, was punished with the loss of the delinquent's eyes; at the time when the killing of a man might be atoned for by paying a moderate fine or composition.

As the king's wealth and power were so great, it may reasonably be supposed that the riches of his ministers were in proportion. Odo, bishop of Bayeux, William's brother, was become so rich, that he resolved to purchase the papacy. For this purpose, taking the opportunity of the king's absence, he equipped a vessel in the isle of Wight, on board of which he sent immense treasures, and prepared for his embarkation. He was detained, however, by contrary winds; and, in the mean time, William being informed of his designs, resolved to prevent the exportation of so much wealth from his dominions. Returning therefore from Normandy, where he was at that time, he came to England the very instant his brother was stepping on board. He immediately ordered him to be made prisoner: but his attendants, respecting the bishop's ecclesiastical character, scrupled to execute his commands; so that the king was obliged to seize him with his own hand. Odo appealed to the Pope: but the king replied, that he did not seize him as bishop of Bayeux, but as earl of Kent; and, in that capacity, he expected, and would have, an account of his administration. He was therefore sent prisoner to Normandy; and, notwithstanding all the remonstrances and threats of Pope Gregory, was detained in custody during the remainder of William's reign.

90 Death of the queen;

Soon after this, William felt a severe blow in the death of Matilda his queen; and, almost at the same time, received information of a general insurrection in Maine, the nobility of which had always been averse to his government. Upon his arrival on the continent, he found that the insurgents had been secretly assisted and excited by the king of France, who took all opportunities of lessening the Norman power, by creating dissensions among the nobles. His displeasure on this account was very much increased, by notice he received of some railleries thrown out against him by the French monarch. It seems that William, who was become corpulent, had been detained in bed some time by sickness; and Philip was heard to say, that he only lay in of a big belly. This so provoked the English monarch, that he sent him word, he would soon be up, and would, at his churching, present such a number of tapers as would set the kingdom of France in a flame.

To perform this promise, he levied a powerful army; and, entering the Isle of France, destroyed every thing with fire and sword. He took the town of Mante, and reduced it to ashes. But a period was soon put to the conquests and to the life of this great warrior by an accident.

91 and of the king.

His horse happening to put his fore feet on some hot ashes, plunged so violently, that the rider was thrown forward, and bruised his belly on the pommel of the saddle. Being now in a bad habit of body, as well as somewhat advanced in years, he began to be apprehensive of the consequences, and ordered himself to be carried in a litter to the monastery of St Gervaise. Finding his illness increase, and being sensible of the approach of death, he discovered at last the vanity of all human grandeur; and was struck with remorse for those many cruelties and violences of which he had been guilty. He endeavoured to make compensation by presents to churches and monasteries, and gave orders for the liberation of several English noblemen. He was even prevailed upon, though not without reluctance, to release his brother Odo, against whom he was very much incensed. He left Normandy and Maine to his eldest son Robert. He wrote to Lanfranc the primate of England, desiring him to crown William king of England. To Henry he bequeathed nothing but the possessions of his mother Matilda; but foretold, that one day he would surpass both his brothers in power and opulence. He expired on the 9th September 1087, in the 63d year of his age, in the 21st of his reign over England, and 54th of that over Normandy.

92 William Rufus.

William, surnamed *Rufus*, from his red hair, was in Normandy at the time of his father's illness. He no sooner received the letter for Lanfranc, than, leaving his father in the agonies of death, he set out for England; where he arrived before intelligence of the decease of the Conqueror had reached that kingdom. Being sensible that his brother Robert, as being the eldest son, had a preferable title to himself, he used the utmost dispatch in getting himself firmly established on the throne. The English were so effectually subdued, that they made no opposition; but the Norman barons were attached to Robert. This prince was brave, open, sincere, and generous; and even his predominant fault of indolence was not disagreeable to those haughty barons, who affected an almost total independence of their sovereign. The king, on the other hand, was violent, haughty, and tyrannical. A powerful conspiracy was therefore carried on against William; and Odo, bishop of Bayeux, undertook to conduct it. Many of the most powerful nobility were concerned; and

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as the conspirators expected to be in a short time supported by powerful succours from Normandy, they retired to their castles, and put themselves in an offensive posture.

William, sensible of his danger, engaged the English on his side, by promising some mitigation of their hardships, and liberty to hunt in the royal forests. Robert, in the mean time, through his natural indolence, neglected to give his allies proper assistance. The conspirators were obliged to submit. Some of them were pardoned; but most of them confiscated, and their estates bestowed on the barons who had continued faithful to the king.

93 **Proves a tyrant.**

William, freed from this danger, thought no more of his promises to the English. He proved a greater tyrant than his father; and, after the death of Lanfranc, who had been his preceptor, and kept him within some bounds, he gave full scope to his violent and rapacious disposition. Not content with oppressing the laity, he invaded the privileges of the church; which, in those days, were held most sacred. He seized the temporalities of all the vacant bishoprics and abbeys, and openly put to sale those sees and abbeys which he thought proper to dispose of.

94 **Attempts the conquest of Normandy.**

These proceedings occasioned great murmurs among the ecclesiastics, which were quickly spread through the nation, but the terror of William's authority preserved the public tranquillity. In 1090, the king thought himself strong enough to attempt the conquest of Normandy, which at that time was in the greatest confusion through the indolent and negligent administration of Robert. Several of the barons had revolted, and these revolts were encouraged by the king of France. Robert also imagined he had reason to fear the intrigues of his own brother Henry, whom for 3000 merks he had put in possession of *Cottentin*, near a third part of the duchy of Normandy. He therefore threw him into prison; but finding himself threatened with an invasion from the king of England, he gave Henry his liberty, and even made use of his assistance in suppressing the insurrections of his rebellious subjects. William, however, was no sooner landed in Normandy, than the nobility on both sides interposed, and a treaty of peace was concluded. In this treaty Henry finding his interests entirely neglected, retired to St Michael's Mount, a strong fortress on the coast of Normandy, and infested the neighbourhood with his incursions. He was besieged by his two brothers, and obliged to capitulate in a short time; after which, being deprived of all his dominions, he wandered about for some time with very few attendants, and often in great poverty.

The peace with Robert was of no long duration. In the interval some hostilities with Scotland succeeded, and these terminated in the death of Malcolm king of that country; after which new broils ensued with Normandy. The rapacious temper of William prompted him to encroach upon his brother's territories, and the same rapacity prompted him to use a very extraordinary expedient in order to accomplish his designs. Having gone over to Normandy to support his partisans, he ordered an army of 20,000 men to be raised in England, and conducted to the sea-coast as if they were to be immediately embarked: but when they came there, instead of embarking, they were forced to pay the king ten shillings a man; after which they were dismissed to their several countries. With this money William engage the king of France to depart from the protection of Robert; and also bribed many of the Norman barons to revolt. He was called from Normandy, however, by an irruption of the Welsh; and having repulsed them, he was prevented from attempting other enterprises by a conspiracy of his barons.

In 1096, however, the superstition of Robert put the king of England in possession of those dominions which he had not been able to conquer by force of arms. The crusades were now commenced, and Robert was desirous of undertaking an expedition into the Holy Land. As money for this purpose was wanting, he mortgaged his dominions to his brother for 10,000 merks. The king raised the money by violent extortions on his subjects; forcing even the convents to melt their plate, in order to furnish the quota demanded of them. He was then put in possession of Normandy and Maine; and Robert with a magnificent train set out for the Holy Land.

After the death of Lanfranc, the king had retained in his own hands the revenues of Canterbury, as he had done those of many other bishoprics; but falling into a dangerous illness, he was seized with remorse; and the clergy represented to him that he was in danger of eternal perdition if he did not make atonement for those impieties and sacrileges of which he had been guilty. He therefore instantly resolved to supply the vacancy of Canterbury; he sent for Anselm, a Piedmontese by birth, abbot of Bec in Normandy, who was much celebrated for his piety and devotion. The abbot refused the dignity with great earnestness; fell on his knees, wept, and intreated the king to change his purpose; and when he found him obstinate in forcing the pastoral staff upon him, he kept his fist so hard clenched, that it required the utmost violence of the bystanders to open it, and force him to receive that ensign of his spiritual dignity. William soon after recovered his health, and with it his violence and rapacity. As he now spared the church no more than before, a quarrel with Anselm soon ensued; and this was the more dangerous to the king, on account of the great character for piety which the primate had acquired by his zeal against abuses of all kinds, particularly those of dress and ornament.

At this time there was a mode which prevailed not only in England, but throughout Europe, both among men and women, of giving an enormous length to their shoes, drawing the toe to a sharp point, and affixing to it the figure of a bird's bill, or some such ornament which was turned upwards, and which was often sustained by gold or silver chains tied to the knee. The ecclesiastics took exception at this ornament, which they said was an attempt to belie the Scripture, where it is affirmed, that no man can add a cubit to his stature; and they not only declaimed against it with vehemence, but assembled some synods, in which the fashion was absolutely condemned. Such, however, are the contradictions in human nature, that all the influence of the clergy, which at that time was sufficient to send vast multitudes of people into Asia to butcher one another, was not able to prevail against those long pointed shoes. The fashion, contrary to what hath happened to almost all others, maintained its ground for several centuries; and even Anselm found his endeavour deavours against it ineffectual. He was more successful in decrying the long hair and curled locks then worn by the courtiers. He refused the ashes on Ash-Wednesday to such as were so accoutred; and his authority and eloquence had such influence, that the young men universally abandoned that ornament, and appeared in the cropt hair recommended to them by the sermons of the primate. For this reformation Anselm is highly celebrated by his historian Eadmer, who was also his companion and secretary.

When William's profaneness returned with his health, he was engaged in almost perpetual contests with this austere prelate *. These were pretty well settled, when the king, who had undertaken an expedition into Wales, required Anselm to furnish him with a certain number of soldiers. The primate regarded this as an invasion of the rights of the church; and therefore, though he durst not refuse compliance, sent the men so miserably accoutred, that the king was exceedingly displeased, and threatened him with a prosecution. Anselm demanded restitution of all his revenues which the king had seized, and appealed to the pope. The quarrel, however, ran so high, that the primate found it

97
Who leaves the kingdom.

dangerous to remain in England. He desired and obtained the king's permission to retire beyond sea. His temporalities were confiscated immediately on his departure; but Pope Urban received him as a martyr in the cause of religion, and even threatened the king with sentence of excommunication. William, however, proceeded in his projects of ambition and violence, without regarding the threats of the pope; who he knew was at that time too much engaged with the crusades to mind any other business. Though his acquisition of Maine and Normandy had brought him into perpetual contests with the haughty and turbulent barons who inhabited those countries, and raised endless tumults and insurrections; yet William seemed still intent on extending his dominions either by purchase or conquest. William earl of Poictiers and duke of Guienne had resolved upon an expedition to the Holy Land; and, for this purpose, had put himself at the head of a vast multitude, consisting, according to some historians, of 60,000 horse, and a much greater number of foot. Like Robert of Normandy, he offered to mortgage his dominions for money sufficient to conduct this multitude into Asia. The king accepted his offer; and had prepared a fleet and army to take possession of these dominions, when an unfortunate accident put an end to his projects and his life. He was engaged in hunting, the sole amusement, and indeed the principal occupation, of princes in those rude times. Walter Tyrrel, a French gentleman remarkable for his skill in archery, attended him in this recreation, of which

98
Death of the king.

the New Forest was the scene. William had dismounted after a chase; and Tyrrel, impatient to show his dexterity, let fly an arrow at a stag which suddenly started before him. The arrow glanced from a tree, and struck the king to the heart. He instantly fell down dead; and Tyrrel, terrified at the accident, clapt spurs to his horse, hastened to the sea-shore, and embarked for France, where he joined the crusade that was setting out from that country. This happened on the 2d of August 1100, after the king had reigned 13 years, and lived about 40. His body was found in the woods by the country-people, and buried without ceremony at Winchester.

After the death of William, the crown of right devolved to Robert his eldest brother; for William had no legitimate children. But what Robert had formerly lost by his indolence, he was again deprived of by his absence at the holy war.

99
Prince Henry usurps the crown.

Prince Henry was in the forest with William Rufus at the time the latter was killed. He no sooner heard the important news than he hurried to Winchester, and secured the royal treasure. William de Breteuil keeper of the treasure, arrived almost the same instant, and opposed his pretensions; telling him, that the treasure belonged to his elder brother, who was now his sovereign, and for whom he was determined to keep it. But Henry, drawing his sword, threatened him with instant death if he dared to disobey him; and others of the late king's retinue, who came every moment to Winchester, joining the prince's party, he was obliged to desist. Henry lost no time in fully accomplishing his purpose. In less than three days he got himself crowned king of England by Maurice bishop of London. Actual possession supplied every deficiency of title; and no one dared to appear in defence of the absent prince.

100
His charter in favour of the people.

The beginning of King Henry's reign promised to be favourable to the English liberty; owing chiefly to his fear of his brother. To conciliate the affections of his subjects, he passed a charter calculated to remove many of the grievous oppressions which had been complained of during the reign of his father and brother. He promised, that at the death of any abbot or bishop, he never would seize the revenues of the see or abbey during the vacancy, but would leave the whole to be reaped by the successor; and that he would never let to farm any ecclesiastical benefice, or dispose of it for money. To the laity he promised, that, upon the death of any earl, baron, or military tenant, his heir should be admitted to the possession of his estate, on paying a just and lawful relief; without being exposed to those enormous exactions which had been formerly required. He remitted the wardship of minors; and allowed guardians to be appointed, who should be answerable for the trust. He promised not to dispose of any heiress in marriage but by advice of all the barons; and if any baron intended to give his daughter, sister, niece, or kinswoman in marriage, it should only be necessary for him to consult the king, who promised to take no money for his consent, nor even to refuse permission, unless the person to whom it was proposed to marry her should happen to be his enemy. He granted his barons and military tenants the power of bequeathing by will their money or personal estates; and if they neglected to make a will, he promised that their heirs should succeed to them. He renounced the right of imposing moneyage, and of levying taxes at pleasure, on the farms which the barons kept in their own hands. He made some general professions of moderating fines; he offered a pardon for all offences; and remitted all debts due to the crown. He also required, that the vassals of the barons should enjoy the same privileges which he granted to his own barons; and he promised a general confirmation and observance of the *laws of King Edward* *. To give greater authenticity to these concessions, a copy

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* See *Anselm*.

* See *Feodal System*.

A.D. 1100.

copy of the charter was lodged in some abbey of each county.

King Henry, farther to increase his popularity, degraded and committed to prison Ralph Flambard bishop of Durham, who had been the chief instrument of oppression under his brother. He sent for Anselm who was then at Lyons, inviting him to return and take possession of his dignities. Anselm returned; but when Henry proposed to him to do the same homage to him which he had done to his brother, the king met with an absolute refusal. During his exile, Anselm had assisted at the council of Bari; where, besides fixing the controversy between the Greek and Latin churches concerning the procession of the Holy Ghost, the right of election to church-preferments was declared to belong to the clergy alone, and spiritual censures were denounced against all ecclesiastics who did homage to laymen for their sees and benefices, and on all laymen who exacted it. The rite of homage † by the feudal customs was, that the vassal should throw himself on his knees, put his joined hands between those of his superior, and should in that posture swear fealty to him. But the council declared it execrable, that pure hands, which could create God, and offer him up for the salvation of mankind, should be put, after this humiliating manner, between profane hands, which, besides being inured to rapine and bloodshed, were employed day and night in impure purposes and obscene contacts. To this decree therefore Anselm appealed; and declared, that so far from doing homage for spiritual dignity, he would not even communicate with any ecclesiastic who paid that submission, or who accepted of investitures from laymen. Henry durst not insist; and therefore desired that the controversy might be suspended, and that messengers might be sent to Rome to accommodate matters with the Pope, and to obtain his confirmation of the laws and customs of England.

101
Quarrels with the primate.

Henry now took another step which seemed capable of confirming his claims to the crown without any danger of a rival. The English remembered with regret their Saxon monarchs, when they compared the liberty they enjoyed under them with the tyranny of the Normans. Some descendants of that favourite line still remained; and among the rest, Matilda, the niece of Edgar Atheling. Upon her the king fixed his eyes as a proper consort, by whose means the breach between the Saxons and Normans might be cemented. A difficulty, however, occurred, because she had been educated in a nunnery. The affair was examined by Anselm in a council of prelates and nobles summoned at Lambeth. Matilda there proved, that she had put on the veil, not with a design of entering into a religious life, but merely in imitation of a custom familiar to the English ladies, who protected their chastity from the brutal violence of the Normans by taking shelter under that habit, which, amid the horrid licentiousness of the times, was yet generally revered. The council, sensible that even a princess had otherwise no security for her honour, admitted this reason as valid. They pronounced that Matilda was still free to marry; and her nuptials with Henry were celebrated by Anselm with great solemnity and pomp.

102
He marries Matilda.

While Henry was thus rendering himself popular at home, his brother Robert, who had loitered away a twelvemonth in Italy, where he married Sibylla daughter of the count of Conversana, arrived in England, i 1101, in order to put in his late and ineffectual clai to the crown. His fame, however, on account of th exploits he had performed in Palestine, was so grea that even yet he was joined by many noblemen of th first rank, and the whole nation seemed prepossessed i his favour. But Henry, having paid his court to A selm, by his means retained the army in his interest and marched with them to Portsmouth, where Robe had landed his forces a few days before. The armie lay for some time in sight of each other; when an a commodation was effected through the mediation Anselm and other great men. By this treaty it wa agreed, that Robert should resign his pretensions England, and receive in lieu of them an annual pension of 3000 marks; and if either of the princes die without issue, the other should succeed to his dominions; that the adherents of each should be pardoned and restored to all their possessions either in Normand or England; and that neither Robert nor Henr should thenceforth encourage, receive, or protect th enemies of each other.

The two princes separated with mutual marks c friendship; but next year, Henry, under various pretences, confiscated the estates of almost all the noblemen, who had favoured his brother's pretensions. Robert, enraged at the fate of his friends, ventured t come to England in order to remonstrate with hi brother in person. But he met with such a bad reception, that, apprehending his liberty to be in danger, he was glad to make his escape by resigning hi pension.

This infringement of the treaty was followed th ensuing year by an invasion of Normandy, at the desir of Robert's own subjects, whom he was totally incapable of governing *. The event of this war was th defeat and captivity of Robert, who was henceforth deprived not only of all his dominions, but of his personal liberty. He lived 28 years a prisoner, and die in the castle of Cardiff in Glamorganshire. It is eve said by some, that he was deprived of his sight by red-hot copper bason applied to his eyes, and that Kin Henry appeased his conscience by founding the monastery of Reading.

The conquest of Normandy was completed in 1106 and next year the controversy between the king and primate, concerning the investitures of clergymen an their doing homage to princes, was resumed. The kin was very sensible that it was not his interest to quarre with such a powerful body as the clergy were at tha time; and on the other hand, he fully understood th necessity of guarding the prerogatives of the crow from their encroachments. While, therefore, he avoided an open rupture with Anselm, he obstinately refused to give up the privileges which had been enjoye by his predecessors. On the first arrival of Anselm the king had avoided the dispute in the manner alread mentioned. A messenger was dispatched to Rome, i order to compromise matters with the Pope. The messenger returned with an absolute refusal to the king' demands. One of the reasons given by the pope o this occasion was expressed in the following words: "It is monstrous that a son should pretend to beget his father, or a man to create his God: priests are called

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† See *Feodal Tenure*.

called *gods* in scripture, as being the vicars of God: and will you, by your abominable pretensions to grant them their investiture, assume the right of creating them!" Henry was not yet convinced: but as he was determined to avoid, or at least to delay, the coming to any dangerous extremity with the church, he persuaded Anselm, that by farther negotiation he should be able to compound matters with the pope. Messengers were therefore dispatched to Rome a second time from the king; and also from Anselm, who wanted to be fully assured of the pope's intentions. They returned with letters wrote in the most arrogant and positive manner, both to the king and primate. The king suppressed the letter sent to himself; and persuaded the three bishops, by whom it was sent, to assert, upon their episcopal faith, that the pope had assured them of his private good intentions towards King Henry, and of his resolution not to resent any future exertion of his prerogative in granting investitures; though he himself scrupled to give this assurance under his hand, lest other princes should copy the example, and assume a like privilege. Anselm's two messengers, who were monks, affirmed that it was impossible this story could have any foundation; but their word was not deemed equivalent to that of three bishops; and the king, as if he had finally gained his cause, proceeded to fill the sees of Hereford and Salisbury, and to invest the new bishops in the usual manner. Anselm, however, gave no credit to the assertions of the king's messengers; and therefore refused not only to consecrate them, but even to communicate with them; and the bishops themselves, finding they were become universally odious, returned the ensigns of their spiritual dignity.

The quarrel continued between the king and primate, till the latter, sensible of his dangerous situation, desired leave to make a journey to Rome, in order to lay the case before the pope. This permission was easily obtained; but no sooner was the primate gone, than Henry confiscated all his revenues, and sent another messenger to negotiate with the pope. The new messenger told his holiness, that his master would sooner part with his crown than the right of granting investitures. "And I (replied the pope) would rather lose my head than allow him to retain it." This quarrel now became very dangerous to the king; as he was threatened by the pope with excommunication, which would have been attended with terrible consequences. At last, however, a compromise was made in the following manner. Before bishops took possession of their dignities, they had formerly been accustomed to pass through two ceremonials: They received, from the hands of the sovereign, a ring and crosier as the symbols of their office, and this was called their *investiture*: they also made those submissions to the prince, which were required of the vassals by the rites of the feudal law, and which received the name of *homage*. The pope, therefore, was for the present contented with Henry's resigning his right of granting investitures, by which the spiritual dignity was supposed to be conferred; and he allowed the bishops to do homage for their temporal properties and privileges. After this, the pope allowed Anselm to communicate with the prelates who had already received investitures from the crown; and he only required of them some submissions for their past conduct. He also granted to Anselm a plenary power of remedying every disorder, which he said might arise from the barbarousness of the country. About the same time the marriage of priests was prohibited; and even laymen were not allowed to marry within the seventh degree of affinity. By this contrivance the pope augmented the profits which he reaped from granting dispensations, and likewise those from divorces. For as the art of writing was then rare, and parish-registers were not regularly kept, it was not easy to ascertain the degrees of affinity even among people of rank; and any man who had money to pay for it, might obtain a divorce, on pretence that his wife was more nearly related to him than was permitted by the canons. A decree was also published, prohibiting the clergy to wear long hair; and the king, though he would not resign his prerogatives to the church, very willingly cut his hair in the form which was required of him, obliging all the courtiers at the same time to follow his example.

From the time of this compromise, which happened in 1107, to the year 1120, nothing remarkable happened except some slight commotions in Normandy: but this year, Prince William, the king's only son, was unfortunately drowned off the coast of Normandy; and Henry was so much affected, that he is said never afterwards to have smiled or recovered his wonted cheerfulness. It is very doubtful, however, whether the death of this prince was not an advantage to the British nation, since he was often heard to express the utmost hatred of the natives; insomuch that he had threatened, that when he came to the throne, he would make them draw the plough, and would turn them into beasts of burden. These prepossessions he inherited from his father; who, though he was wont, when it might serve his purposes, to value himself on his birth as a native of England, shewed, in the course of his government, an extreme prejudice against that people. All hopes of preferment to ecclesiastical as well as civil dignities were denied to the English during this whole reign; and any foreigner, however ignorant or worthless, was sure to have the preference in every competition. The charter formerly mentioned, which the king granted at the beginning of his reign, was no more thought of; and the whole fell so much into neglect and oblivion, that in the following century, when the barons, who had heard an obscure tradition of it, desired to make it the model of the great charter which they exacted from King John, they could only find one copy of it in the whole kingdom; while the grievances proposed to be redressed by it, continued still in their full extent. 106 Prince William drowned.

As Henry had now no legitimate children except Matilda, whom in 1110 he had betrothed, though only eight years of age, to the emperor of Germany, he was induced to marry a second time in hopes of having sons. He made his addresses accordingly to Adelais the daughter of Godfrey duke of Lovaine, and niece to Pope Calixtus; a young princess of an amiable person. But Adelais brought him no children: and in 1135, the king died in Normandy, from eating too plentifully of lampreys; having lived 67 years, and reigned 35. 107 Death of King Henry.

By the will of King Henry, his daughter Matilda became heiress of all his dominions. She had been married,

married, after her first husband's death, to Geoffrey Plantagenet, eldest son of the count of Anjou, by whom she had a son named *Henry;* but as Geoffrey had given umbrage to the king of England in several instances, no notice was taken of him in the will. The nobility had already sworn fealty to her; and the foremost to show this mark of submission to the king's will had been Stephen, son of the count of Blois (who had married Adela the daughter of William the Conqueror). He had been married to Matilda, daughter and heiress of Eustace count of Boulogne; who brought him, besides that feudal sovereignty of France, a vast property in England, which in the distribution of lands had been conferred by the Conqueror on the family of Boulogne. By this marriage Stephen acquired a new connection with the royal family of England: for Mary, his wife's mother, was sister to David the present king of Scotland, and to Matilda the first wife of Henry and mother of the empress. The king also, imagining that by the aggrandizement of Stephen he strengthened the interest of his own family, had enriched him with many possessions; but instead of this, it appeared by the event that he had only put it more and more in his power to usurp the throne.

108 Stephen usurps the throne.

No sooner was Henry dead, than Stephen hastened from Normandy into England. The citizens of Dover and Canterbury, apprised of his purpose, shut their gates against him; but when he arrived at London, some of the lower class of people, instigated by his emissaries, immediately proclaimed him king. The archbishop of Canterbury refused to give him the royal unction; but this difficulty was got over by Stephen's brother, the bishop of Winchester. Hugh Bigod, steward of the household, made oath before the primate, that the late king, on his death-bed, had discovered a dissatisfaction with his daughter Matilda, and had expressed his intention of leaving the count of Boulogne heir to all his dominions; and the bishop either believing, or pretending to believe, this testimony, gave Stephen the royal unction. Very few of the nobility attended his coronation; but none opposed his usurpation, however unjust or flagrant.

Stephen, in order to establish himself on the throne as firmly as possible, passed a charter, in which he made liberal promises to all ranks of men. To the clergy he promised, that he would speedily fill all the vacant benefices, and never would levy any of the rents during the vacancy. To the nobility he gave liberty to hunt in their own forests; and to the people he promised to remit the tax of danegelt, and to restore the laws of Edward the Confessor. He seized the king's treasure at Winchester, amounting to 100,000l.; with part of which money he hired mercenary soldiers from the continent; and with another part procured a bull from the pope, confirming his title to the English throne.

Matilda, in the mean time, endeavoured to recover her just rights, of which Stephen had deprived her; but for some time she met with no success either in England or Normandy. Her husband Geoffrey himself was obliged to conclude a peace with Stephen, on condition of the king's paying him during that time an annual pension of 5000l.

Robert earl of Gloucester was the first who shook the power of Stephen. He was natural son to the late king; a man of great honour and ability, and was very much attached to the interests of Matilda. When Stephen usurped the throne, he offered to do him homage, and take the oath of fealty; but with an express condition, that the king should maintain all his stipulations, and never invade any of Robert's rights or dignities. With this condition Stephen was obliged to comply, on account of the great power of that nobleman, though he knew that it was meant only to afford him a favourable opportunity of revolting when occasion served. The clergy imitated Robert's example; and annexed to their oath of allegiance the following condition, namely; that they were only bound as long as the king defended the ecclesiastical liberties, and supported the discipline of the church.

109 Distracted state of the kingdom.

The barons, in return for their submission, exacted terms of still more pernicious tendency. Many of them required to have the right of fortifying their castles, and putting themselves in a posture of defence; and with this exorbitant demand the king was forced to comply. All England was immediately filled with these fortresses; which the noblemen garrisoned either with their vassals, or with licentious soldiers, who flocked to them from all quarters. The whole kingdom now became a scene of rapine and devastation. Wars were carried on by the nobles in every quarter; the barons even assumed the right of coining money, and of exercising, without appeal, every act of jurisdiction; and the inferior gentry, as well as the people, finding no defence from the laws, during this total dissolution of sovereign authority, were obliged, for their immediate safety, to pay court to some neighbouring chieftain, and to purchase his protection, both by submitting to his exactions, and by assisting him in his rapine upon others.

In 1137, the earl of Gloucester having projected an insurrection, retired beyond sea, sent the king a defiance, and solemnly renounced his allegiance. The next year David king of Scotland appeared with an army in defence of his niece's title; and penetrating into Yorkshire, committed the greatest devastations. He was defeated, however, with great slaughter, at Northallerton, by some of the northern barons, who had raised a powerful army; and this success so much overawed the malecontents in England, that Stephen's power might have received some stability, had he not unfortunately engaged himself in a contest with the clergy. He had already seen the mischief arising from the liberty he had granted of fortifying so many castles in different parts of the kingdom. He therefore determined to abridge this liberty as much as possible; and for that purpose he began with the castles erected by the clergy, who seemed to have less right to these military securities than the barons. Taking advantage therefore of a fray which had arisen at court between the retinue of the bishop of Salisbury and the earl of Brittany, he seized the bishops both of Salisbury and Lincoln, threw them into prison, and obliged them to deliver up the castles which they had lately erected. This produced such a violent commotion, that the opportunity seemed favourable to the pretensions of Matilda.

110 Matilda lands in England.

On the 22d of September 1139, she landed in England with Robert earl of Gloucester, attended only by 140 knights; but her partisans daily increased, and she was soon in a condition to face

Stephen

Stephen with equal forces in the field. Numberless encounters happened, the detail of which could afford very little entertainment to the reader. War was spread through every quarter; and the turbulent barons having, in a great measure, shaken off all restraint of government, and now obtained the sanction of fighting in the cause of their country, redoubled their oppressions, tyrannies, and devastations. The castles of the nobility became receptacles of licensed robbers; who, sallying forth day and night, spoiled the open country, plundered the villages, and even cities. They tortured the captives to make them reveal their treasures, sold their persons to slavery, and set fire to the houses, after they had pillaged them of every thing valuable. In consequence of this destruction, the land was left untilled; the instruments of husbandry were abandoned; and a grievous famine reduced the nation to the most deplorable state that can be imagined.

111 Stephen defeated and taken prisoner.

After a multitude of indecisive conflicts, a battle ensued which seemed likely to ensure the public peace for some time. Stephen had marched his forces to relieve the city of Lincoln; the earl of Gloucester led a body of troops to assist those of Matilda's party, who were besieging that place. The two armies engaged on the 2d of February within sight of the city, and a desperate battle ensued. At last Stephen's army was defeated. He himself was for some time left without attendants; and fought on foot in the midst of his enemies, assaulted by multitudes, and resisting all their efforts with astonishing intrepidity. Being hemmed in on every side, he forced a way for some time with his battle-axe; but that breaking, he drew his sword, and with it furiously assailed his antagonists for some time longer. But at length the sword also flying in pieces, he was obliged to surrender himself a prisoner. He was conducted to Gloucester; and though at first treated with respect, he was in a short time, upon some suspicions, thrown into irons.

112 Matilda crowned.

About a month after, Matilda was crowned at Winchester with great solemnity; but soon showed herself totally incapable of governing such a turbulent nation. She determined to repress the power of the nobles, who had now left only the shadow of authority to their sovereign. But being destitute of policy or prudence sufficient to accomplish so difficult an undertaking, a conspiracy was soon formed against her, and the bishop of Winchester detached a party of his friends and vassals to block up the city of London where the queen resided. At the same time measures were taken to instigate the Londoners to a revolt, and to seize the queen's person. Matilda, having timely notice of this conspiracy, fled to Winchester. Here she was soon after besieged by the bishop: but the town being distressed by famine, she with difficulty made her escape; while her brother the earl of Gloucester, endeavouring to follow, was taken prisoner, and exchanged for Stephen.

113 Stephen restored.

Matilda was now obliged to take shelter in Oxford, while Stephen reascended the throne. The civil war broke out with redoubled fury. Many battles were fought, and both parties were involved in many distresses. Matilda escaped from Oxford at a time when the fields were covered with snow, by being dressed all in white, with four knights her attendants dressed in the same colour. Another time Stephen was surprised by the earl of Gloucester at Wilton, and made his escape with the utmost difficulty. At last Matilda was obliged to quit the kingdom; and the death of the earl of Gloucester soon after seemed to give a fatal blow to her interests. In 1153, however, Prince Henry, Matilda's son by her second husband Geoffrey, came over to England, in order once more to dispute Stephen's pretensions to the crown. After some success on his first landing, he was opposed by Stephen with a powerful army, and matters seemed likely to come to the decision of a general engagement. But while the two armies continued within a quarter of a mile of each other, a treaty was set on foot by the interposition of William earl of Arundel, for terminating the dispute in an amicable manner. The death of Eustace, Stephen's son, whom he had designed for the throne, which happened during the course of the treaty, facilitated its conclusion. It was agreed, that Stephen should reign during his life, and that justice should be administered in his name; that Henry, on Stephen's death, should succeed to the kingdom; and that William, Stephen's son, should inherit Boulogne and his patrimonial estate. This treaty filled all Europe with joy; and after the barons had sworn to it, Henry left England, and Stephen returned to the peaceable enjoyment of his throne. His reign, however, was but of short continuance; his death happening on the 25th of October 1154.

114 His death.

Henry was on the continent besieging a castle of one of the mutinous barons, when news was brought him of Stephen's death. But, as he was sensible of the goodness of his title, he did not abandon his enterprise till the place was reduced. He then set out on his journey, and was received in England with the utmost joy. The first acts of his reign seemed to promise a happy and prosperous administration. He instantly dismissed the mercenary soldiers who had committed the greatest disorders throughout the nation. He ordered all the castles which had been erected since the death of Henry I. to be demolished, except a few which he retained in his own hands for the protection of the kingdom. The adulterated coin which had been struck during the reign of Stephen was cried down, and new money struck of the right value and standard. He resumed many of those benefactions which had been made to churches and monasteries in the former reigns. He gave charters to several towns, by which the citizens claimed their freedom and privileges independent of any superior but himself. These charters were the ground-work of the English liberty; for thus a new order, namely, the more opulent of the people, began to claim a share in the administration, as well as the nobility and clergy. Thus the feudal government was at first impaired; and liberty began to be more equally diffused throughout the nation.

115 Henry II.

Henry II. on his accession to the English throne, found himself possessed of very extensive dominions on the continent. In the right of his father, he possessed Anjou, Touraine, and Maine; in that of his mother, Normandy; in that of his wife, Guienne, Poictou, Xaintonge, Auvergne, Perigord, Angoumois, and the Limousin. Soon after, he annexed Brittany to his other states, by marrying his son, who was yet a child, to the heiress of Brittany, who was a child also,

also, and was already in possession of the superiority over that province. These territories composed above a third of the French monarchy, and were by far the most opulent part of it; so that Henry, though vassal to the king of France, was greatly superior to him in power; and when England was added to all these, the French king had great reason to apprehend some disaster to himself and family. The king of England, however, resided at too great a distance to be able to employ this formidable power with success against the French monarch.. He soon became a kind of stranger in his continental dominions; and his subjects there considered their allegiance as more naturally due to their superior lord, who lived in their neighbourhood, and who was acknowledged to be the supreme head of their nation. Their immediate lord was often at too great a distance to protect them; and a commotion in any part of Henry's extensive dominions gave great advantages against him. The wise and vigorous administration of Henry, however, counterbalanced in a great measure these disadvantages; and he maintained a surprising tranquillity throughout his extensive dominions during the greatest part of his reign.

116
Monstrous wickedness of the clergy.

Henry found no great difficulty in circumscribing the power of the barons; but when he attempted to do the same thing with the clergy, he met with the most violent opposition. That body had carried their independence on the civil power so far, that now they seemed to aim at nothing else than a liberty to commit all manner of crimes with impunity. During the reign of Stephen, they had extorted an immunity from all but ecclesiastical penalties *; and that grant they were resolved to maintain for the future. It may easily be supposed, that a law which thus screened their wickedness, contributed to increase it; and we accordingly find upon record, not less than 100 murders committed by men in holy orders, in the short period since the king's accession, not one of which was punished even with degradation, while the bishops themselves seemed to glory in this horrid indulgence. The king did not make any attempts against them during the life of Theobald archbishop of Canterbury, who was a man of a mild character, and besides had great merit, because, during the former reign, he had refused to put the crown on the head of Eustace, Stephen's son. He died in 1162; and the king, after his death, advanced to the see of Canterbury Thomas à Becket, his chancellor, on whose compliance he thought he might entirely depend.

117
Contests of the king with Thomas à Becket.

The new archbishop was the first man of English pedigree, who, since the Norman conquest, had risen to any considerable station. Before his instalment in the see of Canterbury, Becket had been exceedingly complaisant, good-humoured, and agreeable to his master; and had also been accustomed to live very freely. But no sooner was he invested with this high dignity, than he totally altered his conduct, and put on all those airs of affected and ostentatious humility which could recommend him to the superstitious and ignorant multitude in that age. The first step taken by this hypocrite after his advancement, was to resign the office of chancellor. This he did without consulting the king: the reason he gave was, that henceforth he must detach himself from secular affairs, and be solely employed in the duties of his sacred function; but in reality that he might break off all connection with Henry. As he knew that the king intended to abridge the ecclesiastical power, he thought the best method would be to become himself the aggressor. He therefore summoned the earl of Clare to surrender the barony of Tunbridge; which, ever since the Conquest, had remained in the family of that nobleman; but which, as it had formerly belonged to the see of Canterbury, the primate pretended that his predecessors were prohibited by the canons from alienating.—William de Eynsford, a military tenant of the crown, was patron of a living which belonged to a manor that held of the archbishop of Canterbury; and Becket, without regard to William's right, presented, on a new and illegal pretence, one Laurence to that living, who was violently expelled by Eynsford. Upon this Eynsford was excommunicated. He complained to the king, that he, who held *in capite* of the crown, should, contrary to the practice established by the Conqueror and maintained ever since by his successors, be subjected to that terrible sentence, without the previous consent of the sovereign. Henry, by a messenger, commanded Becket to absolve Eynsford. The haughty primate answered, that it belonged not to the king to inform him whom he should absolve, and whom excommunicate; but, after all, he was obliged to comply with the king's orders, though with the worst grace imaginable.

As Henry perceived that the crown was now in danger, through the superstition of the people, of falling totally under the power of the clergy, he resolved to exert himself to the utmost against their scandalous usurpations. Among their other inventions to obtain money, they had now inculcated the necessity of penance as an atonement for sin; and having again introduced the practice of paying them large sums as an equivalent for these penances, the sins of the people had thus become a revenue to the priests; and the king computed, that, by this invention alone, they levied more money upon his subjects than what flowed by all the funds and taxes into the royal exchequer. To ease the people of so heavy and arbitrary an imposition, the king required, that a civil officer of his appointment should be present in all ecclesiastical courts, and should for the future give his consent to every composition made for spiritual offences. About this time also the king had an opportunity of proceeding against the clergy on another footing. A clerk in Worcestershire, having debauched a gentleman's daughter, murdered her father. The king required that the clerk should be delivered up to the magistrate. Becket pleaded the privilege of the church; confined the criminal in the bishop's prison, lest he should be seized by the king's officers; and maintained that no greater punishment could be inflicted on him than degradation. The king then required, that, immediately after he was degraded, he should be tried by the civil powers; but the primate asserted, that it was iniquitous to try a man twice upon the same accusation, and for the same crime. Upon this, Henry summoned an assembly of all the prelates in England; and put to them this decisive question, Whether or not they were willing to submit to the ancient laws and customs of the kingdom? The bishops unanimously replied, that they were willing, *saving their own order*. The king was provoked

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* See (Benefit of) *Clergy*.

provoked to the last degree at this equivocal answer. He left the assembly with evident marks of displeasure; and required the primate instantly to surrender the castles of Eye and Berkham. The other prelates were terrified; but Becket continued inflexible: however, he was at last prevailed upon, by the interposition of Philip the pope's legate and almoner, to retract the saving clause, and promise without any reserve to observe the ancient customs.

The king was not now to be satisfied with general promises from the clergy: he was determined that the ancient laws and customs should be defined, as well as the privileges of the clergy. He therefore summoned another great council of the clergy and nobility at Clarendon, to whom he submitted this important affair. A number of regulations was there drawn up, which were afterwards well known by the title of the *Constitutions of Clarendon*. By these it was enacted, that clergymen accused of any crime should be tried in the civil courts; that laymen should not be tried in spiritual courts, except by legal and reputable witnesses; that the king should ultimately judge in ecclesiastical and spiritual appeals; that the archbishops and bishops should be regarded as barons, and obliged to contribute to the public expences like other persons of their rank; that the goods forfeited to the king should not be protected in churches or church-yards by the clergy; and that the sons of villeins should not take orders without the consent of their lord. These, with some others of less consequence, to the number of 16, were subscribed by all the bishops present, and even by Becket himself; who, however, at first, showed some reluctance.

Nothing now remained but to get the constitutions ratified by the pope; but in this the king was disappointed. The pope rejected them with the utmost indignation; and, out of 16, admitted only six, which he thought were not important enough to deserve censure.—Becket was now mortified to the highest degree. He retracted his consent to the constitutions, redoubled his austerities, and even refused to execute any part of his sacerdotal function till he had obtained absolution from his holiness. Henry, considering these humilities as insults offered to himself, desired the pope to send him a legate. He did so; but annexed a clause to his commission, by which he was prohibited from acting against the archbishop of Canterbury. The king sent back the commission to the pope; and being now exasperated beyond all patience, commenced furious prosecutions against Becket. He first sued him for some lands belonging to his primacy; and Becket being detained by sickness from coming into court, his non-attendance was construed into disrespect. The primate afterwards defended his cause in person; but all his goods and chattels were confiscated, and the bishop of Winchester was obliged to pronounce the sentence. Another suit was commenced against him for 300l. which he had levied on the honours of Eye and Berkham, and the primate agreed to give securities for the payment of the sum. The next day a third suit was commenced against him for 1000 marks, which the king had lent him upon some former occasion: and immediately following these, a still greater demand was made; namely, that Becket should give an account of the money he had received and expended during the time he was chancellor. The money was computed at no less than 40,000 marks; and the primate, unable either to give an account, or find securities, took the following extraordinary method of evading the king's designs. He arrayed himself in his episcopal vestments; and with the cross in his hand, went forward to the palace. Having entered the royal apartments, he sat down, holding up the cross as his banner and protection. The king, who sat in an inner apartment, ordered by proclamation all the prelates and nobility to attend him; to whom he loudly complained of Becket's insolence. The whole council joined in condemning this instance of his unaccountable pride; and determined to expostulate with him about his inconsistency concerning the constitutions of Clarendon. But all their messages, threats, and arguments, were in vain. Becket put himself, in the most solemn manner, under the protection of the supreme pontiff, and appealed to him against any penalty which his iniquitous judges might think proper to inflict. Then leaving the palace, he asked the king's immediate permission to quit Northampton; but being refused, he secretly withdrew in disguise, and at last found means to cross over to the continent.

118 Becket flies to the continent.

Becket was received with the greatest marks of esteem, first by the king of France (who hated Henry on account of his great power), and then by the pope, whose cause he had so strenuously defended in England. Henry at the same time sent ambassadors to the pope, who were treated with coolness and contempt, while Becket was honoured with the greatest marks of distinction. These favours bestowed upon an exile and a perjured traitor (for such had been Becket's sentence of condemnation in England), irritated the king to such a degree, that he resolved to throw off at once all dependence upon the pope. He accordingly issued out orders to his justiciaries; inhibiting, under severe penalties, all appeals to the pope or the archbishop; and forbidding any of them to receive mandates from them, or to apply to their authority. He declared it treasonable to bring over from either of them any interdict upon the kingdom. This he made punishable in secular clergymen by the loss of their livings, and by castration; in regulars, by the amputation of their feet; and in laymen, by death. On the other hand, the pope and the archbishop did not fail to issue forth their fulminations in such a manner as to shake the very foundation of the king's authority. Becket excommunicated by name all the king's chief ministers who had been concerned in sequestrating the revenues of his see, and all who obeyed or favoured the constitutions of Clarendon. He even threatened to excommunicate the king if he did not speedily repent; and had not the pope himself been threatened every day with the machinations of an antipope, whose pretensions he was afraid the king of England might support, the sentence of excommunication would certainly have been denounced.

At first, Henry paid little regard to these fulminations; but afterwards, when he found that his authority over his subjects began to decline on that account, and that his rivals on the continent were endeavouring to disturb the tranquillity of his dominions, he began sincerely to desire a reconciliation. This the pope and Becket

Becket also became desirous of, because they saw that their utmost endeavours were insufficient to draw Henry's subjects into a revolt against him. The treaty of accommodation, however, was often broken off, through the extreme jealousy of each of the parties; but at length, by the mediation of the pope's legate, all differences were adjusted, and Becket was reinstated in the see of Canterbury.

119 Is restored, and behaves with his former insolence.

On the recovery of his dignity, the primate behaved with all his usual arrogance. Instead of retiring quietly to his diocese when he landed in England, he made a progress through Kent with all the splendour and magnificence of a sovereign pontiff. As he approached Southwark, the clergy, the laity, and all ranks of people came forth to meet him, and celebrated his triumphant entry with hymns of joy. Being thus confident of the support of the people, he resolved to make his enemies feel the severest effects of his vengeance. He suspended the archbishop of York, who had crowned Henry's eldest son in his absence. He excommunicated the bishops of London and Salisbury, with some of the principal nobility and prelates who had assisted at the coronation. One man he excommunicated for having spoken against him, and another for having cut off the tail of one of his horses. The excommunicated and degraded prelates immediately made their complaints to the king; and he having dropped some passionate expressions, intimating a desire to have Becket's life taken away, the supposed will of the king was instantly accomplished; nor could the king's express orders to the contrary arrive time enough to hinder the execution of this fatal purpose. See Becket.

120 Grief of the king for his death.

The king was thrown into the utmost consternation on hearing of Becket's murder. He knew that the primate's death would accomplish what his most violent opposition during his life could never have done, and therefore he gave himself up to sorrow: for three days he even refused all nourishment; till at last his courtiers were obliged to break in upon his solitude, and induce him to acquiesce in an event which could not possibly be recalled. The pope was with some difficulty made sensible of the king's innocence; but refused to grant him a pardon, except on conditien that he should make every future submission and perform every injunction the holy see thought proper to demand. When things were thus adjusted, the assassins who had murdered Becket were allowed to retire in safety to the enjoyment of their former dignities; and the king, with a view to divert the minds of the people to a different object, undertook an expedition into Ireland, and totally reduced that island. See Ireland.

121 Dissensions in Henry's family.

The king was scarcely freed from the war with Ireland, and the dangerous controversy in which he had engaged with the church of Rome, when he found himself involved in the most unnatural contests with his children, to whom he had always behaved in the most tender and affectionate manner. He had ordered Henry his eldest son to be anointed king; and had destined him for his successor in the kingdom of England, the duchy of Normandy, and the counties of Anjou, Maine, and Touraine; territories which lay contiguous, and which might thus easily lend their assistance to one another. Richard his second son was invested in the duchy of Guienne and county of Poictou: Geoffrey, his third son, inherited, in right of his wife, the duchy of Brittany: and the new conquest of Ireland was destined for the appendage of John his fourth son, for whom he had negotiated a marriage with Adelais the only daughter of Humbert count of Savoy and Maurienne; and with whom he was to receive as a dowry very considerable demesnes in Piedmont, Savoy, Bresse, and Dauphiny. This greatness of Henry's family alarmed the king of France; and he therefore excited young Prince Henry to demand of his father, either the immediate resignation of the crown of England, or the duchy of Normandy. The king refused to comply with such an extravagant demand; upon which the prince made his escape to Paris, where he was protected by the French king. This happened in 1173; and the same year, Queen Eleanor, finding that she was now grown very disagreeable to the king, communicated her discontent to her two younger children Geoffrey and Richard, whom she engaged also to demand the territories assigned them, and then fly to the court of France. The queen herself was meditating an escape to the same court, and had put on man's apparel for that purpose, when she was seized and confined by Henry's order. The licentious barons in the mean time wished for a change of government; hoping to have liberty, under young and inexperienced princes, to commit those rapines and violences which they could not do with safety when governed by such a prudent and vigilant king as Henry. In the midst of this universal defection, however, the English monarch still retained his usual intrepidity, and prepared with as much vigour as possible for the contest. As he could depend on the fidelity of very few of his nobility, he was obliged to enlist in his service a number of desperate ruffians called *Brabençons*, and sometimes *Routiers* or *Cottereaux*, though for what reason is not mentioned in history. These banditti were very numerous during the times of the feudal government, when many private wars were carried on between the nobles; and 20,000 of these, with a few forces furnished by his faithful barons, composed the whole of Henry's army on this occasion.

122 Queen Eleanor confined.

With this force the king of England totally overthrew the schemes of his enemies on the continent; but being very desirous of putting an end to the war, he this very year (1173) agreed to a conference with the king of France. At this interview, Henry offered his children the most advantageous terms. He insisted only on retaining the sovereign authority in all his dominions. To Henry he offered half the revenues of the crown of England, with some places of surety in that kingdom; or if he chose rather to reside in Normandy, half the revenues of that duchy, with all those of Anjou. He made a like offer to Richard in Guienne; he promised to resign all Brittany to Geoffrey; and if these concessions were not deemed sufficient, he agreed to add to them whatever the pope's legates, who were present, should require of him. The conference, however, was broken off by the violence of the earl of Leicester; who not only reproached Henry in the most indecent manner, but even put his hand to his sword, as if he intended to attempt some violence against him.

In the mean time, the most of the English nobility united in opposition against their sovereign; and an irruption at this time by the king of Scotland assisted their rebellious schemes. The earl of Leicester soon after invaded Suffolk at the head of a body of Flemings; but they were repulsed with great slaughter, and the earl himself was taken prisoner. Soon after, William king of Scotland, who had been repulsed, and agreed to a cessation of arms, broke the truce, and invaded England with an army of 80,000 men, committing the most terrible devastations. Henry in the mean time, to reconcile himself thoroughly to the church, performed the penances at the tomb of Thomas à Becket which he had formerly promised to do. As soon as he came within sight of the church of Canterbury, he alighted from his horse, walked barefoot towards the town, and prostrated himself before the shrine of the saint. He remained a whole day in prayer and fasting, watched the holy relics all night, made a grant of 50l. a year to the convent for a constant supply of tapers to illuminate the shrine; and not satisfied with these submissions, he assembled a chapter of monks, disrobed himself before them, put a scourge into each of their hands, and presented his bare shoulders to their strokes. Next day he received absolution; and, departing for London, had the agreeable news of the defeat and captivity of William king of Scotland, which happened on the very day of his absolution.

123 King of Scotland defeated and taken prisoner.

This victory proved decisive in Henry's favour. The English barons who had revolted, or were preparing for a revolt, instantly delivered up their castles to the victor, and the kingdom was in a few weeks restored to perfect tranquillity. Prince Henry, who was ready to embark with a great army to join the English rebels, abandoned all thoughts of the enterprise. Soon after a treaty was concluded with the king of France; in which Henry granted his children much less advantageous terms than he had offered them before. The principal were, some pensions for their support, castles for their residence, and an indemnity to all their adherents. The greatest sufferer by this war was William king of Scotland. He was compelled to sign a treaty, by which he obliged himself to do homage to Henry for the kingdom of Scotland. It was agreed, that his barons and bishops should do the same; and that the fortresses of Edinburgh, Stirling, Berwick, Roxburgh, and Jedburgh, should be delivered into the hands of the conqueror till the articles were performed. This treaty was executed most punctually and rigorously on the 10th of August 1175. The king, barons, and prelates of Scotland, did homage to Henry in the cathedral of York; the greatest humiliation to which the Scottish nation had ever been subjected.

124 Owns himself Henry's vassal.

125 New dissensions in Henry's family.

Henry was now freed from all troubles, either at home or abroad, for five years; during which time he made several salutary laws for the good of his kingdom. But, in 1180, the ambitious spirit of his children involved him in fresh calamities. Richard, who had been invested by his father in the sovereignty of Guienne, refused to do homage to his elder brother, as King Henry had required him to do. Young Henry and Geoffrey, uniting their arms, invaded their brother's dominions; and while the king was endeavouring to compose their differences, he found himself conspired against by them all. The conspiracy, however, was defeated by the death of Prince Henry in 1183. He had retired to Martel, a castle near Turenne, where he was seized with a fever; and perceiving the approaches of death, he was at last struck with remorse for his undutiful behaviour towards his father. He sent a messenger to the king, who was not far distant; expressed his contrition for his faults; and intreated the favour of a visit, that he might at least die with the satisfaction of having received his forgiveness. The king, who had so often experienced his son's ingratitude and violence, apprehended that his sickness was entirely a feint, and dared not trust himself in the prince's hands. But soon after, receiving certain intelligence of his death, and proofs of his sincere repentance, the good old king was affected with the deepest sorrow. He thrice fainted away; he accused his own hard-heartedness in refusing the dying request of his son; and he lamented that he had deprived the prince of the last opportunity of making atonement for his offences.

Prince Henry, who died in the 28th year of his age, left no posterity. His brother Richard succeeded to his dominions, and soon discovered as turbulent a spirit as that which had actuated his brother. He refused to give up Guienne, which Henry had designed for his fourth son John; and even made preparations for carrying on war against his father, and brother Geoffrey. Henry sent for Eleanor his queen, the heiress of Guienne; to whom Richard, either dreading an insurrection in her favour, or out of a sense of duty, willingly yielded up the territory, and retired peaceably to his father's court. This breach, however, was no sooner made up, than Geoffrey demanded Anjou to be added to his dominions in Brittany. This the king refused; upon which he fled to the court of France, and prepared to levy an army against his father. Henry, however, was freed from the danger which threatened him from that quarter, by his son's death, who was killed in a tournament at Paris. The loss of this prince gave few, except the king himself, any uneasiness; for he was universally hated, and went among the people by the name of the *Child of Perdition*. The widow of Geoffrey, soon after his decease, was delivered of a son, who received the name of *Arthur*, and was invested in the duchy of Brittany, under the guardianship of his grandfather, who, as duke of Normandy, was also superior lord of that territory. Philip, as lord paramount, disputed for some time his title to this wardship; but was obliged to yield to the inclinations of the Bretons, who preferred the government of Henry. Some other causes inflamed the dissension between these two monarchs, and Philip once more seduced Richard from his duty. He insisted, that his marriage with Adelais, Philip's sister, should be immediately completed, and threatened to enforce his pretensions with a formidable army. This occasioned another conference between Gisors and Trie, the usual place of meeting, under a vast elm that is said to have shaded more than an acre. In the midst of this conference the archbishop of Tyre appeared before the assembly in the most miserable habit, and begged assistance against the infidels, who, under Saladin, had almost totally expelled the Christians from Asia. His intelligence

126 His extreme grief and death.

gence appeared so very dismal, that the kings of France and England laid aside their animosity. Both of them immediately took the cross; but Richard, who had long wished to have all the glory of such an expedition to himself, could not bear to have even his father for a partner in his victories. He therefore entered into a confederacy with the king of France; so that Henry found himself at last obliged to give up all thoughts of the crusade, in order to defend himself against this unnatural combination. The event of the war proved very unfortunate for Henry, who lost several towns, and narrowly escaped falling into the hands of the enemy himself. At last a treaty was concluded at the intercession of the duke of Burgundy, the count of Flanders, and the archbishop of Rheims; but upon terms very humiliating to the king of England. It was agreed that Richard should marry the princess Adelais, and be crowned king of England during the lifetime of his father; that Henry should pay 20,000 merks to the king of France, as a compensation for the charges of the war; that his own barons should engage to make him observe this treaty, and in case of violating it, to join Philip and Richard against him; and that all his vassals who had espoused the cause of Richard should receive an indemnity for their offence. These terms, mortifying as they were, Henry bore with patience; but when, upon receiving a list of the barons that were to be pardoned, he found his own son John, who was his favourite, among them, he could no longer support his grief. He broke out into the most lamentable expressions of despair; cursed the day in which he received his miserable being; and bestowed on his ungrateful children a malediction which he could never afterwards be prevailed upon to retract. Soon after, he fell into a lingering fever occasioned by his grief; and of this he died on the 6th of July 1189, in the 58th year of his age and 35th of his reign. His natural son Geoffrey, who alone had behaved dutifully towards him, attended his corpse to the nunnery of Fontevrault, where it lay in state in the abbey-church. Next day Richard, who came to visit the dead body of his father, was struck with horror at the sight. At his approach, the blood was seen to gush out at the mouth and nostrils of the corpse; and this accident was, by the superstition of the times, interpreted as the most dreadful rebuke. Richard could not endure the sight. He exclaimed that he was his father's murderer; and expressed a strong, though too late, sense of his undutiful conduct.

127 Richard I.

128 Massacre of the Jews.

Richard succeeded to the throne without opposition immediately after his father's death; and, on his accession, set his mother Eleanor (who had been again confined) at liberty. A romantic desire for strange adventures, and an immoderate zeal for the external rites of religion, were the ruling passions of the times. By the first of these Richard was inflamed to the highest degree, and therefore behaved as if the whole design of his government had been to attempt the recovery of the Holy Land from the Infidels. The superstition of the people showed itself in a most violent and tragical manner on the very day of the king's coronation. The Jews were the objects of universal hatred, so that Richard had issued out orders forbidding any of them from appearing at his coronation. But some of them bringing him large presents from their nation, presumed, notwithstanding these orders, to approach the hall in which the king dined. Being discovered, they were exposed to the insults and injuries of the bystanders; in consequence of which they fled, and were pursued by the people. A report was spread, that the king had given orders to massacre all the Jews. This supposed command was executed in the most cruel manner. Multitudes were slaughtered in the city of London; and this example was followed in most of the cities of England. Five hundred Jews had retired into York castle for safety: but finding themselves unable to defend the place, they murdered their wives and children; threw the dead bodies over the wall against their enemies who attempted to scale it; and then, setting fire to the houses, perished in the flames. The gentry in the neighbourhood, who were all indebted to the Jews, ran to the cathedral where their bonds were kept, and made a solemn bonfire of them before the altar.

129 Richard's preparations for his journey into Palestine.

Richard immediately began to take measures for his expedition into Palestine. His father had left him 100,000 marks; and this sum he augmented by all expedients he could think of, however pernicious to the public, or dangerous to the royal authority. He set up to sale the revenues and manors of the crown, and several offices of the greatest trust and power. Liberties, charters, castles, were given to the best bidders. His friends warned him of the danger attending this venality; but he told them he would sell the city of London itself, if he could find a purchaser. Numerous exactions were also practised upon all ranks and stations; menaces, promises, and expostulations, were used to fright the timid, and allure the avaricious. A zealous preacher of those times was emboldened to remonstrate against the king's conduct; and advised him to part with his three daughters, which were pride, avarice, and sensuality. To this Richard readily replied, "You counsel right, my friend; and I have already provided husbands for them all. I will dispose of my pride to the templars; my avarice to the monks; and as for my sensuality, the clergy shall share that among them." At length the king having got together a sufficient supply for his undertaking, and even sold his superiority over Scotland for a moderate sum, set out for the Holy Land; whither he was impelled by repeated messages from the king of France, who was ready to embark on the same enterprise.

130 Taken prisoner on his return.

An account of Richard's exploits in this expedition is given under the articles EGYPT, SICILY, CYPRUS, &c.—Having at last concluded a truce with Saladin, he set out on his return for England. He was, however, at a loss how to proceed. He durst not return by the way he came, as this would put him in the power of the king of France, between whom and the king of England an irreconcileable enmity had taken place. No way therefore was left but by going more to the north; for which reason he took shipping for Italy, but was wrecked near Aquileia. From thence he travelled towards Ragusa, and resolved to make his way through Germany in the habit of a pilgrim. But his expences and liberalities having betrayed him, notwithstanding this disguise, he was arrested by Leopold duke of Austria, who commanded him to be loaded with shackles. This prince had served under Richard at at the siege of Acre (the ancient Ptolemais), where having received some disgust, he took this base method of revenging himself. Henry VI. emperor of Germany, was then equally an enemy to Richard, on account of his having married Berengaria the daughter of Tancred king of Sicily. He therefore required the royal captive to be delivered up to him, and stipulated a large sum of money to the duke as a reward for his service.

The kingdom of England in the mean time was in great confusion. Richard had left it under the direction of Hugh bishop of Durham, and Longchamp bishop of Ely. The tempers of these prelates being very different, an animosity between them soon took place. Longchamp at last arrested his colleague, and obliged him to resign his power in order to obtain his liberty. The king, by many letters, commanded Longchamp to replace his coadjutor, but to no purpose. When the situation of the king became uncertain, Longchamp tyrannized to such a degree, that John the king's brother thought proper to oppose him. He then left the kingdom; and upon this the archbishop of Rouen was made justiciary in his room. The king of France being informed of these dissensions, strove to increase them as much as possible; and had even almost prevailed upon John to throw off his allegiance, by promising to put him in possession of all Richard's continental dominions.

131 **Treachery of John the king's brother.**

When the English first received the news of Richard's captivity, a general indignation was excited through the whole nation. The greatest, and almost the only traitor in the kingdom, was the king's own brother John. On the very first invitation from the court of France, he went abroad and held a consultation with Philip, the object of which was the perpetual ruin and captivity of his unhappy brother. He promised to deliver into Philip's hands a great part of Normandy; and, in return, he received the investiture of all Richard's transmarine dominions: it is even said, that he did homage to the French king for the crown of England.

In consequence of this treaty, Philip invaded Normandy, and made considerable progress in the conquest of it. He was, however, at last repulsed by the earl of Leicester, who was now returned from the Holy Land; and a truce was concluded, on condition of paying the French king 20,000 merks, and putting four castles into his hands by way of security for the payment.—John, who had come over to England, met with still less success in his enterprises. He was only able to make himself master of the castles of Windsor and Wallingford; but when he came to London, and demanded the kingdom as heir to his brother, of whose death he pretended to have received certain intelligence, he was rejected by all the barons, and measures were taken to oppose and subdue him. The defence of the kingdom was so well provided for, that John, after some fruitless efforts, was obliged to conclude a truce with his opponents; and, before the expiration of it, he thought proper to retire to France, where he openly acknowledged his alliance with Philip.

All the efforts of Richard's enemies proved ineffectual to detain him in captivity. He was brought before the diet of the empire at Worms, where the emperor Henry brought against him a charge of many

crimes and misdemeanours: but to this the king replied with so much spirit and eloquence, that the German princes exclaimed loudly against the conduct of the emperor; the pope threatened him with excommunication; and Henry, who had hearkened to the proposals of the king of France and Prince John, found that it would be impossible for him to execute his and their base purposes, and detain the king of England any longer in captivity. He therefore concluded a treaty with him for his ransom; and agreed to restore him to his liberty for 150,000 merks, about 100,000l. of our money, of which 100,000 merks were to be paid immediately, and 67 hostages delivered for the remainder.

132 **Richard released from captivity.**

The money for the king's ransom was most cheerfully raised by the English. The churches and monasteries melted down their plate to the amount of 30,000 merks; the bishops, abbots, and monks, paid a fourth part of their yearly rent; the parochial clergy contributed a tenth part of their tithes; and the requisite sum being thus collected, Queen Eleanor and Walter archbishop of Rouen set out with it for Germany, paid the money to the emperor and duke of Austria at Mentz, delivered them hostages for the remainder, and freed Richard from his captivity. His escape was very critical. Henry had been detected in the assassination of the bishop of Liege, and in an attempt of the like nature on the duke of Louvaine; and finding himself extremely obnoxious to the German princes on account of these odious practices, he had determined to seek support from an alliance with the French king, and to detain Richard in perpetual captivity, notwithstanding the sum he had already received for his ransom. He therefore gave orders that Richard should be pursued and arrested; but the king making all imaginable haste, had already embarked at the mouth of the Scheldt, and was out of sight of land when the emperor's messengers reached Antwerp. The king of France no sooner heard of Richard's deliverance, than he wrote to John his confederate in these terms: "Take care of yourself: the devil is broke loose."

133 **Returns to England.**

The king of England returned from captivity on the 20th of March 1194, and was received with the utmost joy by his subjects. He had been but one day landed, when his treacherous brother John came to make his submission. At the intercession of Queen Eleanor he was received into favour. "I forgive him (said the king), and hope I shall as easily forget his offences as he will my pardon." Richard was impatient to revenge himself on the king of France, and therefore instantly made war upon him. But though both kings were inflamed with the most violent resentment against each other, they found it impossible to engage their powerful barons heartily in their cause. The war, therefore, produced no remarkable event; and, in 1195, was concluded by a truce for five years. On some slight occasion it was ready to break out anew, when the pope's legate interposed, and a treaty was about to be concluded. King Richard in the mean time was wounded by an arrow at the siege of Chalus, a castle of Limoges. The wound was not in itself dangerous; but being unskilfully treated, a mortification ensued, and the king expired on the 6th of April 1199, in the 10th year of his reign and 42d of his

134 **His death.**

his age. By his will he left the kingdom to his brother John, but distributed a fourth part of his treasure among his servants.

135 John succeeds to the crown.

John succeeded to the crown of England without opposition, but soon found his affairs embarrassed on the continent. The king of France, who, during the life of King Richard, had always supported the pretensions of John, now gave a like support to the claims of Prince Arthur the son of Geoffrey, who, though only 12 years of age, promised to be deserving of the kingdom. But in this matter the king of France showed so much regard to his own interest, that Constantia, the mother of the young prince, thinking that her ally designed to keep for himself the provinces which he pretended to conquer for Arthur, submitted herself and her son to John, who detained them in Mans; and thus became undisputed master of the whole empire.

136 His bad qualities.

The new king was weak, tyrannical, cruel, and treacherous. In short, he seemed to be endowed with almost every bad quality that can fall to the share of man. His conduct, therefore, soon rendered him universally odious. Imagining himself now secure on the side of France, he indulged his passion for Isabella, the daughter and heiress of the count of Angouleme, with whom he was much enamoured. His queen, the heiress of the family of Gloucester, was still alive; and Isabella was married to the count de la Marche, though, by reason of her youth, the marriage had not been consummated. John persuaded the count de Angouleme to carry off his daughter from her husband; at the same time that he procured, under some pretence or other, a divorce from the queen. Thus he incurred the displeasure of the pope, and also of the count de la Marche, and a powerful confederacy was formed against him.

As John had neither courage nor policy sufficient to keep his barons in awe, he took a method for that purpose equally base and cruel. This was by hiring a set of ruffians, whom he called his *champions*, to fight duels with them, in cases where they required to clear themselves from any charge by fighting a duel, according to the custom of those times. Thus he proposed to get rid of his refractory barons; but they, despising opponents who were so far below their rank, refused to fight with them, and a dangerous combination was formed among the barons against him.

137 Murders his nephew.

The murder of Prince Arthur rendered John still more generally detested. The young prince with his mother had fled to the court of France, where they were received with the greatest kindness, and found their interest more vigorously supported than before. Their enterprises were attended with considerable success, when Arthur himself had the misfortune to be taken prisoner. All the other captives were sent to England; but the prince was shut up in the castle of Falaise, and from that time was never heard of. It was universally believed that John had murdered him with his own hand; and this inflamed the general resentment against him to such a degree, that he soon after lost all his French provinces. In 1205, the duchy of Normandy itself was also conquered by Philip, and John was forced to fly with disgrace to England.

The king was resolved to wreak his vengeance upon the barons, who, he pretended, had deserted his standard in Normandy. For this reason, he levied large sums on their estates; in order, as he said, to undertake an expedition to the continent. This expedition, however, he several times capriciously deferred; and once having ventured out to sea, returned again without making the smallest attempt. At last, he landed at Rochelle, and burnt the city of Angiers; but hearing that the enemy were preparing to oppose him, he returned without attempting any thing else.

This irresolute and cowardly behaviour of John made him contemptible in the eyes of his subjects; but the Norman princes had so far extended the prerogatives of the English crown, that the barons, however discontented, durst not yet attempt to change the form of government. 138 His contest with the pope. John, by entering into a controversy with the church, completed his ruin. The clergy, who for some time had acted as a community totally independent of the civil power, had their elections of each other generally confirmed by the pope, to whom alone they owned subjection. The election of archbishops, however, had been a subject of continual dispute between the suffragan bishops and the Augustine monks. In the mean time the archbishop of Canterbury died; and the Augustine monks, in a very private manner, elected Reginald, their superior, in his place. The bishops exclaimed against this election, as a manifest innovation of their privileges; and a furious theological contest was likely to ensue. John very imprudently took a side in this controversy, and espoused the cause of the suffragan bishops; in consequence of which, John de Grey bishop of Norwich was chosen. The cause was appealed to Rome; and Pope Innocent III. seizing with avidity an opportunity of extending his power, commanded the monks to choose Cardinal Stephen Langton, an Englishman, then at the court of Rome. The power of nominating an archbishop of Canterbury (a person of almost equal authority with the king), was an acquisition that would effectually give the court of Rome an unlimited authority over England. John, therefore, was resolved not to submit to this imposition; but he had not judgment sufficient to conduct him. He violently expelled the monks from their convent, and seized upon their revenues. The pope perceiving, from this absurd conduct, that John was unequal to the task he had undertaken, after some intreaties, threatened to put the whole kingdom under an interdict. The prelates threw themselves on their knees before the king, and in the most earnest manner intreated him to avoid the resentment of the holy tribunal, by receiving the primate, and restoring the monks to their convent. John, however, broke out into the most violent invectives. He swore by *God's teeth* (his usual oath), that if the kingdom was put under an interdict, he would banish the whole body of the clergy, and confiscate all their possessions. The pope at last, finding he might do it with safety, issued forth this terrible sentence, so much dreaded by the whole nation. A stop was immediately put to divine service, and the administration of all the sacraments except baptism. 139 The kingdom laid under an interdict. The church-doors were shut, and the images of the saints laid on the ground. The dead were refused Christian burial; and were thrown into ditches and on the highways, without any funeral solemnity. Marriage was celebrated in the church-yards, and the people prohibited the use of meat as in in times of public penance. They were debarred from all pleasure; even from shaving their beards, saluting each other, or paying any regard to their apparel. The clergy deplored the unhappy state of the nation in the most lamentable manner; while John, in revenge, imprisoned all their concubines, and treated the adherents of Langton with the utmost rigour.

140
The king excommunicated, and the kingdom given to Philip of France.

The furious and imprudent efforts of John proved totally ineffectual. He had scarce a friend left in the whole nation; and therefore, in 1209, the pope denounced a sentence of excommunication against him. This was soon followed by another still more terrible; namely, the absolving all the subjects of the king of England from their allegiance, and declaring every one to be excommunicated who had any commerce with him at his table, council, or even in private conversation. The king, rendered quite furious by these repeated indignities, wreaked his vengeance on his unhappy subjects, whose affections he ought rather to have attempted to conciliate. The pope, therefore, proceeded to execute the full measure of his wrath on this devoted prince, by giving away his kingdom to Philip of France. He published a crusade all over Europe against King John; exhorting the nobility, the knights and men of every condition, to take up arms against him, and enlist under the French banner. Philip was not less active on his part. He summoned all the vassals of the crown to attend him at Rouen; and having collected a fleet of 1700 vessels, was ready, in 1213, to invade England.

The pope had now overstretched his power; and had the English nation been governed by a prince of any degree of prudence or resolution, the power of the clergy would in all probability have been totally broken. The people, however superstitious and ready to obey in matters of religion, could not tamely submit to be given away by the pope as slaves from one master to another; and therefore this consideration, added to the natural antipathy subsisting between the French and English, put John, notwithstanding all his offences, at the head of an army of 60,000 men. But the pope was too great a politician to suffer matters to be carried to extremities. He promised himself many more advantages from the submission of John than from an alliance with Philip; and therefore came over in person, or, according to some, sent over his legate, to England, under pretence of conferring with the barons, but in reality to hold a conference with John. He there represented to this forlorn prince, the numbers of the enemy, the hatred of his own subjects, and the secret confederacy there was against him in England. He intimated, that there was but one way to secure him from the impending danger; namely, to put himself under the protection of the pope, who was a merciful father, and still willing to receive a repenting sinner. The abject and irresolute spirit of John submitted to this last piece of arrogance, and he took an oath to obey whatever the pope should command. In consequence of this oath, he took another, the most extraordinary mentioned in the records of history; and which, as it was taken while he commanded an army of 60,000 men, discovers a meanness of spirit almost incredible. The terms imposed by it were expressed in the following words. "I John, by the grace of God, king of England and lord of Ireland, in order to expiate my sins, from my own free will, and the advice of my barons, *give* to the church of Rome, to Pope Innocent and his successors, the kingdom of England, and all other prerogatives of my crown. I will hereafter hold them as the pope's vassal. I will be faithful to God, to the church of Rome, to the pope *my master*, and his successors legitimately elected. I promise to pay him a tribute of 1000 merks; to wit, 700 for the kingdom of England, and 300 for the kingdom of Ireland."

141
John's submission to the pope.

This oath was taken by the king before all the people, kneeling, and with his hands held up between those of the legate. Having then agreed to reinstate Langton in the primacy, he received the crown which he had been supposed to have forfeited; while the legate, to add to his former insolence, trampled under his feet the tribute which John had consented to pay.—The king of France was enraged at this behaviour of the pope; and resolved to execute his project of conquering England, in spite of him and all his censures. His fleet, however, was attacked in their harbours by the English, who took 300 vessels, and destroyed about 100 more; while Philip, finding it impossible to prevent the rest from falling into the hands of the enemy, set fire to them himself, and thus was obliged to give up all hopes of success.

142
The barons attempt to reduce the prerogatives of the crown.

John being thus freed from all danger, continued to follow the same cruel and tyrannical measures which had hitherto rendered him odious to his subjects. His scandalous subjection to the clergy now gave the barons an opportunity of exerting themselves, in order to reduce the enormous prerogatives of the crown. Their designs were greatly facilitated by the concurrence of Langton the primate, who on all occasions showed a sincere regard for the interests of the kingdom. At a synod of his prelates and clergy, convened in St Paul's, on pretence of examining into the losses of some bishops who had been exiled by John, he privately conferred with a number of barons, to whom he expatiated upon the vices and injustice of their sovereign. He showed them a copy of Henry the first's charter; (being the only one in the kingdom, and which had been buried in the rubbish of an obscure monastery). Langton exhorted the barons to insist on a renewal of it; and this they solemnly swore to perform. The same agreement was afterwards renewed at a more numerous meeting of barons summoned by Langton at St Edmonsbury. Here it was resolved, that at Christmas they should prefer their common petition in a body, and in the mean time they separated with a design to put themselves in a posture of defence, enlist men, and fortify their castles. In the beginning of January 1215, they repaired to London, accoutred in their military garb and equipage, and presented their petition to the king, alleging that he had promised to grant a confirmation of the laws of Edward the Confessor, at the time he was absolved from his excommunication. John resented their presumption; and required a promise under their hands and seals, that they would never demand, or attempt to extort, such privileges for the future. This they refused with such unanimity and resolution, that the king desired time to consider of their demands. He promised, that, at the festival of Easter, he would give a positive answer to their petition; and offered them the archbishop of Canterbury, the bishop of

Ely, and the earl mareschal, as sureties for fulfilling his engagements.

The barons accepted of his securities, and departed peaceably; but John had no design of complying with their desires. He had recourse to the clergy, whose power he had seen and felt in so many instances. He courted their favour, by granting them a charter establishing all those rights of which they were already in the possession, and which he now pretended to confirm when he had not the liberty to refuse. To ingratiate himself still farther with this body, he took the cross, and appealed to the pope against the usurpation of the barons. The pope wrote letters to England, reproaching the primate and bishops with favouring these dissensions; and commanded them to promote peace between the two parties. He exhorted the barons to conciliate the king, not with menaces, but with humble intreaties; and promised, upon their obedience, to interpose his own authority in favour of such of their petitions as he should find to be just. At the same time, he annulled their association, and forbade them to enter into any confederacy for the future.

The barons paid no regard to the pope's remonstrances; knowing that the fulminations of the court of Rome would be of little avail, unless they were seconded by the clergy of England. After waiting till Easter, when the king promised to return them an answer, they met by agreement at Stamford. There they assembled a force of above 2000 knights, and a prodigious number of foot. Thence they marched to Brackley, about 15 miles from Oxford, the place where the court then resided. John, hearing of their approach, sent the archbishop of Canterbury, the earl of Pembroke, and others of his council, to know the particulars of their request, and what those liberties were which they so much importuned him to grant. The barons delivered a schedule containing the chief articles of their demands, founded on the charters of Henry and Edward; but which were in the highest degree displeasing to the king. He burst into a furious passion, asked the barons why they did not also demand his kingdom; and swore that he would never comply with such exorbitant demands. The confederates then chose Robert Fitzwalter for their general; whom they dignified with the title of "Mareschal of the army of God and of the holy church." They laid siege to Northampton, took Bedford, and were joyfully received into London. They wrote letters to all the nobility and gentry who had not yet declared in their favour, threatening their estates with devastation in case of refusal or delay.

In the mean time the king was left at a place called *Odiham* in Surrey, attended only by seven knights. He vainly endeavoured to avert the storm by the mediation of his bishops and ministers. He appealed to Langton against the barons, not suspecting that he was engaged in the confederacy; and desired him to fulminate the church censures against those who had made war upon their lawful prince. Langton declared that he would pass no censure where he found no delinquent; but said, that much might be done if the king would dismiss some foreign auxiliaries which he had lately brought over. Upon this John disbanded a great body of Germans and Flemings whom he had hitherto retained in his service, and Langton refused to excommunicate a single baron. The king, being now quite defenceless, was obliged at last to comply with the demands of his subjects. A conference was accordingly appointed, and all things were adjusted for this most important treaty.

143 They force him to sig Magna Charta.

The king's commissioners met the barons at a place called *Runimede*, between Staines and Windsor; and which is yet held in reverence as the spot where the standard of freedom was first erected in England. Here the king signed the charter called *Magna Charta*: which continues in force to this day, and is still regarded as the great bulwark of British liberty. See *Magna Charta*.

144 Principal articles of it.

This charter, however, at the time that it was made, secured liberty to the clergy, barons, and gentlemen, much more than to the bulk of the people, who did not for a long time obtain any privileges of importance. Freedom of elections was secured to the clergy; and it was determined, that fines on them for any offence should be laid on in proportion to their estates, and not the value of their benefices. The privileges secured to the barons were, either abatements in the rigour of the feudal laws, or relief from arbitrary and ambiguous decisions before the courts. It was also decreed, that barons should recover the lands of their vassals, even though forfeited by felony, after having been in the possession of the crown for a year and a day; and no tax was to be imposed without consent of the great council of the nation, excepting in case of the captivity of the king, the knighting of his eldest son, or marrying his eldest daughter. No land belonging to any baron was to be seized for a crown debt, unless the possessor had not personal property enough to pay it; neither was any vassal to be allowed to sell so much of his land as to incapacitate him from performing the necessary service to his lord. It was also determined, that when the great council of the nation was called, the prelates, earls, and barons should be summoned by a particular writ, and the lesser barons should receive a summons from the sheriff. In favour of the people it was stipulated, that they should have from the barons all the immunities and privileges granted by the king to the former. Merchants were to be allowed to carry on their business without any arbitrary tolls or impositions, and to go out of the kingdom and return at pleasure. The goods of every freeman were to be disposed of according to his will; or if he died intestate, the nearest heir should succeed him. No carts, horses, or wood, were to be taken by the crown officers without the consent of the owner. The king's courts were to be stationary, and no delay to be made in doing justice to every one; no freeman should be taken or imprisoned, dispossessed of his free tenement, outlawed or banished, unless by the legal judgment of his peers, &c. It was likewise stipulated, that London should remain in the hands of the barons, and the Tower be consigned to the primate, till the 15th of August following; or till the articles of the charter should be fulfilled. To give the more security for this, the king allowed them to choose 25 of their own number, to whose authority no limits were set either in extent or duration. If any complaint were made of a violation of the charter, either by the king or his officers, any four of the barons might admonish the king to redress the grievance; and if satisfaction were not obtained,

obtained, they might assemble the whole council of 25; and they, in conjunction with the great council, were empowered to compel him to fulfil the charter. In case of his resistance, they had liberty to levy war against him, attack his castles, and use every kind of violence, except against his person, or those of the queen or children. All men throughout the kingdom were bound, under the penalty of confiscation, to swear obedience to the 25 barons; and the freeholders of each county were to choose 12 knights, whose business it was to report such evil customs as ought to be redressed in terms of Magna Charta.

But although John had thus obliged himself, by writing, to allow liberty to his subjects, he had no mind that they should enjoy it in reality. The sense of his subjection to his own vassals sunk deep in his mind. He became sullen, silent, and reserved. He shunned the society of his former friends; and retired into the isle of Wight, as if to hide his disgrace in solitude; but, in reality, to meditate revenge against the barons. He sent to the continent to enlist a large body of mercenary troops, and made complaints to the pope of the insurrections of the barons against him. The pontiff very warmly espoused his cause; a bull was sent over, annulling the whole charter; and at the same time the foreign troops arriving, the king once more found himself in a condition to demand his own terms from his subjects.

145 The king raises an army against his barons.

The barons had made no preparations for war, not suspecting the introduction of a foreign army. The king, therefore, was for some time undisputed master of the field, and the most horrid cruelties were committed by his army. The nobility who had been most active in procuring the great charter fled with their families to Scotland, where they obtained the protection of King Alexander by doing homage to him. The barons being totally unable to raise an army capable of contending with that of John, applied to their old enemy Philip of France, offering to acknowledge his eldest son Louis for their sovereign, on condition of his protecting them from the fury of John and his mercenaries. The French king accepted their proposal with joy; and twenty-five hostages which he demanded being sent over, began to make the most diligent preparations for this expedition, regardless of the menaces of the pope, who threatened him with excommunication, and actually excommunicated his son Louis some time after.

146 They offer the kingdom to Louis the French king's son.

The first troops who came to the assistance of the barons, were only a body of 7000 men; but, soon after, Louis with a powerful army landed at Sandwich. The first effect of this invasion was, that most of John's foreign troops deserted, refusing to serve against the heir of their monarchy. Many considerable noblemen also deserted his cause, and Louis daily gained ground. This prince advanced to London, where the barons and burghers did him homage, and took the oath of allegiance, after he had sworn to confirm the liberties and privileges of the people. His imprudence, however, in preferring on all occasions his French subjects to the English, soon excited a jealousy against him, which proved very prejudicial to his cause. This jealousy was greatly increased by the death-bed confession of the count de Melun, one of his courtiers, who declared to those about him, that it was Louis's design to exterminate the English barons as traitors, and to bestow their dignities and estates upon his French subjects, on whose fidelity he could more safely rely. This caused a considerable desertion among Louis's party: so that John once more found himself in a condition to make an effort for his crown. He resolved to penetrate into the heart of the kingdom; and, for this purpose, he departed from Lynn, and took the road towards Lincolnshire at the head of a great body of troops. His road lay along the shore, which was overflowed at high water; but the king, not being apprised of this, or being ignorant of the tides of the place, lost all his carriages, treasure, and baggage by their influx. He himself escaped with the utmost difficulty, and arrived at the abbey of Swinstead; where his grief for the loss he had sustained, and the distracted state of his affairs, threw him into a fever, which soon appeared to be attended with fatal symptoms. He died at Newark in the year 1216, the 51st of his age, and 18th of his reign. He left two legitimate sons: Henry, who succeeded him on the throne, and was about nine years of age; and Richard, who was about seven. He left also three daughters; Jane, married to Alexander king of Scotland; Eleanor, married to the earl of Pembroke; and Isabella, married to the emperor Frederic II.

147 Death of King John.

When John died, the earl of Pembroke was mareschal of England. By this office he was at the head of the army, and of consequence, in times of such turbulence, at the head of the state. He was a nobleman of great honour and fidelity, and had continued faithful to John in his greatest reverses of fortune. He now determined to support the authority of the infant Prince Henry; and therefore carried him immediately to Gloucester, where the ceremony of coronation was performed, in the presence of Gaulo the legate and a very few noblemen, by the bishops of Winchester and Bath. The young prince was obliged to swear fealty to the pope, and renew the homage which his father had done for the kingdom; after which, the earl of Pembroke was chosen protector.

148 Henry III.

149 He grants new charters.

Till the king arrived at the years of maturity, the transactions of his reign can only be considered as the consequences of the disposition of his tutors. Pembroke caused him grant a new charter of liberties, consisting of the concessions extorted from John, with some alterations; and the next year it was renewed, with the addition of some other articles. Thus these famous charters were brought very nearly to the shape in which they have ever since stood; and they were, during many generations, esteemed the most sacred rampart to national liberty and independence. As they secured the rights of all orders of men, they were anxiously defended by all, and became in a manner the basis of the English monarchy, and a kind of original contract, which both limited the authority of the king, and ensured the conditional allegiance of his subjects. Though often violated, they were still claimed and recalled by the nobility and people; and as no precedents were supposed valid that infringed them, they rather acquired, than lost, authority, from the frequent attempts made against them, in several ages, by regal and arbitrary power.

These charters were made use of by Pembroke as arguments to draw off the malecontent barons from their allegiance to Louis. He represented to them, that,

whatever

A. D. 1216.

whatever jealousy they might have entertained against the late king, a young prince, the lineal heir of their ancient monarchs, had now succeeded to the throne, without succeeding either to the resentments or principles of his predecessor: That the desperate expedient, which they had employed, of calling in a foreign potentate, had, happily for them, as well as for the nation, failed of entire success; and it was still in their power, by a quick return to their duty, to restore the independence of the kingdom, and to secure that liberty for which they so zealously contended: That, as all past offences of the barons were now buried in oblivion, they ought, on their part, to forget their complaints against their late sovereign; who, if he had been anywise blameable in his conduct, had left to his son the salutary warning to avoid his paths, which had led to such fatal extremities: And that, having now obtained a charter for their liberties, it was their interest to show, by their conduct, that the acquisition was not incompatible with their allegiance; and that the rights of the king and people, so far from being hostile and opposite, might mutually support and sustain each other.

150
Decline of Prince Louis's party.

These considerations, enforced by Pembroke's known character of constancy and fidelity, had a very great influence on the barons. Most of them began to negotiate with him, and many actually returned to their duty. At the same time Louis continued to disgust those of his own party by the preference which he visibly gave to the French. Though he went over to France, therefore, and brought fresh succours from thence, he found that his party was greatly weaker than before, by the desertion of his English confederates: and that the death of King John had, contrary to his expectations, occasioned the total ruin of his affairs. In a short time Pembroke was so much strengthened by deserters from Louis's party, that he ventured to invest Mount Sorel; though upon the approach of the count de Perche with the French army, he desisted from that enterprise. The French general immediately marched to Lincoln; and, being admitted into the town, laid siege to the castle, and soon reduced it to extremity. Pembroke summoned his forces from every quarter, in order to relieve this important place; and he appeared so much superior to the French, that they shut themselves up within the city, resolving to take shelter there. But the garrison of the castle, having received a strong reinforcement, made a vigorous sally upon the besiegers, while the English army assaulted them from without. The French army was totally routed; the count de Perche with only two persons more were killed; but many of the chief commanders, and about 400 knights, were made prisoners. On the news of this fatal event, Louis raised the siege of Dover, and retired to London; where he received intelligence of a new disaster, which put an end to all his hopes. A French fleet, which carried a strong reinforcement, had appeared on the coast of Kent: where they were attacked and repulsed with considerable loss by Philip d'Albiney. He is said to have gained the victory by the following stratagem. Having got the wind of the French, he came down upon them with violence; and throwing on their faces a great quantity of quicklime, which he purposely carried on board, they were so blinded that they were disabled from defending themselves. This misfortune so discouraged the barons who yet adhered to Louis, that they came from every quarter to make their submission to Pembroke: and Louis himself, finding his affairs totally desperate, was glad to make his escape from a country where every thing was become hostile to him. He therefore concluded a peace with the protector; promised to evacuate the kingdom; and only stipulated, in return, an indemnity to his adherents, and a restitution of their honours and fortunes, together with the free and equal enjoyments of those liberties which had been granted to the rest of the nation.

When the king grew up, he was found to be very unfit for the government of such a turbulent people as the English at that time were. Though his temper was mild and humane, he was also very weak, fickle, and irresolute. He disgusted the people by the caresses he bestowed on foreigners; and this disgust rose once to such a height, that the barons refused to assemble in the general council of the nation, or parliament, at his desire. When commanded to do so, they sent a message to Henry, desiring him to dismiss his foreigners; otherwise they would drive both him and them out of the kingdom, and put the crown on the head of one who was more worthy to wear it. The facility of Henry's temper also induced him to heap riches upon his foreign favourites in a manner which he could by no means afford: this often brought him into very great straits; and to relieve himself, he was obliged to have recourse to many arbitrary measures, which he could not otherwise have chosen. Nothing, however, of very great moment happened till the year 1255, when the pope found means to embark Henry in a scheme for the conquest of Naples, or Sicily on this side the Fare, as it was called; an enterprise which not only brought much dishonour to the king, but involved him for some years in very great expence and trouble. The court of Rome some time before had reduced the kingdom of Sicily to the same state of feudal vassalage which he pretended to exercise over England; but Mainfroy, an usurper, under pretence of governing the kingdom for the lawful heir, had seized the crown, and was resolved to reject the pope's authority. As the pope found that his own force alone was not sufficient to gain his point, he had recourse to Richard the king of England's brother, who had been created earl of Cornwall, and had such talents for amassing money, that he was reckoned the richest prince in Christendom. To him the pope offered the kingdom of Sicily, upon the single condition of his conquering it from the usurper. Richard was too wise to accept this offer; upon which the pope applied to Henry, and offered him the crown of Sicily for his second son Edmund. Henry, dazzled by this proposal, without reflecting on the consequences, or without consulting his brother or the parliament, gave the pope unlimited credit to expend whatever sums he thought necessary for completing the conquest of Sicily. In consequence of this unlimited grant, his holiness determined to exert his apostolical authority to the utmost, in extorting money from the English. A crusade was published, requiring every one who had taken the cross against the infidels, or even vowed to advance money for that purpose, to support the war against Mainfroy, whom he accused as being a more terrible enemy

enemy to the Christian faith than any Saracen. A tenth on all the ecclesiastical benefices in England was levied for three years; and orders were given to excommunicate the bishops who did not make punctual payment. A grant was made to the king of the goods of intestate clergymen, as well as of the revenues of vacant benefices and those of non-residents. These taxations, however grievous, were submitted to with little murmuring; but another suggested by the bishop of Hereford excited the most violent clamours. This prelate, who at that time resided at the court of Rome, drew bills on all the abbots and bishops of the kingdom, to the amount of no less than 150,540 marks, which he granted to Italian merchants in consideration of the money they had advanced or pretended to advance for the support of the Sicilian war. As it was apprehended that the English clergy would not easily submit to such an extraordinary demand, a commission was given to Rustand, the pope's legate, to use his authority. An assembly of the prelates and abbots was accordingly summoned; who, on hearing the proposal sanctified with the names both of the pope and king, were struck with the utmost surprise and indignation. A violent altercation took place; during which the legate told them, that all ecclesiastical benefices were the property of the pope, and that he might dispose of them as he pleased. The affair ended, however, in the submission of the clergy: but the barons still continued refractory, and for some time answered the king's demands of supplies with expostulations; urging the king's partiality to foreigners, and the various injuries the nation had sustained from the servants of the crown. The great council of the nation, which had lately obtained the name of *parliament*, was therefore dissolved, and another called, but with as little success as before. The king, however, had involved himself in so much debt, that a large supply was become absolutely necessary; and as that could by no means be obtained from parliament, he was now reduced to the humiliating expedient of going about among such of his subjects as he thought most attached to him, and begging assistance from them at their own houses. At length his barons, perceiving the exigencies to which he was reduced, seemed willing to afford him aid; and, upon his promising to grant them a plenary redress of grievances, a very liberal supply was obtained, for which he renewed their charter with more than usual solemnity. All the prelates and abbots were assembled with burning tapers in their hands: the magna charta was read in their presence; and they denounced sentence of excommunication upon all who should infringe upon its decisions. They then put out their tapers on the ground, and exclaimed, "May every soul that proves false to this agreement so stink and corrupt in hell." The king subjoined, "So help me God, I will inviolably keep all these things, as I am a man, as I am a Christian, as I am a knight, and as I am a king crowned and anointed."

[153] Henry solemnly renews Magna Charta.

154 He breaks his engagements, which occasions a revolution.

No sooner had the king received the supplies of which he stood so much in need, than he forgot all his engagements, put his confidence entirely in foreign counsellors, and evaded or broke through in numberless instances the charters he had given. This conduct rendered him so obnoxious to the barons, that Simon Mountfort earl of Leicester, a man of a very violent and ambitious temper, determined to attempt an innovation in the government. He formed a powerful confederacy against the king, and the designs of the conspirators were effectually put in execution in the year 1258. Henry had summoned a parliament in expectation of receiving supplies for his Sicilian project; when the barons appeared in the hall, clad in complete armour, with their swords by their sides. The king, struck with this unusual appearance, asked them what was their purpose, and whether they pretended to make him their prisoner? Roger Bigod, earl mareschal, answered in name of the rest, that he was not their prisoner; that they even intended to grant him large supplies, in order to fix his son on the throne of Sicily; that they only expected some return for this expence and service; and that as the king had frequently made submissions to the parliament, had acknowledged his past errors, and had still allowed himself to be carried into the same path, which gave them such reason of complaint, he must now yield to more strict regulations, and confer authority on those who were able and willing to redress the public grievances. Henry instantly assured them of his intentions to grant them all possible satisfaction; and for that purpose summoned another parliament at Oxford, to digest the new plan of government, and to elect proper persons who were to be entrusted with the chief authority. This assembly, afterwards called the *mad parliament*, went very expeditiously to work on the business of reformation. Twenty-four barons were appointed, with supreme authority, to reform the abuses of the state; and Leicester was placed at their head. Their first step was to order four knights to be chosen out of each county, who should examine into the state of their respective constituents, and should attend at the ensuing parliament to give information of their complaints. They ordained that three sessions of parliament should be regularly held every year; that a new high sheriff should be elected annually; that no wards nor castles should be entrusted to foreigners, no new forests made, nor the revenues of any counties let to farm.

155. Bad conduct of the new rulers.

These constitutions were so just, that some of them remain to this day. But the parliament having once obtained the sovereign power, took care not to part with it again. They not only protracted the time of their sitting under various pretences; but at last had the effrontery to impose an oath upon every individual of the nation, declaring an implicit obedience to all the statutes executed or to be yet executed by the barons who were thus appointed as rulers. They not only abridged the authority of the king, but the efficacy of parliament also; giving up to 12 persons the whole parliamentary power between each session.—Their usurpations were first opposed by the knights of the shires, whom they themselves had appointed. These had for some time begun to be regularly assembled in a separate house, to consider of the national grievances; the first of which was the conduct of the 24 rulers. They represented, that though the king had performed all that was required of him, the barons had hitherto done nothing on their part that showed an equal regard for the people; that their own interest and power seemed the only aim of all their decrees; and they even called upon the king's eldest son Prince Edward

England.

A. D. 1258.

Edward to interpose his authority, and save the sinking nation.

156 Opposed by Prince Edward.

The prince was at this time about 22 years of age, and by his active and resolute conduct had inspired the nation with great hopes. He told those who made the application to him, that he had sworn to the late constitutions; and, on that account, though they were contrary to his own private opinions, he was resolved not to infringe them. At the same time, however, he sent a message to the barons, requiring them to bring their undertaking to an end, or otherwise to expect the most vigorous resistance to their usurpations. On this the barons were obliged to publish a new code of laws, which, though it contained scarce any thing material, yet, it was supposed, would for a while dazzle the eyes of the people, until they could take measures to establish their authority upon surer foundations. In this manner, under various pretences, they continued their power for three years; while the whole nation loudly condemned their treachery, and the pope himself at last absolved the king and his subjects from the oath they had taken to obey their injunctions. Soon after this, a parliament was called, and the king reinstated in his former authority. The barons were obliged to submit for a time; but the earl of Leicester having joined the Welsh, who at this time made an irruption into England, the kingdom was reduced to the most deplorable situation. The pusillanimity of the king prevented any proper or judicious method from being pursued for extricating the people from their distresses; and at last a treaty was concluded with the barons on the most disadvantageous terms that can be imagined. They were restored to the sovereignty of the kingdom, took possession of all the royal castles and fortresses, and even named the officers of the king's household. They summoned a parliament to meet at Oxford, in order more fully to settle the plan of government; and by this assembly it was enacted that the authority of the 24 barons should continue not only during the life of King Henry, but also during that of Prince Edward.

157 Who is defeated and taken prisoner, with the king and his brother.

These scandalous conditions would have been easily complied with by King Henry; but they were utterly rejected by Prince Edward, and a civil war immediately ensued. The prince was at first successful; but, through his impetuosity, occasioned the loss of a great battle, in which his father and uncle were taken prisoners, and he himself was obliged soon after to surrender to the earl of Leicester. The king was now reduced to the most deplorable situation. His partisans were totally disarmed, while those of the earl of Leicester still kept themselves in an offensive posture. Leicester seized the estates of no fewer than 18 barons; engrossed to himself the ransom of all the prisoners; monopolized the sale of wood to foreign markets; and at last ordained that all power should be exercised by nine persons, who were to be chosen by three others, or the majority of them; and these three were the earl of Leicester himself, the earl of Gloucester, and the bishop of Chichester.

158 First House of Commons.

The miserable situation to which the kingdom was now reduced, proved at last the means of settling the government on a more proper foundation. Leicester, in order to secure himself, was obliged to have recourse to an aid, till now entirely unknown in England, namely, that of the body of the people. He called a parliament, where, besides the barons of his own party, and several ecclesiastics who were not proper tenants of the crown, he ordered returns to be made of two knights from every shire; and also deputies from the boroughs, which had been hitherto considered as too inconsiderable to be allowed any share in the legislation. This parliament was called on the 20th of January 1265: and here we find the first outline of an English House of Commons; an institution which has ever since been considered as the bulwark of British liberty.

England.

A. D. 126

The new parliament was far from being so compliant to Leicester as he had desired or expected. Many of the barons who had hitherto stedfastly adhered to his party were disgusted with his boundless ambition; and the people, who found that a change of masters was not a change from misery to happiness, began to wish for the re-establishment of royal authority. Leicester at last, to make a merit of what he could not prevent, released Prince Edward from his confinement, and had him introduced at Westminster-hall, where his freedom was confirmed by the unanimous voice of the barons. But though Leicester had all the popularity of restoring the prince, he was yet politic enough to keep him guarded by his emissaries, who watched all his actions. At last, however, he found means to make his escape in the following manner. The duke of Gloucester, being disgusted with Leicester, retired from court, and went to his estates on the borders of Wales. His antagonist pursued him thither: and to give the greater authority to his arms, carried the king and prince of Wales along with him. This furnished young Edward with the opportunity he had so long desired. Being furnished by the earl of Gloucester with a horse of extraordinary swiftness, he took leave of his attendants, who were in fact his guards, but were not able to come up with him. They pursued him, however, for some time; but the appearance of a body of troops belonging to Gloucester soon put an end to their pursuit.

159 Prince Edward recovers his liberty.

The prince no sooner recovered his liberty, than the royalists joined him from all quarters, and an army was soon procured which Leicester could not withstand. This nobleman now found himself in a remote quarter of the kingdom; surrounded by his enemies; and debarred from all communication with his friends by the river Severn, whose bridges Edward had broken down. In this extremity, he wrote to his son to hasten to his assistance from London, with a considerable body which he had under his command. With this view his son advanced to Kenilworth; but here he was surprised, and his army entirely dispersed by Prince Edward. The young prince, immediately after this victory, advanced against Leicester himself; who, ignorant of the fate of his son's army, had passed the Severn in boats. He was by no means able to cope with the royalists; his men being inferior both in numbers and resolution to their antagonists. His army was defeated with great slaughter. Leicester himself was slain, though he called out for quarter, together with his eldest son Henry, and about 160 knights and other gentlemen. The old king had been purposely placed by the rebels in the front of the battle, where he was wounded, and in great danger of being killed; but, crying out, "I am Henry of Winchester your king," he was saved and put in a place of security by his son, who

160 Earl of Leicester defeated and killed.

who had flown to his assistance. The body of Leicester being found among the dead, was barbarously mangled by one Roger Mortimer; and then sent to his widow, as a testimony of the royal party's barbarity and success.

This victory, gained at Evesham, proved decisive in favour of the royal party. Almost all the castles, garrisoned by the barons, hastened to make their submissions, and opened their gates to the king. The Isle of Axholme alone, and that of Ely, trusting to the strength of their situation, ventured to make resistance; but were at last reduced, as well as the castle of Dover, by the valour and activity of Prince Edward. Adam de Gourdon, a courageous baron, maintained himself some time in the forests of Hampshire, committing depredations in the neighbourhood; and obliged the prince to lead a body of troops into that country against him. Edward attacked the camp of the rebels; and being transported by the ardour of action, leaped over the trench with a few followers, and encountered Gourdon himself in a single combat. The victory was long disputed between these two valiant combatants; but ended at last in the prince's favour, who wounded his antagonist, threw him from his horse, and took him prisoner. He not only granted him his life, but introduced him that very night to the queen at Guildford, procured his pardon, and was ever after faithfully served by him.

In 1271, Prince Edward, having settled the affairs of the kingdom, undertook an expedition to the Holy Land, where he signalized himself by many acts of valour. The king's health declined visibly after the departure of his son; and at last, worn out with cares and the infirmities of age, he expired at St Edmonsbury on the 16th of November 1272, in the 64th year of his age and the 56th of his reign.

161
Death of Henry III.

162
Edward I.

Prince Edward had reached Sicily in his return from the Holy Land, when he received an account of his father's death; at which he expressed much concern. As he knew that England was at that time in a state of perfect tranquillity, he was in no haste to return, but spent near a year in France before he made his appearance in England. He was received by his subjects with the utmost joy, and crowned at Westminster by Robert archbishop of Canterbury on the 19th of August 1274. He immediately applied himself to the correcting of those disorders which the civil commotions, and weak administration of his father, and introduced. A system of strict justice, bordering on severity, was introduced and kept up through the whole of this reign. The Jews were the only part of his subjects whom Edward oppressed. Many arbitrary taxes were levied upon them; 280 of them were hanged at once for adulterating the coin; the goods of the rest were confiscated, and all of them banished the kingdom.

163
Conquers Wales.

In 1276, the king undertook an expedition against Lewellyn prince of Wales, who had refused to do homage for his crown. The conquest of that country was not fully accomplished till the year 1283; after which the principality of Wales was annexed to the crown of England, and thenceforth gave a title to the king's eldest son *.—In 1286, the settlement of Wales appeared so complete, that the king went abroad in order to make peace between Alfonso king of Arragon and Philip le Bel king of France, who had a difference about the kingdom of Sicily. He succeeded in his negotiations; but, staying abroad three years, he found that many disorders had been introduced in his absence. Many instances of robbery and violence had broke out in all parts of England; but the corruption of the judges, by which the fountains of justice were poisoned, was of still more dangerous consequence. Edward, in order to remedy this prevailing abuse, summoned a parliament, and brought the judges to a trial; where all of them except two, who were clergymen, were convicted of this flagrant iniquity, were fined, and deposed from their office. The amount of the fines levied upon them is of itself a sufficient proof of their guilt, being above 100,000 marks; an immense sum in those days, sufficient to defray the expences of a war betwixt two great nations. The king afterwards made all the new judges swear that they would take no bribes; but the deposing and fining the old ones was the more effectual remedy.

164
Attempts the conquest of Scotland.

In 1291, King Edward began to meditate the conquest of Scotland, which employed him during the rest of his life; but which, though that kingdom was by him reduced to the greatest distress, he was never able to accomplish †. At the same time, he was engaged in expensive contests with France; and these multiplied wars and preparations for war, by obliging him to have frequent recourse to parliamentary supplies, became the remote causes of great and important changes in the government. The parliament was modelled into the form which has continued ever since. As a great part of the property of the kingdom, by the introduction of commerce and improvements in agriculture, was transferred from the barons to the lower class of people, so their consent was thought necessary for raising the supplies. For this reason, the king issued writs to the sheriffs, enjoining them to send to parliament, along with two knights of the shire, two deputies from each borough within their county; and these provided with sufficient powers from their constituents to grant such demands as they should think reasonable for the safety of the state. The charges of these deputies were to be borne by the boroughs which sent them; and so far were they from considering this deputation as an honour, that nothing could be more displeasing to any borough than to be thus obliged to send a deputy, or to any individual than to be thus chosen. The authority of these commoners, however, increased through time. Their union gave them weight; and it became customary among them, in return for the supplies which they granted, to prefer petitions to the crown for the redress of those grievances under which the nation was supposed to labour. The more the king's necessities increased, the more he found it necessary to give them an early redress; till, from requesting, the commons proceeded to requiring; and having all the property of the nation, they by degrees began also to be possessed of the power.

165
New models the parliament.

166
Dies and is succeeded by Edw. II.

Edward I. died of a dysentery at Carlisle on the 7th of July 1307, as he was leading a great army into Scotland, against the inhabitants of which he had vowed the most dreadful vengeance. He was succeeded by his son Edward II. whom he had charged with his dying breath to prosecute the war against Scotland, and never to desist till he had finally subdued the kingdom.

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* See *Wales*

† See *Scotland.*

A. D. 1314.

kingdom. But the new king was of a very different disposition from his father. The Scots gradually recovered their power; and in 1314 gave the English such a terrible defeat at Bannockburn, that for many years no superiority of numbers could encourage them to look the Scots in the face. See SCOTLAND.

167
Discontents of his jects.

The reign of Edward II. affords no particulars of great moment. Being a prince of a weak understanding, though endued with no remarkable bad qualities, his reign was one continued series of quarrels with his turbulent subjects. His favourites were the most general causes of discontent. The first of these was one Piers Gaveston, the son of a Gascon knight of some distinction, who had honourably served the late king, and who, in reward for his services, had obtained an establishment for his son in the family of the prince of Wales.—To be the favourite of any king whatever, is no doubt in itself a sufficient offence to the rest of the courtiers. Numberless faults were therefore found with Gaveston by the English barons. When the king went over to France to espouse the princess Isabella, to whom he had been long contracted, Gaveston was left guardian of the realm, with more ample powers than had usually been conferred in such a case. But when the queen, who was of an imperious and intriguing spirit, arrived, Gaveston had the misfortune to fall under her displeasure also, on account of the ascendency he had acquired over the king. A conspiracy was therefore soon formed against the favourite; at the head of which were the queen, and the earl of Lancaster, cousin-german to the king, and the most opulent and powerful nobleman in England. The king, unable to resist such a combination, was at last obliged to banish Gaveston; but recalled him some time after. This was sufficient to spread an alarm over the whole kingdom: a civil war ensued; and the nobility having got Gaveston into their hands, soon freed themselves of any farther apprehensions from him, by putting him to death.

After the unfortunate defeat at Bannockburn, King Edward chose a new favourite named *Hugh le Despenser*. He was a young man of a noble English family, some merit, and very engaging accomplishments. His father was a person of a much more respectable character than the son; but the being admitted to a share of King Edward's favour was a sufficient crime. The king imprudently dispossessed some lords of their estates, in order to bestow them upon this favourite; and this was a sufficient pretence for openly attacking both the father and son. The earls of Lancaster and Hereford flew to arms. Sentence was procured from parliament of perpetual exile against the two Spencers, with a forfeiture of all their estates. At last the king took the field at the head of 30,000 men, and pressed the earl of Lancaster so closely, that he had not time to collect his forces together; and, flying from one place to another, he was at last stopped in his way towards Scotland, and made prisoner. He was immediately condemned by a court-martial; and executed on an eminence near Pomfret, with circumstances of the greatest indignity.

A. D. 131

168
Insurrection against him by the queen.

Spencer now triumphed for some time over his enemies; most of the forfeitures were seized for his use, and he is said to have been guilty of many acts of rapine and injustice. But he was soon opposed by a more formidable enemy. Queen Isabella fled to France, and refused to return to England till Spenser was removed from the royal presence, and banished the kingdom. Thus she made herself popular in England, where Spenser was universally disliked; and she had the pleasure of enjoying the company of a young nobleman named *Mortimer*, upon whom she had lately placed her affections. The queen's court, therefore, became a sanctuary for all the malecontents who were banished their own country, or who chose to come over. When she thought matters were ripe for her purpose, she set sail from Dort harbour, accompanied by 3000 armed men. She landed without opposition on the coast of Suffolk, on the 24th of September 1326; and she no sooner appeared, than there seemed to be a general revolt in her favour. The unfortunate king found the spirit of disloyalty spread over the whole kingdom. He had placed some dependence on the garrison of Bristol, which was under the command of the elder Spenser; but they mutinied against their governor; and that unfortunate favourite was delivered up, and condemned by the tumultuous barons to the most ignominious death. He was hanged on a gibbet in his armour; his body was cut in pieces and thrown to the dogs; and his head was sent to Winchester, where it was set on a pole, and exposed to the insults of the populace. Young Spenser did not long survive his father. He was taken, with some others who had followed the fortunes of the wretched king, in an obscure convent in Wales. The queen had not patience to wait the formality of a trial; but ordered him to be immediately led forth before the insulting populace, and seemed to take a savage pleasure in beholding his distress. He was executed on a gibbet 50 feet high; his head was sent to London, where it was received by the citizens with brutal triumph, and fixed on the bridge.

169
Edward deposed.

In the mean time the king, who hoped to find refuge in Wales, was quickly discovered, and delivered up to his adversaries, who insulted him in the grossest manner. He was conducted to the capital amidst the insults and reproaches of the people, and confined in the Tower. A charge was soon exhibited against him; in which no other crimes but his incapacity to govern, his indolence, his love of pleasure, and his being swayed by evil counsellors, were objected against him. His deposition, however, was quickly voted by parliament; he was assigned a pension for his support; his son Edward, a youth of 14, was chosen to succeed him, and the queen was appointed regent during the minority. The deposed monarch did not long survive the loss of his crown. He was at first consigned to the custody of the earl of Lancaster; but this nobleman showing some marks of respect and pity, he was taken out of his hands, and delivered over to the lords Berkeley, Mautravers, and Gournay, who were entrusted alternately, each for a month, with the charge of guarding him. While he was in Berkeley's custody, he was still used with some degree of humanity; but when the turn of Mautravers and Gournay came, every species of indignity was practised upon him, as if they had designed to accelerate his death by the bitterness of his sufferings. It is reported, that one day when Edward

Edward was to be shaved, they ordered cold and dirty water to be brought from a ditch for that purpose; and when he desired it to be changed, and was still denied his request, he burst into tears, and exclaimed, That in spite of their insolence he should be shaved with clean and warm water. As his persecutors, however, saw that his death might not arrive, even under every cruelty they could practise, and were daily afraid of a revolution in his favour, they determined to rid themselves of their fears by destroying him at once. Mortimer, therefore, secretly gave orders to the two keepers, who were at his devotion, instantly to dispatch the king; and these ruffians contrived to make the manner of his death as cruel and barbarous as possible. Taking advantage of Berkeley's sickness, in whose custody he then was, and who was thereby incapacitated from attending his charge, they came to Berkeley-castle, and put themselves in possession of the king's person. They threw him on a bed, and held him down with a table which they had placed over him. They then ran a horn-pipe up his body, through which they conveyed a red-hot iron; and thus burnt his bowels without disfiguring his body. By this infernal contrivance they expected to have their crime concealed: but the horrid shrieks of the king, which were heard at a distance from the castle, gave a suspicion of the murder; and the whole was soon after divulged by the confession of one of the accomplices. Gournay and Mantravers were held in detestation by all mankind; and when the ensuing revolution deprived their protectors of power, they found it necessary to fly the kingdom. Gournay was afterwards seized at Marseilles, delivered over to the seneschal of Guienne, and put on board a ship with a view of carrying him over to England; but he was beheaded at sea, by secret orders, as was supposed, of some nobles and prelates of England, anxious to prevent any discovery which he might make of his accomplices. Mantravers concealed himself for some years in Germany; but having found means of rendering some services to Edward III. he ventured to approach his person, threw himself on his knees before him, and received a pardon.

170 and cruelly murdered.

171 Sovereign power assumed by the queen and Mortimer.

By the death of Edward II. the government fell entirely into the hands of the queen and her paramour Mortimer. The parliament, which raised young Edward to the throne, had indeed appointed 12 persons as his privy-council, to direct the operations of government. Mortimer excluded himself, under a show of moderation; but at the same time secretly influenced all the measures that came under their deliberation. As this influence began very soon to be perceived, and the queen's criminal attachment to Mortimer was universally known, these governors soon became very obnoxious to the people. The first stroke given to Mortimer's power was during an irruption of the Scots, when the favourite prevented the young king from attacking the enemy. Though it is very probable that the English army would have been destroyed by making an attack on an army situated in such an advantageous post as the Scots at that time occupied, Mortimer incurred great blame on that account. He was accused of having allowed the Scots to make their escape; and the general disgust on this account was increased by his concluding a peace with that kingdom, wherein the English renounced all title to the sovereignty of Scotland for the sum of 30,000 marks. Soon after Mortimer seized and executed the earl of Kent, brother to the late king; who, supposing Edward II. to be still alive, had formed a design of reinstating him in his kingdom. The execution was so sudden, that the young king had not time even to interpose in his behalf; and Mortimer soon after seized this nobleman's estate for his own use, as he did all the immense fortunes of the Spensers.

Edward, finding the power of Mortimer a continual restraint upon himself, resolved to shake off an authority that was likewise grown odious to the whole nation. The queen and Mortimer had for some time chosen the castle of Nottingham for their residence. It was strictly guarded, the gates were locked every night, and the keys carried to the queen. It was therefore agreed between the king and some of the barons, who secretly entered into his designs, to seize upon them in this fortress. Sir William Eland the governor was induced to admit them through a subterraneous passage, which had been formerly contrived for an outlet, but was now choked up with rubbish, and known only to one or two. Through this passage the noblemen in the king's interest entered the castle in the night-time; and Mortimer, without having it in his power to make any resistance, was seized in an apartment adjoining to that of the queen. The parliament, which was then sitting, condemned him, without either permitting him to make his defence, or examining a single witness against him. He was hanged on a gibbet at a place called *Elmes*, about a mile from London. A similar sentence was passed against some of his adherents, particularly Gournay and Mantravers, who found an opportunity of escaping as above mentioned. The queen, who was perhaps the most culpable of the whole, was screened by the dignity of her station. She was, however, deposed from all share of power; and confined for life to the castle of Risings, with a pension of 3000 pounds a-year. From this confinement she was never set free, though the king paid her an annual visit of ceremony. She lived 25 years after her deposition.

172 Mortimer executed.

Edward III. proved the greatest warrior that ever sat on the English throne. He first attempted to raise Edward Baliol to the sovereignty of Scotland; but this he found impossible fully to accomplish. Edward next formed a project of invading and conquering France, to the sovereignty of which he pretended a right. His first expectations were attended with so little success, that on his return to England he found the nation very much discontented, and himself harassed by his numerous creditors. without any sufficient resource for paying them. Being determined, however, not to bear any blame himself if he could throw it anywhere else, he took the first opportunity of wreaking his vengeance upon his subjects. Finding therefore the tower of London negligently guarded on his arrival, he imprisoned the constable and all his inferior officers, treating them with the greatest severity. He then fell upon the sheriffs and collectors of the revenue, whom he dismissed from their employments, and appointed an inquiry into their conduct to be made by persons who, knowing the king's humour, were sure to find every one guilty who came before them. The keeper of the privy-seal, the chief-justice, the mayor of London,

173 Edward invades France unsuccessfully.

174 His arbitrary behaviour on his return.

the bishops of Chichester and Litchfield, with the chancellor and treasurer, were deposed and imprisoned. In this career of resentment and cruelty, however, he found himself opposed by the archbishop of Canterbury, whom he had appointed to collect the taxes laid on for the support of the French war.

175 Is opposed by the archbishop of Canterbury;

That prelate happening to be absent at the time of the king's arrival, did not immediately feel the effects of his resentment. Being informed, however, of the humour in which his sovereign was, he issued a sentence of excommunication against all who, on any pretence whatever, should exercise violence against the persons or estates of clergymen, or who infringed those privileges secured by the great charter, or who accused a prelate of treason, or any other crime, in order to bring him under the king's displeasure. A regular combination was formed against the king by the clergy, with the primate at their head; who, to excite the indignation of the people as much as possible, reported that the king intended to recal the general pardon and the remission to old debts which had been granted, and to impose new and arbitrary taxes without consent of parliament. The archbishop also, in a letter to the king, informed him, that there were two powers by which the world was governed, viz. the holy pontifical apostolical dignity and the regal authority; of which the clerical power was evidently the supreme, as the priests were to answer even for the conduct of kings at the last judgment; and were besides the spiritual fathers of all the faithful, kings and princes not excepted; having, besides, a heavenly charter, entitling them to direct their wills and actions, and to censure their transgressions. On this the king resolved to mortify him, by sending no summons to him when the parliament was called: but the prelate, undaunted by this mark of resentment, appeared before the gates of the parliament-house with his crosier in his hand, demanding admittance as the first peer of the realm.

176 and obliged at last to submit:

This application was rejected for two days, but at last complied with; and the parliament now seemed inclined to abridge the king's authority considerably. They began with observing, that as the great charter had been violated in many points, particularly by the illegal imprisonment of many freemen and the seizure of their goods, it was necessary to confirm it anew, and to oblige all the chief officers of the law and others to swear to the observance of it. It was also required, that whenever any of the great offices became vacant, the king should fill them up by the advice of his council and the consent of such barons as should at the time be found to reside in the neighbourhood of the court. They enacted also, that on the third day of every session the king should resume all such offices into his own hand, excepting those of the justices of the two benches and the barons of exchequer; that the ministers should for the time be reduced to private persons; that they should in that condition answer before parliament to any accusation preferred against them; and that, if they were found in any respect guilty, they should be finally deprived of their offices, and others appointed in their stead. In return for such ample concessions, the king was offered a grant of 20,000 sacks of wool; and such was his urgent necessity, that he was compelled to accept of it even upon these terms. Still, however, he determined to adhere to his engagements no longer than till this necessity was removed. Though the agreement, therefore, was ratified in full parliament, he secretly entered a protest, that, as soon as his convenience permitted, he would from his own authority revoke what had been extorted from him. This protest was afterwards confirmed by a public edict; in which he asserted, that that statute had been made contrary to law; that it was prejudicial to the prerogatives of the crown, which he had only dissembled when he seemed to ratify it; and that in his own breast he had never assented to it: and declared, that from henceforth it had no force or authority.

177 But regains his power.

This exertion of arbitrary power, which it might have been imagined would have occasioned a prodigious clamour, was not taken notice of by any of the subsequent parliaments; so that in the course of two years Edward had entirely regained his authority, and obtained a repeal of the obnoxious statute just mentioned.

178 Performs great exploits in France.

Having thus settled matters to his satisfaction, the king resumed his expedition against France, where he gained great advantages. In his absence the Scots invaded England; but were entirely defeated at Durham, and their king himself taken prisoner. The English king in the mean time continued his victories on the continent; in which he was greatly assisted by Edward surnamed the *Black Prince*, the greatest hero recorded in the English annals. But for the wars of Edward III. and the exploits of this famous prince, see the articles SCOTLAND and FRANCE. The Black Prince died on the 8th of June 1376, and the king survived only about a year. He expired on the 21st of June 1377, and was succeeded by his second son Richard.

179 Richard II.

As the new king was only eleven years old when he ascended the throne, the government was vested in the hands of his three uncles, the dukes of Lancaster, York, and Gloucester. The different dispositions of these noblemen, it was thought, would cause them check the designs of each other. Lancaster was neither popular nor enterprising; York was indolent and weak; and Gloucester turbulent, popular, and ambitious. Discontents first arose among the common people. They had now acquired a share of liberty sufficient to inspire them with a desire for more, and this desire was greatly increased by the discourses of John Ball a seditious preacher. He went about the country, and inculcated on his audience, that mankind were all derived from one common stock; and that all of them had equal right to liberty and the goods of nature, of which they had been deprived by the ambition of a few insolent rulers.

These doctrines were greedily swallowed by the populace, who were farther inflamed by a new imposition of three groats a-head upon every person in the kingdom above 15 years of age. This had been granted as a supply by parliament, and was no doubt necessary on account of the many expensive wars in which the kingdom was engaged; but its apparent injustice, in laying no more burden upon the rich than the poor, excited the utmost resentment of the people. The manner, too, of collecting this tax, soon furnished them with an occasion of revolt. It began in Essex, where a report was industriously spread that the peasants were to be destroyed, their houses burned, and their farms plundered. A blacksmith, well known by the name

180 Dangerous insurrection by Wat Tyler.

181 He is killed.

of *Wat Tyler*, was the first that excited them to arms. The tax-gatherers coming to this man's house while he was at work, demanded payment for his daughter. This he refused, alleging that she was under the age mentioned in the act. One of these fellows offered to produce a very indecent proof to the contrary, and at the same time laid hold of the maid. This the father resenting, immediately knocked out the ruffian's brains with his hammer. The bystanders applauded the action; and exclaimed that it was high time for the people to take vengeance on their tyrants, and to vindicate their native libery. The whole country immediately took arms, and the insurgents soon amounted to about 100,000 men. They advanced to Blackheath, where they sent a message to the king, who had taken shelter in the Tower, desiring a conference with him. The king was desirous of complying with their demands, but was intimidated by their fierce behaviour. In the mean time, they entered the city, burning and plundering the houses of such as were obnoxious for their power or riches. Their animosity was particularly levelled against the lawyers, to whom they showed no mercy. The king, at last, knowing that the Tower was not able to resist their assaults, went out among them, and desired to know their demands. To this they made a very humble remonstrance; requiring a general pardon, the abolition of slavery, freedom of commerce in the market-towns, and a fixed rent instead of those services required by the tenure of villenage. The king granted all these requests; and charters were made out by which the grant was ratified. In the mean time, however, another body of these insurgents had broke into the Tower, and murdered the chancellor, the primate, and the treasurer, with some other officers of distinction. They then divided themselves into bodies, and took up their quarters in different parts of the city. At the head of one of these was Wat Tyler, who led his men into Smithfield, where he was met by the king, who invited him to a conference under pretence of hearing and redressing his grievances. Tyler ordered his companions to retire till he should give them a signal, and boldly ventured to begin a conference with the king in the midst of his retinue. His demands were, That all slaves should be set free; that all commonages should be open to the poor as well as to the rich; and that a general pardon should be passed for the late outrages. Whilst he made these demands, he now and then lifted up his sword in a menacing manner: which insolence so raised the indignation of William Walworth lord mayor of London, that, without considering the danger to which he exposed his majesty, he stunned Tyler with a blow of his mace; while one of the king's knights riding up, dispatched him with his sword. The mutineers, seeing their leader fall, prepared themselves to take revenge. Their bows were already bent for execution; when Richard, though not yet 16 years of age, rode up to the rebels, and with admirable presence of mind cried out: "What, my people, will you kill your king? Be not concerned for the loss of your leader. I myself will now be your general. Follow me into the field, and you shall have whatever you desire." The multitude immediately desisted, and followed the king into the fields, where he granted them the same charters that he had before granted to their companions. These charters, however, were soon after revoked, and the common people reduced to the same situation in which they had formerly been.

182 The king loses the favour of the people.

183 His excessive favour for the earl of Oxford.

184 A conspiracy against the king.

The courage, address, and presence of mind, which the king had discovered in quelling such a dangerous tumult, gave great hopes to the nation: but, in proportion as Richard advanced in years, these hopes were blasted; and his want of capacity, or at least of solid judgment, appeared in every enterprise he attempted. The king had unluckily lost the favour of the common people after the insurrection just mentioned. He allowed the parliament to revoke the charters of enfranchisement and pardon which had been granted; some of the ringleaders in the late disorders had been severely punished, and some even put to death without any form or process of trial. Thus the popular leaders were greatly exasperated by this cruelty, though probably the king did not follow the dictates of his own mind so much in it as the advice of his counsellors. But having thus lost the favour of one party, he quickly after fell under the displeasure of the other also. Supposing himself to be in too great subjection to his uncles, particularly the duke of Gloucester, he attempted to shake off the yoke, by raising others to such a degree of power as might enable them to rival them. His first favourite was Robert de Vere earl of Oxford, a young man of an agreeable person, but dissolute in his behaviour, who soon acquired an absolute ascendant over him. So much was he determined to show his attachment to this nobleman, that he first created him marquis of Dublin, a title never known in England before; then duke of Ireland; transferring to him the entire sovereignty of that island by patent for life. He gave him in marriage his cousin-german, the daughter of the earl of Bedford; but soon after permitted him to divorce her for another lady with whom he had fallen in love. This nobleman soon became the dispenser of all the king's favours to such a degree, that a conspiracy was formed against him; at the head of which were Mowbray earl of Nottingham, Fitz Alan earl of Arundel, Percy earl of Northumberland, Montacute earl of Salisbury, and Beauchamp earl of Warwick. Vere was impeached in parliament; and though nothing of moment was even alleged against him, he was condemned and deprived of his office. They next proceeded to attack the royal authority itself. Under pretence that the king was yet unable to govern the kingdom, though at that time 21 years of age, they appointed a commission of 14 persons to whom the sovereignty was to be transferred for a year. This measure was driven forward by the duke of Gloucester, and none but his own faction were admitted as members of the committee. The king could not without regret perceive himself thus totally deprived of authority. He first endeavoured to gain over the parliament to his interests, by influencing the sheriffs of each county, who were then the only returning officers. This measure failing, he next applied to the judges. They declared, that the commission which had deprived the king of his authority was unlawful, and that those who procured or advised it were punishable with death. Their sentence was quickly opposed by declarations from the lords. The duke of Gloucester armed his partisans, and appeared at Haringsay park near

Highgate,

Highgate, at the head of a body of men sufficient to intimidate the king and all his adherents. These insurgents, sensible of their own power, began by demanding of the king the names of those who had advised him to his late rash measures. A few days afterwards they appeared armed in his presence, and accused by name the archbishop of York, the duke of Ireland, the earl of Suffolk, and Sir Robert Tresilian, one of the judges who had declared in his favour, together with Sir Nicholas Bember, as public and dangerous enemies to the state. The duke of Ireland fled into Cheshire, where he attempted to raise a body of forces; but was quickly obliged to fly into Flanders, on the arrival of the duke of Gloucester with a superior army. Soon after, the king was obliged to summon a parliament, where an accusation was drawn up against five of his counsellors. Of these only Sir Nicholas Bember was present; and he was quickly found guilty, condemned, and executed, together with Sir Robert Tresilian, who had been discovered and taken during the interval. Lord Beauchamp of Holt was soon after condemned and executed; and Sir Simon Burley, who had been appointed the king's governor, shared the same fate, though the queen continued for three hours on her knees before the duke of Gloucester, imploring his pardon.

185 The king takes the power into his own hands.

Such unparallelled insolence and barbarity in a subject could not go unpunished. In 1389, the king at an extraordinary council of the nobility assembled after Easter, to the astonishment of all present, desired to know his age. Being told that he was turned of two and twenty, he alleged that it was then time for him to govern without help; and that there was no reason why he should be deprived of those rights which the meanest of his subjects enjoyed. The lords answered in some confusion that he had certainly an undisputed right to take upon himself the government of the kingdom. "Yes (replied the king), I have long been under the government of tutors; and I will now first show my right to power by their removal." He then ordered Thomas Arundel, whom the commissioners had lately appointed chancellor, to give up the seals; which he next day delivered to William Wickham bishop of Winchester. He next removed the duke of Gloucester, the earl of Warwick, and other lords of the opposition, from the council; and all the great officers of the household, as well as the judges, were changed.

The king being thus left at liberty to govern as he thought proper, for some time behaved in such a manner as to gain the affections of the people. It does not appear indeed that he ever gave much cause of complaint; but it was impossible for any prince in those days to keep himself secure on the throne but by a very severe and vigorous administration. The duke of Gloucester, perceiving that Richard was not of a warlike disposition, frequently spoke with contempt of his person and government, and deliberated concerning the lawfulness of throwing off all allegiance to him. The king being informed of his conduct by spies appointed for that purpose, at last formed a resolution of ridding himself of Gloucester and his faction at once. He therefore ordered that nobleman to be immediately arrested and sent over to Calais, where there was no danger of his being rescued by his numerous adherents. The earls of Arundel and Warwick were seized at the same time; and a new parliament, which the king knew would be perfectly obedient to his will, was summoned to Westminster. Here the commission of 14, who had usurped on the royal authority, was annulled for ever; all those acts which had condemned his former ministers were repealed; and the general pardon which the king had formerly given when he assumed the government into his own hands, was revoked. Several of Gloucester's party were condemned and executed, and at last that nobleman himself was called for to take his trial as well as the rest; but he had before been privately dispatched in prison.

186 Duke of Gloucester murdered.

After the destruction of the duke of Gloucester and the heads of his party, a misunderstanding arose among the noblemen who had joined in the prosecution. The duke of Hereford appeared in parliament, and accused the duke of Norfolk of having spoken seditious words against his majesty in a private conversation. Norfolk denied the charge, gave Hereford the lie, and offered to prove his innocence by single combat. The challenge was accepted; but on the day appointed for the duel, the king would not suffer the combatants to engage, but commanded both of them to leave the kingdom. The duke of Norfolk he banished for life, but the duke of Hereford only for ten years. The former retired to Venice, where in a short time he died of a broken heart. Hereford behaved in a resigned and submissive manner; which so pleased the king, that he consented to shorten the time of his banishment four years: he also granted him letters patent, ensuring him of the enjoyment of any inheritance which should fall to him during his absence; but upon the death of his father the duke of Lancaster, which happened shortly after, Richard revoked those letters, and kept the estate to himself.

187 Dukes of Hereford and Norfolk banished.

188 Hereford forms a scheme of dethroning the king.

This last injury inflamed the resentment of Hereford to such a degree, that he formed a design of dethroning the king. He was a great favourite both with the army and people; he was immensely rich, and connected by blood or alliance with all the great families of the nation. The king at the same time, it is said, gave himself up to an idle, effeminate life; and his ministers following his example, the national honour was lost. The number of malecontents daily increased, and only waited for the absence of the king, in order to put their schemes in execution; and this opportunity soon offered.

The earl of March, presumptive heir to the crown, having been appointed the king's lieutenant in Ireland, was slain in a skirmish with the natives of that country; which so incensed Richard, that, unmindful of his precarious situation at home, he went over to Ireland with a considerable army, in order to revenge his death in person. The duke of Lancaster (for that was the title which Hereford assumed on the death of his father) hearing of the king's absence, instantly embarked at Nantz; and with a retinue only of 60 persons in three small vessels, landed at Ravenspur in Yorkshire. The earl of Northumberland, who had long been a malecontent, together with Henry Percy his son, who from his ardent valour was surnamed *Hotspur*, immediately joined him with their forces; and the people flocked to him in such numbers, that in a few days his army amounted to 60,000 men.

189 Richard deposed and murdered.

Richard, in the mean time, continued in perfect security in Ireland for some time. Contrary winds for three weeks together prevented his receiving any news of the rebellion which was begun in his native dominions. He landed therefore at Milford Haven without suspicion, attended by a body of 20,000 men; but immediately found himself opposed by a power which he could by no means resist. His army gradually deserted him, till at last he was obliged to acquaint the duke, that he would submit to whatever terms he pleased to prescribe. The duke did not think proper to enter into any treaty with the king; but carried him to London, where he was confined close prisoner in the Tower, formally deposed by parliament, or rather by the duke of Lancaster, and at last put to death. The manner of his death is variously related. According to some, eight or nine ruffians were sent to the castle of Pomfret, whither the unhappy prince had been removed, in order to despatch him. They rushed unexpectedly into his apartment; but Richard, knowing their design, resolved to sell his life as dear as possible. He wrested a pole-axe from one of the murderers, with which he killed four of them; but was at length overpowered and killed. Others relate that he was starved in prison; and that, after he was denied all nourishment, he prolonged his life 14 days, by feeding on the flocks of his bed. He died in the year 1399, in the 34th year of his age, and 23d of his reign.—It was during the reign of Richard II. that Wickliff, the noted reformer, published his doctrines in England. See WICKLIFF.

190 Duke of Lancaster's claim to the crown.

After sentence of deposition had been pronounced on Richard by both houses of parliament, the throne being then vacant, the duke of Lancaster stepped forth; and having crossed himself on the forehead and on the breast, and called on the name of Christ, gave in his claim to the throne in the following words, which we shall give in the original language. "In the name of Fadher, Son, and Holy Ghost, I Henry of Lancaster, challenge this rewme of Ynglonde, and the crown, with all the membres and the appurtenances; als I that am descendit by right line of the blode, coming fro the gude King Henry therde, and throge that right that God of his grace hath sent me, with help of kyn, and of my frendes to recover it; the which rewme was in poynt to be ondone by default of governance, and ondoying of the gude laws."

The right which the duke here claimed by descent from Henry III. proceeded on a false story that Edmund earl of Lancaster, son of Henry III. was really the elder brother of Edward I.; but that, by reason of some deformity in his person, he had been postponed in the succession, and Edward the younger brother imposed on the nation in his stead. The present duke of Lancaster inherited from Edmund, by his mother, the right which he now pretended to the crown; though the falsehood of the story was so generally known, that he thought proper to mention it only in general terms.—No opposition, however, was made to the validity of this title in parliament; and thus commenced the differences between the houses of York and Lancaster, which were not terminated but by many bloody and ruinous wars.

191 Henry IV.

The reign of Henry IV. was little else than a continued series of insurrections. In the very first parliament he called, no fewer than 40 challenges were given and accepted by different barons; and though Henry had ability and address enough to prevent these duels from being fought, it was not in his power to prevent continual insurrections and combinations against himself. The most formidable one was conducted by the earl of Northumberland, and commenced A. D. 1403. The occasion of it was, that Henry denied the earl liberty to ransom some Scots prisoners which had been taken in a skirmish with that nation. The king was desirous of detaining them, in order to increase his demands upon Scotland in making peace; but as the ransom of prisoners was in that age looked upon as a right belonging to those who had taken them, the earl thought himself grievously injured. The injury appeared still the greater, because Northumberland considered the king as indebted to him both for his life and crown. He therefore resolved to dethrone Henry; and to raise to the throne young Mortimer, who was the true heir to the crown, as being the son of Roger Mortimer earl of March, whom Richard II. had declared his successor. For this purpose he entered into an alliance with the Scots and Welsh, who were to make an irruption into England at the same time that he himself was to raise what forces he could in order to join them. But when all things were prepared for this insurrection, the earl found himself unable to lead on the troops, by a sudden fit of illness with which he was seized at Berwick. On this, young Percy (surnamed *Hotspur*) took the command; and marched towards Shrewsbury, in order to join the Welsh. But the king had happily a small army with which he intended to have acted against the Scots; and knowing the importance of celerity in civil wars, instantly hurried down that he might give battle to the rebels. He approached Shrewsbury before a junction with the Welsh could be effected; and the impatience of Percy urged him to an engagement, which at that time he ought to have declined. The evening before the battle, he sent a manifesto to Henry; in which he renounced his allegiance, set the king at defiance, and enumerated all the grievances of which he imagined the nation might justly complain. He reproached him (and very justly) with his perjury; for Henry, on his first landing in England, had sworn upon the gospels, before the earl of Northumberland, that he had no other intention but to recover possession of the duchy of Lancaster, and that he would ever remain a faithful subject to King Richard. He aggravated his guilt, in first dethroning and then murdering that prince; and in usurping on the title of the house of Mortimer; to whom, both by lineal succession and by declarations of parliament, the throne, then vacant by Richard's death, did of right belong. Several other heavy charges were brought against him; which, at that time, could be productive of no other effect than to irritate the king and his adherents to the utmost.

192 Insurrection of the earl of Northumberland.

193 His son defeated and killed at Shrewsbury.

The armies on each side were in number about 12,000; so that they were not unmanageable by their commanders; and as both leaders were men of known bravery, an obstinate engagement was expected. The battle was fought on the 20th of July 1403; and we can scarce find in those ages any other in which the shock was so terrible and constant. At last Percy being killed by an unknown hand, the victory was decided in favour of the royalists. There are said to have fallen on that day near 2300 gentlemen, and 6000 private men, of whom near two-thirds were of Percy's army.

The earl of Northumberland having recovered from his sickness, and levied an army, was on his march to join his son; but being opposed by the earl of Westmorland, and hearing of the defeat at Shrewsbury, he dismissed his forces, and came with a small retinue to the king at York. He pretended that his sole intention was to mediate between the contending parties; and the king thought proper to accept of his apology, and grant him a pardon for his offence. The other rebels were treated with equal lenity; and none of them, except the earl of Worcester and Sir Richard Vernon, who were regarded as the chief authors of the insurrection, perished by the hands of the executioner. This lenity, however, was not sufficient to keep the kingdom quiet; one insurrection followed another almost during the whole of this reign; but either through Henry's vigilance, or the bad management of the conspirators, they never could unite their forces in such a manner as was necessary for bringing their projects to bear.

194 Archbishop of York executed.

This reign is remarkable for the first capital punishment inflicted on a clergyman of high rank. The archbishop of York having been concerned in an insurrection against the king, and happening to be taken prisoner, was beheaded without either indictment, trial, or defence; nor was any disturbance occasioned by this summary execution. But the most remarkable transaction of this reign was, the introduction of that absurd and cruel practice of burning people on account of their religion. Henry, while a subject, was thought to have been very favourable to the doctrines of Wickliff; but when he came to the throne, finding his possession of it very insecure, he thought superstition a necessary implement of his authority, and therefore determined by all means to pay court to the clergy. There were hitherto no penal laws against heresy; not indeed through the toleration of the court of Rome, but through the stupidity of the people, who could not perceive the absurdities of the established religion. But when the learning and genius of Wickliff had once broken the fetters of prejudice, the ecclesiastics called aloud for the punishment of his disciples; and Henry, who was very little scrupulous in his conduct, resolved to gratify them. He engaged parliament to pass a law for this purpose: it was enacted, that when any heretic, who relapsed, or refused to abjure his opinions, was delivered over to the secular arm by the bishop or his commissaries, he should be committed to the flames before the whole people. This weapon did not remain long unemployed in the hands of the clergy. William Sautré, rector of St Osithes in London, had been condemned by the convocation of Canterbury; his sentence was ratified by the house of peers; the king issued his writ for the execution; and the unhappy man was burnt alive in the year 1401. The doctrines of Wickliff, however, seem to have already gained ground very considerably in England. In 1405, the commons, who had been required to grant supplies, proposed in plain terms to the king to seize all the temporalities of the church, and employ them as a perpetual fund to serve the exigencies of the state. They insisted that the clergy possessed a third of the lands of the kingdom; and they contributed nothing to the public burdens; and that their exorbitant riches tended only to disqualify them from performing their ministerial functions with proper zeal and attention. When this address was presented, the archbishop of Canterbury, who then attended the king, objected that the clergy, though they went not in person to the wars, sent their vassals and tenants in all cases of necessity; while at the same time, they themselves who staid at home were employed night and day in offering up their prayers for the happiness and prosperity of the state. The speaker answered with a smile, that he thought the prayers of the church but a very slender supply. The archbishop, however, prevailed in the dispute; the king discouraged the application of the commons; and the lords rejected the bill which the lower house had framed for despoiling the church of her revenues. The commons were not discouraged by this repulse. In 1410, they returned to the charge with more zeal than before. They made a calculation of all the ecclesiastical revenues, which, by their account, amounted to 485,000 marks a-year, and included 18,400 ploughs of land. They proposed to divide this property among 15 new earls, 1500 knights, 6000 esquires, and 100 hospitals; besides 20,000l. a-year, which the king might keep for his own use: and they insisted that the clerical functions would be better performed than at present, by 15,000 parish priests, at the rate of 7 marks a-piece of yearly stipend. This application was accompanied with an address for mitigating the statutes enacted against the Wickliffites or Lollards, so that the king knew very well from what source it came. He gave the commons, however, a severe reply; and further to satisfy the church that he was in earnest, ordered a Lollard to be burnt before the dissolution of parliament.

195 Burning of heretics introduced.

The king had been for some time subject to fits, which continued to increase, and gradually brought him to his end. He expired at Westminster in 1413, in the 46th year of his age, and the 13th of his reign. He was succeeded by his son Henry V. whose martial talents and character had at first occasioned unreasonable jealousies in the mind of his father, so that he thought proper to exclude him from all share of public business. The active spirit of Henry being thus restrained from its proper exercise, broke out in every kind of extravagance and dissipation. It is even reported, that when heated with liquor, he scrupled not to accompany his riotous associates in attacking the passengers on the streets and highways, and robbing them of their goods. No sooner, however, did he ascend the throne, than he called together his former companions, acquainted them with his intended reformation, exhorted them to imitate his example; but strictly prohibited them, till they had given proofs of their sincerity in this particular, to appear any more in his presence: After which, he dismissed them with liberal presents. His father's wise ministers, who had checked his riots, found that they had, unknown to themselves, being paying the highest court to their sovereign; and were received with all the marks of favour and confidence. The chief justice, who had formerly imprisoned the prince himself, and therefore trembled to approach the royal presence, met with praises

196 Henry V.

praises instead of reproaches for his past conduct, and was exhorted to persevere in the same rigorous and impartial execution of the laws. The king was not only anxious to repair his own misconduct, but also to make amends for those iniquities into which policy or necessity of affairs had betrayed his father. He expressed the deepest sorrow for the fate of the unhappy King Richard, and even performed his funeral obsequies with pomp and solemnity, and heaped favours upon all those who had shown themselves attached to him. He took into favour the young earl of March, though his competitor for the throne; and gained so far on his gentle and unambitious nature, that he remained ever after sincerely attached to him. The family of Percy was restored to its fortune and honours; and the king seemed desirous to bury all distinctions in oblivion. Men of merit were preferred, whatever party they had been of; all men were unanimous in their attachment to Henry; and the defects of his title were forgotten amidst the personal regard which was universally paid him.

197 Enforces the laws against heretics.

The only party which Henry was not able to overcome was the new sect of Lollards, or reformers of religion. These were now gaining such ground in England, that the Romish clergy were greatly alarmed, and Henry was determined to execute the laws upon them. The head of that party at present was Sir John Oldcastle, Lord Cobham; a nobleman who had distinguished himself by his valour and military talents on many occasions, and acquired the esteem both of the late and present king. His high character and zeal for the new sect pointed him out to Arundel archbishop of Canterbury as a proper object of ecclesiastical fury, and therefore he applied to Henry for permission to indict him. The king desired him first to try gentle methods, and undertook to converse with Lord Cobham himself upon religious subjects. He did so, but could not prevail, and therefore abandoned Cobham to his enemies. He was immediately condemned to the flames: but having found means to make his escape, he raised an insurrection; which was soon suppressed, without any other consequence than that of bringing a stain on the sect to which he belonged. Cobham himself made his escape, but four years afterwards was taken and executed as a traitor. Immediately after, the most severe laws were passed against the Lollards. It was enacted, that whoever was convicted of Lollardy, besides suffering capital punishment according to the laws formerly established, should also forfeit his lands and goods to the king; and that the chancellor, treasurer, justices of the two benches, sheriffs, justices of the peace, and all the chief magistrates in every city and borough, should take an oath to use their utmost endeavours for the extirpation of heresy.

Notwithstanding these terrible laws, the very parliament which enacted them, namely that of 1414, when the king demanded a supply, renewed the offer formerly pressed upon Henry IV. and intreated the king to seize all the ecclesiastical revenues, and convert them to the use of the crown. The clergy were greatly alarmed. They could offer the king nothing of equal value. They agreed, however, to confer on him all the priories alien, which depended on capital abbeys in Normandy, and which had been bequeathed to them when that province was united to England. The most effectual method, however, of warding off the blow at present was by persuading the king to undertake a war with France, in order to recover the provinces in that kingdom which had formerly belonged to England. This was agreeable to the dying injunction of Henry IV. He advised his son never to let the English remain long in peace, which was apt to breed intestine commotions; but to employ them in foreign expeditions, by which the prince might acquire honour, the nobility in sharing his dangers might attach themselves to his person, and all the restless spirits find occupation for their inquietude. The natural disposition of Henry sufficiently inclined him to follow this advice, and the civil disorders of France gave him the fairest prospect of success. Accordingly, in 1415, the king invaded France at the head of 30,000 men. The great progress he made there is related at length under the article FRANCE. He had espoused the king's daughter, and conquered the greatest part of the kingdom. His queen was delivered of a son named *Henry*, whose birth was celebrated by the greatest rejoicings both at London and Paris; and the infant prince seemed to be universally regarded as heir to both monarchies. But Henry's glory, when it seemed to be approaching the summit, was blasted at once by death, and all his mighty projects vanished. He was seized with a fistula, a distemper which at that time the physicians had not skill enough to cure; and he expired on the 31st of August 1422, in the 34th year of his age, and the 10th of his reign.

198 France invaded.

199 Death of Henry V.

200 Henry VI.

Henry VI. succeeded to the throne before he was quite a year old, and his reign affords only the most dismal accounts of misfortunes and civil wars. His relations very soon began to dispute about the administration during the minority. The duke of Bedford, one of the most accomplished princes of the age, was appointed by parliament protector of England, defender of the church, and first counsellor to the king. His brother, the duke of Gloucester, was fixed upon to govern in his absence, while he conducted the war in France; and in order to limit the power of both brothers, a council was named, without whose advice and approbation no measure could be carried into execution.

The kingdom of France was now in the most desperate situation. The English were masters of almost the whole of it. Henry VI. though but an infant, was solemnly invested with regal power by legates from Paris; so that Charles VII. of France succeeded only to a nominal kingdom. With all these great advantages, however, the English daily lost ground; and in the year 1450 were totally expelled from France *. It may easily be imagined, that such a train of bad success would produce discontents among the rulers at home. The duke of Gloucester was envied by many on account of his high station. Among these was Henry Beaufort, bishop of Winchester, great uncle to the king, and the legitimate son of John of Gaunt brother to Richard II. The prelate, to whom the care of the king's education had been committed, was a man of great capacity and experience, but of an intriguing and dangerous disposition. He had frequent disputes with the duke of Gloucester, over whom he gained several advantages on account of his open temper. The duke of Bedford

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* See *France*.

ford employed both his own authority and that of parliament to reconcile them, but in vain; their mutual animosities served for several years to embarrass government, and to give its enemies every advantage. The sentiments of the two leaders were particularly divided with regard to France. The bishop laid hold of every prospect of accommodation with that country; and the duke of Gloucester was for maintaining the honour of the English arms, and regaining whatever had been lost by defeats or delay. Both parties called in all the auxiliaries they could. The bishop resolved to strengthen himself by procuring a proper match for Henry, at that time 23 years old; and then bringing over the queen to his interests. Accordingly, the earl of Suffolk, a nobleman whom he knew to be stedfast in his attachments, was sent over to France, apparently to settle the terms of a truce which had then been begun, but in reality to procure a suitable match for the king.

201. Married to Margaret of Anjou.

The bishop and his friends had cast their eyes on Margaret of Anjou, daughter of Regnier, titular king of Sicily, Naples, and Jerusalem; but without either real power or possessions. She was considered as the most accomplished princess of the age, both in mind and person; and it was thought would, by her own abilities, be able to supply the defects of her husband, who appeared weak, timid, and superstitious. The treaty was therefore hastened on by Suffolk, and soon after ratified in England. The queen came immediately into the bishop's measures: Gloucester was deprived of all real power, and every method taken to render him odious to the public. One step taken for this purpose was to accuse his duchess of witchcraft. She was charged with conversing with one Roger Bolingbroke, a priest and reputed necromancer; and also with one Mary Gourdemain, who was said to be a witch. It was asserted that these three in conjunction had made an image of the king in wax, which was placed before a gentle fire: and as the wax dissolved, the king's strength was expected to waste; and upon its total dissolution, his life was to be at an end. This accusation was readily believed in that superstitious age. The prisoners were pronounced guilty, the duchess was condemned to do penance and suffer perpetual imprisonment; Bolingbroke the priest was hanged, and the woman burnt in Smithfield.

The bishop, called also the *Cardinal*, of Winchester, was resolved to carry his resentment against Gloucester to the utmost. He procured a parliament to be summoned, not at London, which was too well affected to the duke, but at St Edmundsbury, where his adherents were sufficiently numerous to overawe every opponent. As soon as Gloucester appeared, he was accused of treason and thrown into prison; and on the day on which he was to make his defence, he was found dead in his bed, though without any signs of violence upon his body.

202 Duke of Gloucester murdered.

The death of the duke of Gloucester was universally ascribed to the cardinal of Winchester, who himself died six weeks after, testifying the utmost remorse for the bloody scene he had acted. What share the queen had in this transaction, is uncertain; but most people believed that without her knowledge the duke's enemies durst not have ventured to take away his life. The king himself shared in the general ill-will, and he never had the art to remove the suspicion. His incapacity also began every day to appear more clearly, and a pretender to the throne soon made his appearance.

203 Duke of York's title to the crown.

In the year 1450, Richard duke of York began to think of preferring his claims to the crown. All the males of the house of Mortimer were extinct; but Anne, the sister of the last earl of March, having espoused the earl of Cambridge, who had been beheaded for treason in the reign of Henry V. had transmitted her latent, but not yet forgotten claim, to her son Richard. This prince, descended by his mother from Philippa, only daughter of the duke of Clarence, second son of Edward III. stood plainly in order of succession before the king; who derived his descent from the duke of Lancaster, third son of that monarch. The duke was a man of valour and abilities, as well as of some ambition; and he thought the weakness and unpopularity of the present reign afforded a favourable opportunity to assert his title. The ensign of Richard was a white rose, that of Henry a red one; and this gave names to the two factions, who were now about to drench the kingdom in blood.

204 Duke of Suffolk banished,

After the cardinal of Winchester's death, the duke of Suffolk, who also had been concerned in the assassination of Gloucester, governed every thing with uncontrollable sway. His conduct soon excited the jealousy of the other nobility, and every odious or unsuccessful measure was attributed to him. The duke, however, imagining that his crimes were of such a nature as could not be proved, boldly called upon his enemies to show an instance of his guilt. The house of commons immediately opened against him a charge of corruption, tyranny, and treason. He was accused of being the cause of the loss of France; of persuading the French king, with an armed force, to invade England; and of betraying the secrets of state. The popular resentment against him was so strong, that Henry, in order to secure him as much as possible, sentenced him to five years banishment. This was considered by his enemies as an escape from justice. The captain of a ship was therefore employed to intercept him in his passage to France. He was seized near Dover, his head struck off on the side of a long-boat, and his body thrown into the sea.

205 and murdered.

206 Insurrection of John Cade.

The complaints against Henry's government were heightened by an insurrection headed by one John Cade, a native of Ireland. He had been obliged to fly over into France for his crimes; but, on his return, seeing the people prepared for violent measures, he assumed the name of *Mortimer*; and, at the head of 20,000 Kentish men, advanced towards Blackheath. The king sent a message to demand the cause of their rising in arms. Cade in the name of the community answered, That their only aim was to punish evil ministers, and produce a redress of grievances for the people. On this a body of 15,000 troops was levied; and Henry marched with them in person against Cade, who retired on his approach, as if he had been afraid of coming to an engagement. He lay in ambush, however, in a wood; not doubting but he should be pursued by the king's whole army: but Henry was content with sending a detachment after the fugitives, and returned to London himself; upon which Cade issued from his ambuscade, and cut the detachment in pieces.

Soon

Soon after, the citizens of London opened their gates to the victor; and Cade, for some time, maintained great order and regularity among his followers. He always led them out into the fields in the night-time, and published several edicts against plunder and violence of any kind. He was not, however, long able to keep his people in subjection. He beheaded the treasurer, Lord Say, without any trial; and soon after, his troops committing some irregularities, the citizens resolved to shut their gates against him. Cade endeavouring to force his way, a battle ensued, which lasted all day, and was ended only by the approach of night. The archbishop of Canterbury, and the chancellor, who had taken refuge in the Tower, being informed of the situation of affairs, drew up, during the night, an act of amnesty, which was privately dispersed among the rebels. This had such an effect, that in the morning Cade found himself abandoned by his followers; and retreating to Rochester, was obliged to fly alone into the woods. A price being set on his head by proclamation, he was discovered and slain by one Alexander Eden; who, in recompense for this service, was made governor of Dover castle.

207 Duke of York suspected by the court.

The court now began to entertain suspicions that the insurrection of John Cade had not happened merely in consequence of his own machinations and ambition, but that he had been instigated thereto by the duke of York, who, as we have already seen, pretended a right to the crown. As he was about this time expected to return from Ireland, and a report took place that he was now to assert his supposed right by force of arms, orders were issued in the king's name to deny him entrance into England. This was prevented by his appearance with no more than his ordinary attendants; but though he thus escaped the danger for the present, he instantly saw the necessity of proceeding in support of his claim.

208 Arguments for and against the houses of York and Lancaster.

His partisans were instructed to distinguish between his right by succession and by the laws of the kingdom. The adherents of Lancaster maintained, that though the advancement of Henry IV. might be looked upon as irregular, yet it was founded upon general consent; or, even allowing it to have been at first invalid, it had now been for a long time established, and acquired solidity of consequence; nor could the right of succession at any rate be pleaded for the purpose of overthrowing the general peace and tranquillity of the kingdom. The principles of liberty as well as the maxims of true policy had been injured by the house of York; while the public were bound to those of Lancaster, no less by political than moral duty, in consequence of the oaths of fealty that had been so often sworn to them; the duke of York himself having repeatedly sworn allegiance to them, and thus indirectly renounced those claims which he now brought forward to disturb the public tranquillity. On the part of the duke of York, it was replied, that the good of the people required the maintenance of order in the succession of princes; that, by adhering constantly to this rule, a number of inconveniences would be prevented which must otherwise ensue; and though that order had been broken through in the case of Henry IV. it was never too late to remedy any pernicious precedent. It would indeed be a great encouragement to usurpers, if the immediate possession of power, or their continuance in it for a few years, could convert them into legal princes; and the people must be in a very miserable situation, if all restraints on violence and ambition were taken off, and full liberty given to every innovator to make what attempts he pleased. They did not indeed deny that time might confer solidity on a government originally founded on usurpation; but a very long course of years was not only required for this purpose, but a total extinction of those who had any just title. The deposition of Richard II. and advancement of Henry IV. were not legal acts, but the effects of mere levity in the people; in which the house of York had acquiesced from necessity, and not from any belief of the justice of their cause; nor could this be ever interpreted into any renunciation of their pretensions; neither could the restoration of the true order of succession be considered as an encouragement to rebellion and turbulence, but the correction of a former abuse by which rebellion had been encouraged. Besides, the original title of Henry IV. was founded entirely on present convenience; and even this was now entirely shifted to the house of York. The present prince was evidently incapable of governing the kingdom by reason of his imbecility; so that every thing was governed either by corrupt ministers or an imperious queen, who engaged the nation in foreign connections entirely contrary to its interests; while, on the other hand, the true heir of the crown was a prince of approved judgment and experience, and a native of England, who, by his restoration, would undoubtedly correct all those abuses of which there was now such just reason to complain.

In this dispute it was evident that the house of York had the better in point of argument: nevertheless, as a prince of the house of Lancaster was in immediate possession of the throne, and could by no means be charged with any crime, the cause of the former was less generally interesting; especially as it must always have been uncertain, *à priori*, whether the duke of York would have governed any better than King Henry.

209 The duke of York foments dissensions between the king and parliament.

After his return from Ireland, however, the former used all his power and influence to foment the discontents which had for some time prevailed in the kingdom; and the conduct of the next parliament manifested the success of his intrigues. A violent attack was made upon such noblemen as were known to be most in favour with the king. The house of commons presented a petition against the duke of Somerset, the duchess of Suffolk, the bishop of Chester, Lord Dudley, and several others of inferior rank; praying not only that the king would remove them from his council, but that he would prohibit them from coming within twelve miles of the court. Henry, not daring to refuse this petition altogether, consented to banish all those of inferior rank, whom the commons had specified, but only for a year; and this too on condition that he had no use for their assistance in quelling any rebellion. But he rejected a bill for attainting the late duke of Suffolk, and proposed some other measures which seemed to militate against the court, though it had passed both the house of lords and the house of commons.

Encouraged by this disagreement between Henry and

210 Richard raises an army;

211 but is obliged to retire.

and his parliament, the duke of York raised an army of 10,000 men, with whom he marched towards London, demanding a reformation in matters of government, and the removal of the duke of Somerset. This first enterprise, however, proved unsuccessful; the gates of the city were shut against him, and he was pursued by the king at the head of a superior army. On this he retired into Kent; and as there was a number of his own friends in the army of the king, a conference took place, in which Richard still insisted upon the removal of the duke of Somerset, and his submitting to be tried in parliament. This request, was in appearance complied with, and Somerset arrested: the duke of York was then persuaded to wait upon the king in his royal pavilion; but, on repeating his charge against the duke, he was surprised to see the latter come out from behind the curtain, and offer to maintain his innocence. Richard perceiving that he had not sufficient interest to ruin his adversary, pretended to be satisfied, and retired to his seat at Wigmore in Wales; and during the time he resided there, a better opportunity was given him of accomplishing his designs than he could have hoped for. The king fell into a kind of lethargic disorder, which increased his natural imbecility to such a degree, that he could no longer retain a shadow of royalty.

212 He is appointed protector in consequence of the king's illness.

Richard now had interest enough to get himself appointed protector, with power to hold parliaments at pleasure; with which high office he was no sooner invested, than he turned out all the Lancastrian party from their offices, and sent the duke of Somerset to the Tower; but on the recovery of the king, which happened in no long time after, he himself was dismissed from his employment, the duke of Somerset released, and the administration once more put into his hands.

213 Is deposed and levies an army.

On this the duke of York levied an army, merely, as he pretended, to enforce the reformation of government and the removal of the duke of Somerset.

214 History of the civil war between Henry and the duke of York.

Thus Henry, though sore against his will, was obliged to face him in the field. A battle ensued at St Alban's; in which the royalists were defeated, and the duke of Somerset, the chief partisan of their cause, killed in the action. The king himself was wounded, and took shelter in a cottage near the field of battle; where he was taken prisoner, but was afterwards treated with great respect and kindness by the duke of York.

Henry, though he was now only a prisoner treated with the forms of royalty, was nevertheless pleased with his situation; but his queen, a woman of a bold and masculine spirit, could not bear to have only the appearance of authority, while others enjoyed all the real power. She therefore excited the king once more to assert his right by force of arms; and after several manœuvres, the duke of York was obliged to retire from court. A negotiation for peace was at first set on foot, but the mutual distrusts of both parties soon broke it off. The armies met at Bloreheath on the borders of Staffordshire, on the 23d of September 1459; and the Yorkists at first gained some advantages. But when a more general engagement was about to ensue, a body of veterans who served under the duke of York deserted to the king; and this so intimidated the duke's party, that they separated the next day without striking a blow. The duke of York fled to Ireland; and the earl of Warwick, one of his ablest and best supporters, escaped to Calais, with the government of which he had been entrusted during the late protectorship.

The York party, though thus in appearance suppressed, only waited a favourable opportunity of retrieving their affairs. Nor was this opportunity long wanting. Warwick having met with some successes at sea, landed at Kent; and being there joined by other barons, marched up to London amidst the acclamations of the people. The city immediately opened its gates to him, and he soon found himself in a condition to face the royal army. An engagement ensued at Northampton on the 10th of July 1460; in which the royalists were entirely defeated, and the king again taken prisoner. The duke of York then openly laid claim to the crown; and on this occasion the first instance of a spirit of national liberty is said to have appeared in the house of lords. The cause of Henry and the duke of York was solemnly debated; and the latter, though a conqueror, did not absolutely gain his cause. It was determined that Henry should possess the throne during his life; and that the duke of York should be appointed his successor, to the utter exclusion of the prince of Wales, who was then a child.

Though the royal party now seemed destitute of every resource, the queen still retained her intrepidity. She fled into Wales, where she endeavoured to raise another army. The northern barons, provoked at the southern ones for settling the government and succession to the crown without their consent, soon furnished her with an army of 20,000 men. Another battle was fought near Wakefield Green, on the 24th of December 1460.

215 Duke of York killed.

The Yorkists were defeated, and the duke himself was killed in the action. His head was afterwards cut off by the queen's orders, and fixed on one of the gates of York, with a paper-crown, in derision of his pretended title. His son the earl of Rutland, a youth of 17, was taken prisoner, and killed in cold blood by Lord Clifford, in revenge for his father's death, who had fallen in the battle of St Alban's.

After this victory, Margaret marched towards London, in order to set the king at liberty; but the earl of Warwick, who now put himself at the head of the Yorkists, led about the captive king, in order to give a sanction to his proceedings. He engaged the queen's forces at St Alban's; but through the treachery of Lord Lovelace, who deserted during the heat of the engagement with a considerable body of forces, Warwick was defeated, and the king fell once more into the hands of his own party.

The submission of the city of London seemed now to be the only thing wanting to complete the queen's success; but Warwick had secured it in his interests, and the citizens refused to open their gates to the queen. In the mean time, young Edward, eldest son of the late duke of York, put himself at the head of his father's party. He was now in the bloom of youth, remarkable for the beauty of his person and his bravery, and was a great favourite of the people. He defeated Jasper Tudor earl of Pembroke, at Mortimer's cross in Herefordshire. The earl himself was taken prisoner, and immediately beheaded by Edward's orders.

216 Edward IV.

ders. After this, he advanced to London; and being joined by the remainder of Warwick's army, he soon obliged Margaret to retire, entered the city amidst the acclamations of the people, and was crowned king on the 5th of March 1461.

217 Affairs of the queen totally ruined.

Notwithstanding all her misfortunes, however, Margaret still continued undaunted. She retired to the north, where she was soon joined by such numbers, that her army amounted to 60,000 men. She was opposed by young Edward and Warwick at the head of 40,000; and both armies met near Touton in the county of York, on the 29th of March 1461. A bloody battle ensued, in which the queen's army was totally defeated; and as Edward, prompted by his natural cruelty, had ordered no quarter to be given, 40,000 of the Lancastrians were slain in the field or in the pursuit. Edward is said to have gained this victory by means of a violent storm of snow, which blew full in the face of the queen's army, and so blinded them that they could scarcely make any use of their arms. After this disaster the queen fled to Scotland with her husband and son; and notwithstanding all the misfortunes she had already met with, resolved once more to enter England at the head of 5000 men granted her by the king of France. But even here she was attended by her usual bad fortune. Her little fleet was dispersed by a tempest, and she herself escaped with the utmost difficulty by entering the mouth of the Tweed. Soon after, a defeat, which her few forces sustained at Hexham, seemed to render her cause entirely desperate; and the cruelties practised upon all her adherents rendered it very dangerous to befriend her.

218 Adventures of the king and queen.

By these repeated misfortunes the house of Lancaster was so effectually ruined, that Margaret was obliged to separate from her husband, and both of them to shift for themselves the best way they could. The king was still protected by some of his friends, who conveyed him to Lancashire, where he remained in safety for a twelvemonth; but being at last discovered, he was thrown into the Tower and kept close prisoner. The queen fled with her son to a forest, where she was set upon by robbers, who stripped her of her rings and jewels, treating her otherwise with the utmost indignity. A quarrel which happened among them about the division of the spoil afforded her an opportunity of escaping from their hands into another part of the forest, where she wandered for some time without knowing what to do. At last, when quite spent with hunger and fatigue, she saw a robber coming up to her with a drawn sword in his hand. Finding it altogether impossible to escape, she suddenly took the resolution of putting herself under his protection. Advancing towards him, therefore, and presenting the young prince, "Here (says she), my friend, I commit to your care the safety of your king's son." This address so much surprised the robber, that, instead of offering her any injury, he professed himself entirely devoted to her service. After living for some time concealed in the forest, she was at last conducted to the sea-side, where she found a ship which conveyed her to Flanders. On her arrival there, she went to her father's house, who, though very poor, gave her such entertainment as he could afford; and in this retreat she staid some years in expectation of finding an opportunity of retrieving her affairs.

219 The queen retires to Flanders.

220 Warwick disgusted by Edward.

Edward, in the mean time, thinking himself securely fixed on the throne, gave a loose to his favourite passions; one of which was an immoderate love of women. To divert him from this, the earl of Warwick, to whom he was indebted for his crown, advised him to marry. Edward consented, and sent him over to the continent to negotiate a match with the princess of Savoy. The negotiation proved successful; but, in the mean time, the king had privately espoused Elizabeth Woodville, daughter to Sir Philip Woodville, who had married the duchess of Bedford after the death of her first husband. Edward had employed his arts of seduction against this lady in vain before he married her; but unfortunately the match was concluded just at the time that the earl of Warwick had proved successful in the negotiation with the princess of Savoy. The minister therefore returned full of indignation against his sovereign: and Edward, forgetting how great cause he had to be offended, determined to remove him entirely from his councils. Warwick was likewise disgusted by the favour shown to the queen's party; which, though certainly a piece of very commendable policy in Edward, was entirely disagreeable to the ambitious disposition of that nobleman. A plan of revenge was therefore thought of; and a most powerful combination was formed against Edward: to accomplish which, Warwick not only employed his own influence, which was very extensive, but likewise that of the duke of Clarence, Edward's brother, to whom the earl had allied himself by giving him his daughter in marriage; after which he persuaded him to embrace his cause. Some circumstances which took place about this time also favoured the scheme. The inhabitants about St Leonard's in Yorkshire complained, that the duties levied for that institution, and which had been originally appointed for pious purposes, were secreted by the managers, who refused to contribute their part. As the clergy were concerned in this affair, they attempted to silence their antagonists by ecclesiastical fulminations against them; upon which the latter took up arms, fell upon the officers of the hospital, and having massacred them, proceeded towards York, to the number of 15,000. In the first skirmish, they had the misfortune to lose their leader, who was instantly executed. The rebels, however, still continued in arms, and in a short time appeared in such numbers as to become formidable to government. Henry earl of Pembroke was sent against them with a body of 5000 men; and having taken Sir Henry Nevil, one of the leaders of the insurgents, prisoner, instantly put him to death; but this was soon revenged by a similar execution on himself, who happened to be defeated and taken prisoner a short time after. This defeat had been occasioned by a disagreement betwixt the earls of Pembroke and Devonshire; in consequence of which the latter had gone off with his troops, leaving Pembroke to shift for himself the best way he could. The king, enraged at this, caused Devonshire to be executed in a like summary manner: but this was of no service to his cause; a new body of insurgents appeared under Sir Robert Welles, son to a nobleman of that name. The latter, in order to secure him from all suspicions of disloyalty, fled to a monastery; but he was soon enticed from thence and put to death by the insidious promises of King Edward, whose treachery was equal to his cruelty. His son

221 The king's brother joins in the conspiracy against him.

222 An insurrection in Yorkshire.

son soon after shared the same fate, being defeated and taken prisoner by Edward, who instantly ordered him to be beheaded, along with Sir Thomas Launde and other persons of distinction.

213 Warwick and Clarence join the insurgents.

Notwithstanding such an appearance of a general insurrection, the king had so little suspicion of the loyalty of Warwick and Clarence, that he employed them in raising troops to quell the insurgents. Instead of executing their commission with fidelity, however, they joined the malcontents with all the forces they could raise; but being quite disconcerted by the defeat and death of Sir Robert Welles, they retired to Lancashire, in hopes of being joined by Lord Stanley, who had married the earl of Warwick's sister. Being disappointed in this, they were obliged to disband their army, and fly into Devonshire, whence they set sail for Calais. Upon their arrival on the continent, matters seemed not to be much mended: the deputy-governor, whom Warwick had left, refused him admittance; nor would he even allow the duchess of Clarence to land, though she had been delivered of a son on board only a very few days before, and was at this time extremely ill. Being well acquainted, however, with the uncertainty of the affairs of England at that time, he afterwards made an apology to Warwick for this behaviour. The latter pretended to be easily reconciled; but immediately left the place, having seized some Flemish vessels which he found lying in the neighbourhood.

214 Reconciliation betwixt Warwick and the queen.

As a very close alliance subsisted between Warwick and the duke of Burgundy, the king of France became uneasy; and therefore, as soon as the earl landed in his dominions, received him with the greatest marks of esteem. The reconciliation betwixt him and the unfortunate Queen Margaret now seemed to be natural, though, considering all circumstances, this must have formerly appeared in a manner impossible. The earl's father had been put to death by the orders of Margaret; and Warwick, in return, had twice taken prisoner King Henry, banished the queen, and put to death almost all their faithful adherents. By the mediation of the French monarch, however, all differences were accommodated.

215 He lands in England.

A fleet was prepared to reconduct them to England; and seizing a proper opportunity, they landed at Dartmouth with a small body of troops, while Edward was in the north suppressing an insurrection which had lately appeared there. Warwick was attended with astonishing success on his arrival in England, and in less than six days saw himself at the head of 60,000 men. Edward was now obliged in his turn to fly the kingdom. Having narrowly escaped an attempt made upon his person by the marquis of Montague, he embarked on board a small fleet which lay off Lynn in Norfolk. While at sea, he was chased by some ships belonging to the Hans Towns, that were then at war both with France and England; but at length, having escaped all dangers, Edward landed safely in Holland, where he met with but an indifferent reception from the duke of Burgundy, with whom he had lately entered into an alliance.

Warwick in the mean time advanced to London, and once more released and placed on the throne the miserable King Henry VI. A parliament was called, which very solemnly confirmed Henry's title to the throne, and Warwick himself was dignified by the people with the title of the *king-maker*. All the attainders of the Lancastrians were reversed; and every one was restored who had lost either honours or fortune by his former adherence to Henry's cause. All the adherents of Edward fled to the continent, or took shelter in monasteries, where they were protected by the ecclesiastical privileges. But Edward's party was not yet destroyed. After an absence of nine months, being seconded by a small body of troops granted him by the duke of Burgundy, he made a descent at Ravenspur in Yorkshire. At first he met with little success; but his army increasing on his march, he was soon in a condition to appear before the capital, which immediately opened its gates.

The unfortunate Henry was thus again plucked from the throne; and the hopes of Warwick were almost totally blasted by the defection of Clarence, Edward's brother. Nothing now remained but to come to an engagement as soon as possible. Warwick knew his forces to be inferior to those of Edward, but placed great dependence on his own generalship. He therefore advanced to Barnet, within ten miles of London, where he resolved to wait the coming of Edward. The latter soon came up with him, and on the 14th of April 1471 a most obstinate and bloody battle was fought. Edward, according to custom, had ordered no quarter to be given; and obtained the victory through a mistake of a body of Warwick's forces, who fell with fury on their own party instead of the enemy. The earl himself was slain, together with his brother, and 10,000 of his bravest followers.

The queen was just then returned with her son from France, where she had been soliciting supplies. She had scarce time to refresh herself from the fatigues of the voyage when she received the fatal news of the death of Warwick, and the total destruction of her party. All her resolution was not able to support her under such a terrible disaster. Her grief now for the first time, it is said, manifested itself by her tears; and she immediately took sanctuary in the abbey of Beaulieu in Hampshire. Here she still found some friends willing to assist her. Tudor earl of Pembroke, Courtney earl of Devonshire, the lords Wenlock and St John, with some other men of rank, encouraged her yet to hope for success, and promised to stand by her to the last. On this assurance, she resumed her courage; and advancing through the counties of Devon, Somerset, and Gloucester, increased her army every day. At last, however, she was overtaken by Edward with his victorious army at Tewkesbury, on the banks of the Severn. The queen's army was totally defeated; the earl of Devonshire and Lord Wenlock were killed in the field; the duke of Somerset, and about 20 other persons of distinction, who had taken shelter in a church, were surrounded, dragged out and immediately beheaded; about 3000 of their party fell in battle, and the army was entirely dispersed.

216 Total destruction of the queen's party.

Queen Margaret and her son were taken prisoners, and brought to the king, who asked the prince in an insulting manner how he dared to invade his dominions? The young prince replied, that he came thither to claim his just inheritance; upon which Edward struck him on the face with his gauntlet. The dukes of Clarence and Gloucester, Lord Hastings, and Sir Thomas Gray, taking this blow as a signal for farther violence, hurried the prince into the next apartment, and there dispatched him with their

their daggers. Margaret was thrown into the Tower along with her husband Henry, who expired in that confinement a few days after. It was universally believed that he was murdered by the duke of Gloucester, though of this there was no direct evidence. Margaret was ransomed by the king of France for 50,000 crowns, and died a few years after in a most miserable situation.

Edward being now freed from all his enemies, began to inflict punishment on those who had formerly appeared against him. Among the cruelties he committed, that on his brother the duke of Clarence was the most remarkable. The king happening to be one day hunting in the Park of Thomas Burdet, a servant of the duke, killed a white buck which was a great favourite of the owner. Burdet, vexed at the loss, broke out into a passion, and wished the horns of the deer in the belly of the person who advised the king to that insult. For this exclamation Burdet was tried for his life, and executed at Tyburn. The duke of Clarence exclaimed against the iniquity of this sentence; upon which he was arraigned before the house of peers, found guilty, and condemned to death. The only favour granted him was to have the choice of his death; and his choice was a very singular one, namely, to be drowned in a butt of Malmsey wine; which was accordingly done.—The rest of this reign affords little else than a history of the king's amours. Among his many mistresses, Jane Shore was the most remarkable; (see SHORE). The king died on the 9th of April 1482, in the 42d year of his age and 21st of his reign, counting from his first assuming the crown. Besides five daughters, he left two sons; Edward prince of Wales, his successor, then in his 13th year; and Richard duke of York in his 9th.

228
Edward V.

On the death of Edward IV. the kingdom was divided into new factions. The queen's family, which, during the last reign, had come into power, was become obnoxious to the old nobility, who considered them as their inferiors. The king had endeavoured to prevent these animosities from coming to a height, by desiring on his death-bed that his brother Richard duke of Gloucester should be entrusted with the regency; and recommended peace and unanimity during the minority of his son. But the king was no sooner dead than the former resentment between these parties broke out with violence; and the duke of Gloucester, who was endued with almost every bad quality, resolved to profit by their contentions.

229
Duke of Gloucester declared protector.

His first step was to get himself declared protector of the realm; and having arrested the earl of Rivers, the king's uncle and guardian, he met young Edward in his way from Ludlow castle, where the late king had resided during the latter part of his reign, and respectfully offered to conduct him to London. Having thus secured the person of the king, he next got possession of his brother's person also. The queen had retired with this child into Westminster abbey; and it was not without extreme regret that she delivered him up at the intercession of the primate and archbishop of York.

In a few days after Gloucester had made himself master of the persons of the two princes, he had them confined in the Tower, under pretence of guarding them from danger; and soon after spread reports of their illegitimacy, and by pretended obstacles put off the young king's coronation. Lord Stanley first began to suspect his designs; and communicated his suspicions to Lord Hastings, who had long been firmly attached to the king's family. Lord Hastings would not at first give credit to this surmise; but he very soon had a fatal proof of the truth of what had been communicated to him. On the 13th of June 1483, he was hurried out of the council-room in the Tower by Gloucester's order, and beheaded on a log of timber. The soldiers who carried him off made a bustle as though an attempt had been made to rescue him, and one of them discharged a blow at Lord Stanley's head with a pole-axe; but he happily escaped by shrinking under the table. The same day were executed the earl Rivers, and some others, who had committed no other crime than being faithful to the young king.

The protector now thought he might with safety lay claim to the throne. He had previously gained over the duke of Buckingham, a nobleman of great influence among the people. He used his utmost endeavours to inspire the people with a notion of the illegitimate birth of the late king, and consequently of his children. Dr Shaw, a popular preacher, was also hired to harangue the people to the same purpose from St Paul's cross. Having expatiated on the incontinence of the queen, and the illegality of the young king's title, he then made a panegyric on the virtues of the protector. "It is the protector (continued he) who carries in his face the image of virtue, and the marks of a true descent. He alone can restore the lost glory and honour of the nation." It was hoped that upon this occasion some of the populace would have cried out, "Long live King Richard!" but the audience remaining silent, the duke of Buckingham undertook in his turn to persuade them. Having expatiated on the calamities of the last reign and the illegitimacy of the present race, he told the people, that he saw only one method of warding off the miseries which threatened the state, which was by electing the protector; but he seemed apprehensive that he would never be prevailed upon to accept a crown accompanied with such difficulty and danger. He next asked his auditors, whether they would have the protector for their king? but was mortified to find that a total silence ensued. The mayor, who was in the secret, willing to relieve him in this embarrassed situation, observed, that the citizens were not accustomed to be harangued by a man of his quality, and would only give an answer to their recorder. This officer, therefore, repeated the duke's speech; but the people continuing still silent, "This is strange obstinacy (cried the duke): we only require of you, in plain terms, to declare, whether or not you will have the duke of Gloucester for your king; as the lords and commons have sufficient power without your concurrence?" At this, some of the meanest apprentices, incited by the servants of the protector and Buckingham, raised a feeble cry of "God save King Richard!" The mob at the door repeated the cry; and throwing up their caps into the air, cried out, "A Richard! A Richard!" After this farce was acted, Buckingham, on the 24th of June 1483, waited on Richard with offers of the crown: but the protector, with hypocritical modesty, at first declined the offer, till being told, that the people, in case of his refusal, must look out for one that would be more compliant,

he

he accepted the government of England and France, with a resolution, as he said, to defend the one and subdue the other.

230 Richard III.

231 Edward V. and his brother murdered.

The first step taken by the new king was to send orders to Sir Robert Brackenbury governor of the Tower, to put the young princes to death. But this he refused; and submissively answered that he knew not how to embrue his hands in innocent blood. A fit instrument for this purpose, however, was not long wanting. Sir James Tyrrel readily undertook the office; and Brackenbury was ordered to resign the keys to him for one night. Tyrrel choosing three associates, Slater, Deighton, and Forest, came in the night-time to the door of the chamber where the princes were lodged; and sending in the assassins, bid them execute their commission, while he himself staid without. They found the young princes in bed, and fallen into a sound sleep. The assassins smothered them with the bolster and pillows; after which they showed their naked bodies to Tyrrel, who ordered them to be buried at the stair-foot under a heap of stones (c).

232 Buckingham determines to support the claim of the earl of Richmond to the throne.

233 He takes up arms, but is abandoned by his army and put to death.

234 Richmond lands in England, but is obliged to return.

235 Richard's title confirmed by parliament.

Richard having thus secured himself on the throne by the most iniquitous methods, attempted to strengthen his interest by foreign alliances, and procuring the favour of the clergy at home by great indulgences; but he found his power threatened from a quarter where he least expected an attack. The duke of Buckingham, who had been so instrumental in raising him to the throne, did not think himself properly rewarded. He made a demand of some confiscated lands in Hereford, to which his family had an ancient claim. Richard either reluctantly complied with his request, or only granted it in part; so that a coolness soon ensued between them, and in a little time Buckingham came to a resolution of dethroning the monarch whom he had just raised. For some time he remained in doubt whether he would assume the crown himself, or set up another. At length he determined on the latter; and resolved to declare for Henry earl of Richmond, who was at that time an exile in Brittany, and was considered as the only surviving branch of the house of Lancaster. He was one of those who had the good fortune to escape the numerous massacres of the former reigns; but as he was a descendant of John of Gaunt by the female line, he was for that reason obnoxious to those in power. He had long lived in exile, and was once delivered over to the ambassadors of Edward IV. who were preparing to carry him to England; when the duke of Brittany, who delivered him, repented of what he had done, and took him from the ambassadors just as they were carrying him on shipboard. His right to the crown by succession was very doubtful: but the cruel behaviour of Richard inclined the people in general greatly to favour him; and, to give an additional strength to his title, a match was projected betwixt him and the princess Elizabeth, the eldest daughter of Edward IV. which, by uniting the two rival families, would put an end to those dissensions which had so long filled the kingdom with bloodshed and confusion. Richard, in the mean time, from some reasons which have not been particularized by historians, began to entertain doubts of the fidelity of Buckingham, and determined to cut him off. For this purpose he sent for him to court: but Buckingham, instead of obeying the summons, fled into Wales, where he raised a considerable army, and forthwith set out to the eastward with a design to invade England. Richard hastened to meet him with what forces he could raise; but the march of Buckingham being retarded by a most uncommon inundation of the Severn which lasted 10 days, his troops were so disheartened at this event, that they almost all deserted him. The duke was therefore obliged to fly in distress, and Richard instantly set a price upon his head. Buckingham was now obliged to trust his life in the hands of an old servant of his own, named *Banister*; but this man, tempted by the greatness of the reward, betrayed him to the sheriff of Shropshire, by whom he was seized and conducted to Richard at Salisbury, who caused him to be executed without delay. The earl of Richmond, in the mean time, had set sail from St Maloes with a body of 5000 men: but after his arrival in England, receiving the disagreeable news of Buckingham's misfortune, he set sail again for Bretagne; while Richard, emboldened by the bad success of his enemies, determined to confirm his title to the throne by calling a parliament, which till this time he had not ventured to do. At present matters were so circumstanced, that the parliament had no other resource than to comply with his desires, and acknowledge his right to the crown. An act was passed confirming the illegitimacy of Edward's children; and an attainder was also confirmed against the earl of Richmond; the duties of tonnage and poundage were granted to the king for life; and his only son Edward, then about twelve years of age, was created prince of Wales. In return for these concessions, Richard passed several popular laws, particularly against the extorting of money by benevolences, and some others calculated to gain the good will of the opposite party. He paid his court also to the queen-dowager with such assiduity and success, that she left her sanctuary, and put herself and her daughters into his hands. The ambition and cruelty of this man indeed are said to have extinguished every sentiment of natural affection as well as humanity. He had married Anne, the second daughter of the earl of Warwick, and widow of Edward prince of Wales, whom he himself had murdered; but having born him but one son, who died about this time, he considered her as an invincible obstacle to the accomplishment of his desires; for which reason it was thought he put an end to her life by poison: and as he knew that the projected match between the earl of Richmond and the princess Elizabeth could only make the rivalship of the former any way formidable, he resolved to obtain a dispensation

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(c) These circumstances are said to have been confessed in the succeeding reign, though the perpetrators escaped punishment. The bodies of the two princes were sought for without any success under the reign of Henry VII.: but in the time of Charles II. the bones of two persons answering to their age were found in the spot where they were said to have been buried; which, being supposed to be the remains of these two unfortunate youths, they were buried under a marble monument in Westminster abbey.

236 Richmond lands in England a second time.

tion from the pope for marrying her himself. The queen-dowager is even said to have come into this scheme, with a view to recover her power; but the princess herself always rejected his addresses with abhorrence. The refusal of the princess occasioned no small perplexity in Richard; and before he could determine on any proper method of accomplishing his purpose, he received news of Richmond's preparations for landing in England. These being soon accomplished, Henry set sail from Harfleur in Normandy, and landed without opposition, on the 17th of August 1485, at Milford haven in Wales. Richard, in the mean time, not knowing where the invasion was to take place, had posted himself at Nottingham; which being almost in the centre of the kingdom, was therefore proper for resisting any invader. Sir Rice ap Thomas and Sir Walter Herbert were commissioned by Richard to oppose his rival in Wales; but the former immediately deserted to him, and the latter made but a very feeble resistance. Richard instantly resolved to meet his antagonist, and to risk every thing on the event of a battle. Richmond, though he had not above 6000 men, and the king near double that number, did not decline the combat; being chiefly encouraged by the promises of Lord Stanley to join him with a body of 7000 men, and with whom he hovered at a little distance from the intended field of battle, seemingly indetermined to join either side.

237 Richard defeated and killed.

The king having commanded his army to form themselves in order of battle, intrusted the van to the duke of Norfolk, while he himself, with the crown on his head, took the command of the main body. Lord Stanley in the mean time posted himself on one flank between the two armies, while his brother Sir William took his station directly opposite. As his intention of either joining the enemy or keeping neutral during the time of the engagement was now far from being doubtful, Richard sent him orders to join the main body; which not being complied with, the tyrant determined to put to death Stanley's son, who had been left with him as a pledge of his father's fidelity. He was persuaded, however, to defer the execution till after the engagement, that Stanley might thereby be induced to delay his purpose in joining the enemy. This, however, did not answer the expectation. Soon after the engagement was begun, Stanley deserted Richard's party, and joining Richmond, entirely decided the fortune of the day. The tyrant perceiving his situation to be quite desperate, and seeing his rival at no great distance from him, drove up against him with fury, in hopes that either Henry's death or his own would decide the victory between them. He killed Sir William Brandon the earl's standard-bearer; he dismounted Sir John Cheyney; and was within reach of Richmond, when Sir William Stanley breaking in with his troops, Richard was surrounded and overwhelmed by numbers. His body was found in the field, covered with dead enemies, and besmeared with blood. It was thrown carelessly across a horse, carried to Leicester, amidst the shouts of insulting spectators, and interred in the Gray-Friars church at that place.

238 Henry VII.

The usurper's crown being found on the field of battle, was placed on the head of the conqueror, while the whole army cried out, "Long live King Henry!" Two days after the battle, Henry gave orders to confine Edward Plantagenet earl of Warwick, and son of the unfortunate duke of Clarence; and to release the princess Elizabeth, who had been confined in the Tower. He then advanced by slow and gradual marches to the city of London, where he was received with the greatest demonstrations of joy. He was crowned king of England on the 30th of October 1485; and to heighten the splendour on that occasion, he bestowed the rank of knights-banneret on 12 persons, and conferred peerages on three. Jasper earl of Pembroke, his uncle, he created duke of Bedford; Thomas Lord Stanley his father-in-law, earl of Derby; and Edward Courteney, earl of Devonshire. At the coronation likewise appeared a new institution, which the king had established for personal security as well as pomp; a band of 50 archers, who were denominated Yeomen of the Guard. But lest the people should take umbrage at this step, as if it implied a diffidence of his subjects, he declared the institution to be perpetual. The ceremony of the coronation was performed by Cardinal Bourchier, archbishop of Canterbury.—On the 18th of January 1486, he was married to the princess Elizabeth; and his marriage was celebrated at London with greater appearance of joy than either his first entry or his coronation had been. Henry remarked, with much displeasure, this general favour borne to the house of York; and the suspicions arising from it, not only disturbed his tranquillity during the whole of his reign, but bred disgust towards his consort herself, and poisoned all his domestic enjoyments.

239 His reign disturbed by frequent rebellions.

240 Lovel and Stafford's insurrection suppressed.

The reign of Henry VII. was for several years disturbed by plots and insurrections. The people, by a long course of civil war, had become so turbulent and factious, that no governor could rule, nor could any king please them. The violent animosity expressed by this monarch, however, against the house of York, may justly be considered as one of the causes of the extreme proneness to rebellion manifested by his subjects. Instead of endeavouring to conciliate the affection of the opposite party, he always strove to quell them by absolute force and violence. For this purpose he took a journey, soon after his accession, to the north of England, where the Yorkists were very numerous: hoping to get the better of them by his presence. In his journey thither, he received intelligence of an insurrection against him by Viscount Lovel, with Sir Henry Stafford and Thomas his brother, who had raised an army, and were marching to besiege the city of Worcester, while Lovel approached to assist them with a body of three or four thousand men. They were dispersed, however, by the offer of a general pardon; which induced Lovel to withdraw from his troops, who were thereupon obliged to submit to the king's mercy. The Staffords took sanctuary in the church of Colnham near Abingdon; but as it was found that this church had not the privilege of protecting rebels, they were taken from thence: the elder was executed at Tyburn; but the younger, pleading that he had been misled by his brother, received a pardon.

241 Prince Arthur born.

This success was soon after followed by the birth of a prince; whom Henry named in honour of the celebrated King Arthur, who is said to have been the direct ancestor of the house of Tudor. All this success, however, as well as the general satisfaction which the birth of a prince descended from the houses both of

242 Discontents of the people.

York and Lancaster necessarily occasioned, were not sufficient to reconcile the hearts of the English to their sovereign. His extreme severity towards the house of York still continued; and unfortunately this was much more beloved by the generality of the nation than that of Lancaster. Many of the Yorkists had been treated with great cruelty, and deprived of their fortunes under pretence of treason; a general resumption had likewise been made of the grants made by the princes of the house of York. It was likewise universally believed that the queen herself met with harsh treatment, on account of her being one of that unfortunate house; and from all these circumstances it was not unreasonably imagined that his enmity was inveterate and invincible. Hence, notwithstanding his politic and vigorous administration, people made no scruple of openly expressing their disapprobation of his conduct and government; and one rebellion seemed to be extinguished only to give birth to another.

243 Imposture of Lambert Simnel.

The king had, at the commencement of his reign, confined the duke of Clarence's son, as has already been mentioned. This unfortunate youth, who had obtained the title of the earl of Warwick, was, through long confinement, entirely unacquainted with the affairs of the world. Simple as he was, however, he was now made use of to disturb the public tranquillity. The queen-dowager was with great reason suspected to be at the bottom of this conspiracy; but not choosing to interfere openly in the matter herself, she employed one Simon a priest of Oxford to execute her purposes. This man cast his eyes upon one Lambert Simnel, a baker's son in the same place, a youth of only 15 years of age; but who, from his graceful appearance and accomplishments, seemed proper for personating a man of quality. A report had been spread among the people, that Richard duke of York, second son of Edward IV. had secretly made his escape from the cruelty of his uncle, and lay somewhere concealed in England. Simon had at first instructed his pupil to assume that name, which he found to be much the object of public affection; but hearing afterwards a new report, that Warwick had escaped from the Tower, and observing that this news was attended with no less general satisfaction, he changed the plan of his imposture, and made Simnel personate that unfortunate prince. The pliant youth was therefore directed by his instructor to talk upon many occurrences, as happening to him in the court of Edward. But as the impostor was not calculated to bear close examination, he was removed to Ireland: and so well had he profited by the lessons given him, that he no sooner presented himself to the earl of Kildare the deputy, claiming his protection as the unfortunate earl of Warwick, than he began to consult with several other noblemen with regard to him. These expressed even a stronger belief in Simnel's story than the deputy himself had done; and in proportion as the story was spread abroad, the more credit it obtained. The impostor was lodged in the castle of Dublin; the inhabitants universally took an oath of allegiance to him, as the true descendant of the Plantagenets; he was crowned with a diadem taken from the statue of the blessed virgin, and proclaimed king by the title of Edward VI.; and the whole kingdom followed the example of the capital.

Such an unexpected event alarmed Henry so much, that he would have gone over to Ireland on purpose to quell the rebellion in person, had he not been afraid of the machinations of the queen-dowager in his absence.

244 The queen dowager confined.

To prevent any thing of this kind, it was resolved to confine her for life in a monastery; under pretence, however, that it was done on account of her having formerly delivered up the princess her daughter to King Richard. The queen murmured against the severity of her treatment; but the king persisted in his resolution, and she remained in confinement till the time of her death, which happened some years after.

The next measure was to show Warwick to the people. He was taken from the Tower, and led through the principal streets of London; after which he was conducted in solemn procession to St Paul's, where great numbers were assembled to see him. Still, however, they proceeded in Dublin to honour their pretended monarch; and he was crowned with great solemnity in the presence of the earl of Kildare, the chancellor, and the other officers of state. At last being furnished by the duchess of Burgundy with a body of 2000 veteran Germans under the command of Martin Swart, a brave and experienced officer, he resolved to invade England. He landed in Lancashire, from whence he marched to York, expecting that the country people would rise and join him on his march. But in this he was deceived: the people were unwilling to join a body of foreigners; and were besides kept in awe by the great reputation of Henry. Lord Lincoln, therefore, who commanded the rebel army, determined to bring the matter to a speedy issue. Accordingly he met the royal army at Stoke in the county of Nottingham. An obstinate engagement ensued, but at length King Henry obtained a complete victory. Lord Lincoln, with 4000 private men, perished in the battle; and Simnel with his tutor Simon were taken prisoners. Simon being a priest, could not be tried by the civil power, and was only committed to close confinement. Simnel was pardoned, and made a scullion in the king's kitchen, whence he was afterwards advanced to the rank of falconer, in which employment he died.

245 Henry punishes his enemies.

Henry being now freed from all danger from that quarter, determined to take ample vengeance on his enemies. For this purpose he took a journey into the north; but though he found many delinquents, his natural avarice prompted him to exact heavy fines from them rather than to put them to death. His proceedings, however, were extremely arbitrary; the criminals being tried, not by the ordinary judges, but either by commissioners appointed for the occasion, or suffering punishment by sentence of a court-martial.

246 Pretends a desire of achieving martial exploits.

Having thus fully established his authority as far as it could be done by suppressing and punishing domestic enemies, he next determined to recommend himself to his subjects by a report of his military disposition; hoping, that by undertaking, or pretending to undertake, some martial enterprises, he would thus gain the favour of a people naturally turbulent, and unaccustomed to live long at peace with their neighbours. He certainly had not, however, the least intention of prosecuting foreign conquests; though to please the people, he frequently gave out that he designed to invade France, and lay waste the whole country, rather than not recover his continental possessions. Under these pretences, particularly that of assisting the Bretons, whom the

247 Obtains a subsidy on pretence of assisting the inhabitants of Bretagne.

248 An insurrection suppressed.

king of France had lately subdued, and who had applied to him for relief, he persuaded his parliament to grant him a considerable supply; but this involved him in some difficulties. The counties of Durham and York, who had always been discontented with Henry's government, and still farther provoked by the oppressions under which they had laboured after the extinction of Simnel's rebellion, opposed the commissioners sent by the king to levy the tax. The latter applied to the earl of Northumberland, requesting his advice and assistance in the execution of their office; but instead of being able to enforce the levying of the tax, he himself was attacked and put to death by the insurgents. This act of violence committed by themselves, seemed to render the insurgents desperate, so that without more ado they prepared to resist the royal power, under the conduct of one Sir John Egremond; but in this ill-conducted and precipitate scheme they met with no success. Henry instantly levied a considerable force, which he committed to the charge of the earl of Surrey; by whom the rebels were quickly defeated, and one of their leaders taken prisoner. Sir John Egremond fled to the duchess of Burgundy, who afforded him protection.

249 Henry makes a feigned invasion of France.

250 Obtains a sum of money and annual pension.

Thus Henry obtained the subsidy which he had solicited under pretence of invading France, though he would willingly have avoided any expence in preparations for that purpose in order to keep the money in his possession; but as the Bretons had applied to him for assistance, and their distresses became every day more urgent, he found himself obliged to attempt something. With this view he set sail for Calais with an army of 25,000 foot and 1600 horse, of which he gave the command to the duke of Bedford and the earl of Oxford: but notwithstanding this apparently hostile disposition, negotiations for peace had been secretly begun, and commissioners even appointed to consider of the terms, three months before King Henry set out for the continent. As the love of money was the prevailing passion of the English monarch, and the possession of Bretagne was a great object to France, an accommodation soon took place betwixt the contending parties. The king of France engaged to pay Henry near 200,000l. as a reimbursement for the expences of his expedition, and stipulated at the same time to pay him and his heirs an annual pension of 25,000 crowns more.

251 Imposture of Perkin Warbeck.

Thus the authority of Henry seemed to be so firmly established, as to leave no reason to dread any rival in time to come; but still he found himself mistaken. The duchess of Burgundy, resenting the depression of her family, and exasperated by her frequent miscarriages in the attempts already made, resolved to make a final effort against Henry, whom she greatly hated. For this purpose she propagated a report that her nephew Richard Plantagenet, duke of York, had escaped from the Tower where his elder brother was murdered, and that he still lay somewhere concealed. Finding this report eagerly received, she soon found a young man who assumed both his name and character. The person chosen to act this part was the son of one Osbeck, or Warbeck, a converted Jew, who had been in England during the reign of Edward IV. His name was *Peter*; but it had been corrupted after the Flemish manner into *Peterkin*, or *Perkin*. It was by some believed, that Edward, among his other amorous adventures, had a secret correspondence with Warbeck's wife, which might account for the great similarity of features between Perkin and that monarch. The duchess of Burgundy found this youth entirely suited to her purposes. The lessons she gave him were easily learned and strongly retained. His graceful air, his courtly address, his easy manners, and elegant conversation, were capable of imposing upon all but those who were privy to the imposture. The kingdom of Ireland was pitched upon for Perkin's first appearance, as it had been before for that of Simnel. He landed at Cork; and immediately assuming the name of *Richard Plantagenet*, was followed by great numbers of credulous people. He wrote letters to the earls of Desmond and Kildare, inviting them to join his party; he dispersed everywhere the strange intelligence of his escape from his uncle Richard's cruelty; and his story meeting with general credit, he soon became an object of the public favour. All those who were disgusted with the king, prepared to join Perkin; but particularly those who formerly were Henry's favourites, and had contributed to place him on the throne. These, thinking their services had not been sufficiently repaid, now became heads of the conspiracy. Their attempts, however, were all frustrated by the vigilance of the king, and most of the conspirators of any note were publicly executed.

Perkin finding it was in vain to attempt any thing in England, went to the court of James IV. of Scotland. Here he was received with great cordiality; and James carried his confidence in him so far, that he even gave him in marriage Lady Catherine Gordon, daughter to the earl of Huntley, and a near kinswoman of his own. But when he attempted to set him on the throne of England, he found himself totally disappointed; and on the conclusion of peace between the two kingdoms, Perkin was obliged to leave Scotland. From thence he went to Flanders; and meeting with but a cool reception there, he resolved to try the affections of the people of Cornwall, who had lately risen against the king on account of a new tax which had been levied upon them. On his first appearance, Perkin was joined by about 3000 of these people, with which force he laid siege to Exeter. Henry, however, having marched against him with a considerable army, Perkin's heart failed him, though his followers now amounted to 7000; and he took shelter in a monastery. His wife fell into the conqueror's hands; who placed her in a respectable situation near the queen's person, with a suitable pension, which she enjoyed till her death. Perkin being persuaded to deliver himself into the king's hands, was compelled to sign a confession of his former life and conduct; but this was so defective and contradictory, that very little regard was paid to it. His life was granted him; though he was still detained in custody, and keepers were appointed to watch his conduct. From these, however, he broke loose; and flying to the sanctuary of Shyne, put himself into the prior's hands. He was once more prevailed upon to trust himself in the king's hands, and was committed to the Tower; but having here entered into a correspondence with the earl of Warwick in order to make their escape, both of them were condemned and executed.

To Henry VII. in a great measure, is owing the

[251] English nation civilized by Henry. present civilized state of the English nation. He had all along two points principally in view; the one to depress the nobility and clergy, and the other to exalt and humanize the populace. In the feudal times every nobleman was possessed of a certain number of vassals over whom he had, by various methods, acquired an almost absolute power; and, therefore, upon every slight disgust, he was able to influence them to join him in his revolt or disobedience. Henry considered, that the giving of his barons a power to sell their estates, which were before unalienable, must greatly weaken their interest. This liberty therefore he gave them; and it proved highly pleasing to the commons, nor was it disagreeable to the nobles themselves. His next scheme was to prevent their giving liveries to many hundreds of their dependents, who were thus kept like the soldiers of a standing army to be ready at the command of their lord. By an act passed in this reign, none but menial servants were allowed to wear a livery; and this law was enforced under severe penalties.

With the clergy, Henry was not so successful. The number of criminals of all kinds who found protection in monasteries and other places appointed for religious worship, seemed to indicate little less than an absolute toleration of all kinds of vice. Henry used all his interest with the pope to get these sanctuaries abolished, but to no purpose. All that he could procure was, that if thieves, murderers, or robbers, registered as sanctuary men, should sally out and commit fresh offences, and retreat again, in such cases they might be taken out of the sanctuary and delivered up to justice.

In 1500, the king's eldest son Arthur was married to the Infanta Catherine of Spain, which marriage had been projected and negotiated seven years. But the prince dying in a few months after marriage, the princess was obliged to marry his younger brother Henry, who was created prince of Wales in his room. Henry himself made all the opposition which a youth of 12 years of age is capable of: but as the king persisted in his resolution, the marriage was by the pope's dispensation shortly after solemnized.—In the latter part of this king's reign, his economy, which had always been exact, degenerated into avarice, and he oppressed the people in a very arbitrary manner. He had two ministers, Empson and Dudley, perfectly qualified to second his avaricious intentions. They were both lawyers, and usually committed to prison by indictment such persons as they intended to oppress; from whence they seldom got free but by paying heavy fines, which were called mitigations and compositions: but by degrees the very forms of law were omitted; and they determined in a summary way upon the properties of the subjects, and confiscated their effects to the royal treasury.—252 Death of Henry VII. Henry VII. died of the gout in his stomach, in the year 1509, having lived 52 years, and reigned 23; and was succeeded by his son Henry VIII. In Henry VII.'s reign was built a large ship of war called the *Great Harry*, which cost 14,000l. This, was, propesly speaking, the first ship in the English navy. Before this period, when the king wanted a fleet, he had no other expedient than to hire ships from the merchants.

253 Henry VIII. Henry VIII. ascended the throne when he was about 18 years of age, and had almost every advantage which a prince can have on his accession. He had a well-stored treasury and indisputed title, and was at peace with all the powers in Europe. Commerce and arts had been some time introduced into England, where they met with a favourable reception. The young prince himself was beautiful in his person, expert in all polite exercises, open and liberal in his air, and loved by all his subjects. The old king, who was himself a scholar, had instructed him in all the learning of the times, so that he was an adept in school-divinity before the age of 18.

All these advantages, however, seemed to have been lost upon the new king. Being destitute of a good heart and solid understanding, he proved a tyrant. Being always actuated, not by reason, but the passion which happened to be uppermost in his mind, he behaved in the most absurd and contradictory manner; and however fortunate some of his measures proved at last, it is impossible that either his motives, or the means he took for the accomplishment of his purposes, can be approved of by any good man.

One of Henry's first actions in his royal capacity was to punish Empson and Dudley, who were obnoxious to the populace on account of their having been the instruments of the late king's rapacity. As they could not be impeached merely on account of their having strictly executed the will of the king, they were accused of having entered into a treasonable conspiracy, and of having designed to seize by force the administration of government; and though nothing could be more improbable than such a charge, the general prejudice against them was so great, that they were both condemned and executed.

In 1510, the king entered into a league with Pope Julius II. and Ferdinand king of Spain, against Louis XII. of France. In this alliance Henry was the only disinterested person. He expected nothing besides the glory which he hoped would attend his arms, and the title of *Most Christian King*, which the pope assured him would soon be taken from the king of France to be conferred upon him. The pope was desirous of wresting from Louis some valuable provinces which he possessed in Italy, and Ferdinand was desirous of sharing in the spoil. Henry summoned his parliament, who very readily granted him supplies, as he gave out that his design was to conquer the kingdom of France, and annex it to the crown of England. It was in vain that one of his old prudent counsellors objected, that conquests on the continent would only drain the kingdom without enriching it; and that England, from its situation, was not fitted to enjoy extensive empire. The young king, deaf to all remonstrances, and hurried away by his military ardour, resolved immediately to begin the war. But after several attempts, which were rendered unsuccessful only by the mismanagement of those who conducted them, a peace was concluded with France on the 7th of August 1514.

Henry's arms were attended with more success in Scotland; where King James IV. with the greatest part of the Scots nobility, and 10,000 of the common people, were cut off in the battle of Flowden †. Henry in the mean time, puffed up with his imaginary successes against France, and his real ones against Scotland,

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† See *Scotland*.

land, continued to lavish his treasures by expensive pleasures, and no less expensive preparations for war. The old ministers who had been appointed by his father to direct him, were now disregarded; and the king's confidence was entirely placed in Thomas afterwards Cardinal Wolsey, who seconded him in all his favourite pursuits, and who, being the son of a private gentleman at Ipswich, had gradually raised himself to the first employments of the state*. He doth not seem to have had many bad qualities besides his excessive pride, which disgusted all the nobility; but the great share he possessed in the favour of such an absolute prince as Henry VIII. put him quite out of the reach of his enemies.

254
Cardinal Wolsey minister.

255
Arbitrary behaviour of the king.

The king having soon exhausted all the treasures left him by his father, as well as the supplies which he could by fair means obtain from his parliament, applied to Wolsey for new methods of replenishing his coffers. The minister's first scheme was to get a large sum from the people under the title of *benevolence;* though no title could be more improperly applied, as it was not granted without the greatest murmurings and complaints. Wolsey even met with opposition in the levying of it. In the first place, having exacted a considerable sum from the clergy, he next applied himself to the house of commons; but they only granted him half the sum he demanded. The minister at first was highly offended, and desired to be heard in the house; but they replied, that none could be permitted to sit and argue there except such as were members. Soon after, the king having occasion for new supplies, by Wolsey's advice attempted to procure them by his prerogative alone, without consulting his parliament. He issued out commissions to all the counties of England for levying four shillings in the pound from the clergy, and three shillings and fourpence from the laity. This stretch of royal power was soon opposed by the people, and a general insurrection seemed ready to ensue. Henry endeavoured to pacify them by circular letters; in which he declared, that what he demanded was only by way of benevolence. The city of London, however, still hesitated on the demand; and in some parts of the country insurrections were actually begun. These were happily suppressed by the duke of Suffolk; but the cardinal lost somewhat of the king's favour on account of the improper advice he had given him. To reinstate himself in his good graces, Wolsey made the king a present of a noble palace called *York-place*, at Westminster, assuring him that from the first he had intended it for the king's use. In order to have a pretence for amassing more wealth, Wolsey next undertook to found two new colleges at Oxford; and for this purpose he received every day fresh grants from the pope and the king. The former imprudently gave him liberty to suppress some monasteries, and make use of their revenues for the erection of his new colleges; but this was a fatal precedent for the pontiff's interests, and it taught the king to seize on the monastic revenues whenever he stood in need of money.

256
Cause of Wolsey's disgrace.

257
Scruples concerning the legality of Henry's marriage.

For a considerable time Wolsey continued to enjoy the king's favour in an extreme degree; and as no monarch was ever more despotic than Henry VIII. no minister was ever more powerful than Wolsey. This extraordinary elevation served only to render his fall the more conspicuous, and himself the more miserable, when it took place: and what was worse, he had long foreseen, from what he knew of the king's capricious and obstinate temper, that it certainly would happen one time or other. The cause of this final overthrow was the desire King Henry began to entertain of having his queen Catharine divorced. The doctrines of the reformation, propagated by Luther in 1517, had gained considerable ground in England, and many professsed a belief in them, notwithstanding the severe persecution which had been carried on against heretics during some of the preceding reigns. The clergy had become so exceedingly corrupt, and were immersed in such monstrous ignorance, that they were universally hated even by their own party; while no regard at all was paid to their decisions, or rather they were looked upon with the utmost abhorrence, by the reformers. Even the papal authority, though still very great, had, in no greater a space of time than ten years (viz. from 1517, when Luther first began to attack it, to the present year 1527), declined very sensibly. The marriage of King Henry, therefore, being looked upon by all parties as in itself illegal, and only sanctified by a dispensation from the pope, had been frequently objected to on different occasions. We are informed by some authors, that when Henry VII. betrothed his son, at that time only 12 years of age, he evidently showed an intention of taking afterwards a proper opportunity to annul the contract; and that he ordered Prince Henry, as soon as he should come of age, to enter a protestation against the marriage; charging him on his death-bed not to finish an alliance so unusual, and liable to such insuperable objections. Some members of the privy-council, particularly Warham the primate, afterwards declared against the completion of the marriage; and even after it was completed, some incidents which in a short time took place were sufficient to make him sensible of the general sentiments of the public on that subject. The states of Castile had opposed a marriage betwixt the emperor Charles and the English princess Mary, Henry's daughter, urging among other things the illegitimacy of her birth. The same objection afterwards occurred on opening a negotiation with France for a marriage with the duke of Orleans.

258
Other reasons for Henry's desire of a divorce.

259
His love for Anne Boleyn.

If these accounts are to be depended upon as authentic, we can scarce perceive it possible but Henry himself must have been somewhat staggered by them; though it is by no means probable that they were his only motives. The queen was six years older than the king, her personal charms were decayed, and his affection lessened in proportion. All her children had died in infancy except one daughter, the princess Mary above mentioned; and Henry was, or pretended to be, greatly struck with this, as it seemed something like the curse of being childless, pronounced in the Mosaic law against some evil doers. Another point of the utmost importance was the succession to the crown, which any question concerning the legitimacy of the king's marriage would involve in confusion. It was also supposed, with great reason, that should any obstacles of this kind occur, the king of Scotland would step in as the next heir, and advance his pretensions to the crown of England. But, above all, it is probable that he was influenced by the love he had now contracted for Anne Boleyn, who had lately

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* See *Wolsey*.

260 Sends to Rome to obtain a divorce.

261 Extreme perplexity of the pope.

been appointed maid of honour to the queen. In this station Henry had frequent opportunities of seeing her, and soon became deeply enamoured; and finding that his passion could not be gratified but by marriage, it is not to be doubted that he was thus obstinately set upon the divorce; for which purpose he sent his secretary to Rome to obtain from Clement a bull for dissolving his marriage with Catharine. That he might not seem to entertain a doubt of the pope's prerogative, he insisted only on some grounds of nullity in the bull granted by his predecessor Julius for the accomplishment of the marriage. In the preamble to this bull, it had been said, that it was granted only upon the solicitation of Henry himself; though it was known that he was then a youth under 12 years of age: it was likewise asserted, that the bull was necessary for maintaining the peace between the two crowns; though otherwise it is certain that there was no appearance of a quarrel betwixt them. These false premises seemed to afford a very good pretence for dissolving it; but, as matters then stood, the pope was involved in the utmost perplexity. Queen Catharine was aunt to the emperor, who had lately made Clement himself a prisoner, and whose resentment he still dreaded: and besides, he could not with any degree of prudence declare the bull of the former pope illicit, as this would give a mortal blow to the doctrine of papal infallibility. On the other hand, Henry was his protector and friend; the dominions of England were the chief resource from whence his finances were supplied; and the king of France, some time before, had got a bull of divorce in circumstances nearly similar. In this exigence he thought the wisest method would be to spin out the affair by negotiation; and in the mean time he sent over a commission to Wolsey, in conjunction with the archbishop of Canterbury, or any other English prelate, to examine the validity of the king's marriage and of the former dispensation; granting them also a provisional dispensation for the king's marriage with any other person.

262 Henry's controversy with him.

The pope's message was laid before the council in England: but they considered, that an advice given by the pope in this secret manner might very easily be disavowed in public; and that a clandestine marriage would totally invalidate the legitimacy of any issue the king might have by such a match. In consequence of this, fresh messengers were dispatched to Rome, and evasive answers returned; the pope never imagining that Henry's passion would hold out during the tedious course of an ecclesiastical controversy. But in this he was mistaken. The king of England had been taught to dispute as well as the pope, and valued himself not a little on his knowlege in theology: and to his arguments he added threats; telling him, that the English were but too well disposed to withdraw from the holy see; and that if he continued uncomplying, the whole country would readily follow the example of their monarch, who should always deny obedience to a pontiff that had treated him with such falsehood and duplicity. The king even proposed to his holiness whether, if he were not permitted to divorce his present queen, he might not have a dispensation for having two wives at once?

263 Trial of the king and queen before the pope's legate.

The pope, perceiving the king's eagerness, at last sent Cardinal Campegio his legate to London; who with Wolsey, opened a court for trying the legitimacy of the king's marriage with Catharine, and cited the king and queen to appear before them. The trial commenced the 31st of May 1529; and both parties presented themselves. The king answered to his name when called: but the queen, instead of answering to hers, rose from her seat, and, throwing herself at the king's feet, made a very pathetic harangue; which her dignity, her virtue, and misfortunes, rendered still more affecting. She told her husband, "That she was a stranger in his dominions, without protection, without counsel, and without assistance; exposed to all the injustice which her enemies were pleased to impose upon her: That she had quitted her native country, without any other resource than her connections with him and his family; and that, instead of suffering thence any violence or iniquity, she had been assured of having in them a safeguard against every misfortune: That she had been his wife during 20 years; and would here appeal to himself, whether her affectionate submission to his will had not merited other treatment than to be thus, after so long a time, thrown from him with indignity: That she was conscious,—he himself was assured,—that her virgin honour was yet unstained when he received her into his bed; and that her connections with his brother had been carried no farther than the mere ceremony of marriage: That their parents, the kings of England and Spain, were esteemed the wisest princes of their time, and had undoubtedly acted by the best advice when they formed the agreement for that marriage, which was now represented as so criminal and unnatural: And that she acquiesced in their judgment, and would not submit her cause to be tried by a court whose dependance on her enemies was too visible ever to allow her any hopes of obtaining from them an equitable or impartial decision." Having spoken these words, the queen rose; and, making the king a low reverence, left the court; nor would she ever again appear in it. The legate having again summoned the queen to appear before them, on her refusal, declared her contumacious, and the trial proceeded in her absence. But when the business seemed to be nearly decided, Campegio, on some very frivolous pretences, prorogued the court, and at last transferred the cause before the see of Rome.

264 Embarrassment of Cardinal Wolsey.

All this time Cardinal Wolsey seemed to be in the same dilemma with the pope, and indeed much worse; as he could not boast of the same independence which his holiness possessed. On the one hand, he was very solicitous to gratify the king his master, who had distinguished him by so many and extraordinary marks of favour; on the other, he feared to offend the pope, whose servant he more immediately was, and who likewise had power to punish his disobedience. He had long known that this affair was certainly to end in his ruin; and by attempting to please all parties, he fell under the displeasure of every one; so that he was at last left without a single friend in the world. The king was displeased on account of his not entering into his cause with the warmth he thought he had reason to expect; Anne Boleyn imputed to him the disappointment of her hopes; while even Queen Catharine and her friends expressed the greatest indignation against him on account of the part he had openly taken in the affair of her divorce. In this miserable situation the king

265 Is disgraced and persecuted.

king sent him a message by the dukes of Norfolk and Suffolk, demanding the great seal; the cardinal refused to deliver it without a more express warrant; upon which Henry wrote him a letter, and on receipt of this it was instantly given up. The seal was bestowed on Sir Thomas More; a man who, besides elegant literary talents, was possessed of the highest capacity, integrity, and virtue. Wolsey was next commanded to depart from York-place palace which he had built in London; and which, though it belonged to the see of York, was now seized by the king, and afterwards became the residence of the British sovereigns, under the name of *Whitehall*. All his furniture and plate, the richness of which seemed rather proper for a monarch than a subject, was seized for the king's use. He was then commanded to retire to Esher, a country-seat which he possessed near Hampton-court, and there to wait the king's pleasure. One disgrace followed another; and his fall was at length completed by a summons to London to answer a charge of high treason. This summons he at first refused to answer, as being a cardinal. However, being at length persuaded, he set out on his journey; but was taken ill, and died by the way. See the article Wolsey.

266 All the universities of Europe consulted about the legality of the king's marriage.

267 Henry's final quarrel with the pope.

After the death of Wolsey, the king, by the advice of Cranmer †, had the legality of his marriage debated in all the universities of Europe; and the votes of these were obtained in his favour by dint of money. The debursements made on the occasion have even been preserved to this day. To a subdeacon he gave a crown, to a deacon two crowns, and so to the rest in proportion to the importance of their station or opinion.—Being thus fortified by the opinions of the universities, and even of the Jewish rabbies (for them also he had consulted), Henry began to think he might safely oppose the pope himself. He began by reviving in parliament an old law against the clergy, by which all those who had submitted to the authority of the pope's legate were condemned to severe penalties. The clergy, to conciliate the king's favour, were obliged to pay a fine of 118,000 pounds. A confession was likewise extorted from them, that the king, and not the pope, was the supreme head of the church and clergy of England. An act was soon after passed against levying the first-fruits, or a year's rent of all the bishoprics that fell vacant. After this the king privately married his beloved Anne Boleyn; and she proving with child soon after marriage, he publicly owned her for his wife, and passed with her through London, with a greater magnificence than had ever been known before. The streets were strewed with flowers, the walls of the houses hung with tapestry, and a universal joy seemed to be diffused among the people. The unfortunate Queen Catharine, perceiving all further opposition to be vain, retired to Ampthill near Dunstable, where she continued the rest of her days in privacy and peace. Her marriage with Henry was at last declared invalid, but not till after the latter had been married to Anne Boleyn, though this declaration ought undoubtedly to have preceded it. See Boleyn.

The pope was no sooner informed of these proceedings, than he passed a sentence, declaring Catharine to be the king's only lawful wife; requiring him to take her again, and denouncing his censures against him in case of a refusal. Henry, on the other hand, knowing that his subjects were entirely at his command, resolved to separate totally from the church of Rome. In the year 1534, he was declared head of the church by parliament; the authority of the pope was completely abolished in England; all tributes formerly paid to the holy see were declared illegal; and the king was entrusted with the collation to all ecclesiastical benefices. The nation came into the king's measures with joy, and took an oath called the *oath of supremacy*; all the credit which the popes had maintained over England for ages was now overthrown at once; and none seemed to repine at the change, except those who were immediately interested by their dependence on Rome.

268 Is declared head of the church.

269 Suppression of the monasteries.

But though the king thus separated from the church of Rome, he by no means adhered to the doctrines of Luther which had been lately published. He had written a book against this celebrated reformer, which the pope pretended greatly to admire; and honoured King Henry, on its account, with the title of "Defender of the faith." This character he seemed to be determined to maintain, and therefore persecuted the reformers most violently. Many were burnt for denying the popish doctrines, and some also were executed for maintaining the supremacy of the pope. The courtiers knew not which side to take, as both the new and old religions were equally persecuted; and as both parties equally courted the favour of the king, he was by that means enabled to assume an absolute authority over the nation. As the monks had all along shown the greatest resistance to Henry's ecclesiastical character, he resolved at once to deprive them of the power of injuring him. He accordingly empowered Cromwell, secretary of state, to send commissioners into the several counties of England to inspect the monasteries; and to report, with rigorous exactness, the conduct and deportment of such as were found there. This employment was readily undertaken by some creatures of the court, whose names were Layton, London, Price, Gage, Petre, and Belasis. They are said to have discovered monstrous disorders in many of the religious houses; whole convents of women abandoned to all manner of lewdness; friars accomplices in their crimes; pious frauds everywhere committed, to increase the devotion and liberality of the people; and cruel and inveterate factions maintained between the inhabitants. Thus a general horror was excited against these communities; and therefore the king, in 1536, suppressed the lesser monasteries, amounting to 376 in number. Their revenues, computed at 32,000 pounds a-year, were confiscated to the king's use; besides their plate and other goods, computed at 100,000 pounds more. In 1538, the greater monasteries also were demolished. The better to reconcile the people to this great innovation, stories were published, perhaps with aggravations, of the detestable lives which the friars led in their convents. The relicks also, and other objects of superstitious veneration, were now brought forth, and became objects of derision to the reformers. A great number of these are enumerated by Protestant writers; such as the parings of St Edmund's toes; some of the coals that roasted St Laurence; the girdle of the virgin Mary, shown in no fewer than eleven different places; two or three heads of St Ursula; the felt of St Thomas of Lancaster, an infallible cure for the headach; part of St Thomas of Canterbury's shirt, much

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† See Cranmer.

much reverenced among big-bellied women; some relicks, an excellent preservative against rain, others against weeds in corn, &c. Some impostures, however, were discovered, which displayed a little more ingenuity in the contrivance. At Hales in the county of Gloucester had been shown, during several ages, the blood of Christ brought from Jerusalem. The veneration for this precious relick may easily be imagined; but it was attended with a most remarkable circumstance not observed in any other relicks. The sacred blood was not visible to any one in mortal sin, even when set before him; nor could it be discovered till he had performed good works sufficient for his absolution. At the dissolution of the monastery, the whole contrivance was discovered. Two of the monks who were let into the secret, had taken the blood of a duck, which they renewed every week: they put it into a phial, one side of which was thin and transparent crystal, the other thick and opaque. When any rich pilgrim arrived, they were sure to show him the dark side, till masses and offerings had expiated his offences; after which they made him happy, by turning the phial.—A miraculous crucifix had been kept at Boxely in Kent, and bore the appellation of the *rood of grace*. The lips, eyes, and head of the image, moved on the approach of its votaries. Helsey bishop of Rochester broke the crucifix at St Paul's cross, and showed to all the people the springs and wheels by which it had been secretly moved. A great wooden idol, called *Darvel Gatherin*, was also brought to London and cut in pieces: and, by a cruel refinement of vengeance, it was employed as fuel to burn Friar Forest; who was punished for denying the king's supremacy, and for some pretended heresies. A finger of St Andrew, covered with a thin plate of silver, had been pawned for a debt of 50 pounds; but as the king's commissioners refused to release the pawn, people made themselves very merry with the poor creditor on account of his security. On this occasion also was demolished the noted shrine of Thomas à Becket, commonly called *St Thomas of Canterbury* *. The riches of it were inconceivable: when broken down, the gold with which it was adorned filled two large chests that eight strong men could scarcely carry out of the church. The king, on the whole, suppressed 645 monasteries, of which 28 had abbots who enjoyed seats in parliament. Ninety colleges were demolished in several counties; 2374 chantries and free chapels, and 110 hospitals. The whole revenue of these establishments amounted to 161,100 pounds.

It is easy to imagine the indignation which such an uninterrupted course of sacrilege and violence would occasion at Rome. In 1535, the king had executed Bishop Fisher, who was created a cardinal while in prison, and Sir Thomas More, for denying or speaking ambiguously about his supremacy. When this was reported in Italy, numerous libels were published all over the country, comparing the king of England to Nero, Domitian, Caligula, and the most wicked tyrants of antiquity. Clement VII. died about six months after he had threatened the king with a sentence of excommunication; and Paul III. who succeeded him in the papal throne, entertained some hopes of an accommodation. But Henry was so much accustomed to domineering, that the quarrel was soon rendered totally incurable. The execution of Fisher was reckoned such a capital injury, that at last the pope passed all his censures against the king, citing him and all his adherents to appear in Rome within 90 days, in order to answer for their crimes. If they failed, he excommunicated them; deprived the king of his realm; subjected the kingdom to an interdict; declared his issue by Anne Boleyn illegitimate; dissolved all leagues which any Catholic princes had made with him; gave his kingdom to any invader; commanded the nobility to take up arms against him; freed his subjects from all oaths of allegiance; cut off their commerce with foreign states; and declared it lawful for any one to seize them, to make slaves of their persons, and to convert their effects to his own use. But though these censures were then passed, they were not openly denounced. The pope delayed the publication till he should find an agreement with England totally desperate, and till the emperor, who was then hard pressed by the Turks and the Protestant princes of Germany, should be in a condition to carry the sentence into execution. But in 1538, when news arrived at Rome that Henry had proceeded with the monasteries as above related, the pope was at last provoked to publish the censures against him. Libels were again dispersed, in which he was anew compared to the most furious persecutors of antiquity, and the preference was now given on their side. Henry, it was said, had declared war with the dead, whom the Pagans themselves respected; was at open enmity with heaven; and had engaged in professed hostility with all the saints and angels. Above all, he was reproached with his resemblance to the emperor Julian, whom (it was said) he imitated in his apostasy and learning, though he fell short of him in his morals. But these terrible fulminations had now lost their effect. Henry had long ago denied the supremacy of the pope, and therefore had appealed from him to a general council; but now, when a general council was summoned at Mantua, he refused to be subject to it, because it was called by the pope, and lay entirely under subjection to that spiritual usurper. He engaged his clergy to make a declaration to the like purpose, and prescribed to them many other alterations with regard to their ancient tenets and practices. It was expected that the spirit of opposition to the church of Rome would have at last made him fall in with the doctrines of the reformed; but though he had been gradually changing the theological system in which he was educated, ever since he came to the years of maturity, he was equally positive and dogmatical in the few articles he retained, as though the whole fabric had continued entire and unshaken: and though he stood alone in his opinion, the flattery of courtiers had so much inflamed his tyrannical arrogance, that he thought himself entitled to regulate by his own particular standard the religious faith of the whole nation. The point on which he chiefly rested his orthodoxy was the most absurd in the whole popish doctrine; namely, that of transubstantiation. All departure from this he held to be a damnable error; and nothing, he thought, could be more honourable for him, than, while he broke off all connections with the Roman pontiff, to maintain, in this essential article, the purity of the Catholic faith.

In 1539, a parliament was called, which met on the 28th day of April. The chancellor opened this parliament

270 The king excommunicated.

271 His absurd and tyrannical conduct.

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* See *Becket*.

272 Law of the six articles framed.

parliament by informing the house of lords, that it was his majesty's earnest desire to extirpate from his kingdom all diversity of opinions with regard to religion; and as this enterprise was, he owned, difficult and important, he desired them to choose a committee from among themselves, who might frame certain articles, and communicate them afterwards to parliament. The lords named the vicar-general Cromwell, now created a peer, the archbishops of Canterbury and York, the bishops of Durham, Carlisle, Worcester, Bath and Wells, Bangor, and Ely. This small committee itself was agitated with such diversity of opinions, that it could come to no conclusion. The duke of Norfolk then moved, that since there was no hope of having a report from the committee, the articles of faith proposed to be established should be reduced to six, and a new committee be appointed to frame an act with regard to them. As this peer was understood to speak the king's mind, his motion was immediately complied with; and, after a short precognition, the bill of the six articles, or the *bloody bill*, as the Protestants justly termed it, was introduced; and having passed the two houses, received the king's assent. By this law the doctrine of the real presence was established; the communion in one kind; the perpetual obligation of vows of chastity; the utility of private masses; the celibacy of the clergy; and the necessity of auricular confession. The denial of the real presence subjected the person to death by fire, and to the same forfeiture as in cases of treason; and admitted not the privilege of abjuring: an unheard-of cruelty, unknown even to the inquisition itself. The denial of any of the other articles, even though recanted, was punishable by the forfeiture of goods and chattels, and imprisonment during the king's pleasure: an obstinate adherence to error, or a relapse, was adjudged to be felony, and punishable by death. The marriage of priests was subjected to the same punishment. Their commerce with women was, for the first offence, forfeiture and imprisonment; and for the second, death. Abstaining from confession, and from receiving the eucharist at the accustomed times, subjected the person to fine, and to imprisonment during the king's pleasure; and if the criminal persevered after conviction, he was punishable by death and forfeiture as in cases of felony. Commissioners were to be appointed by the king for inquiring into these heresies and irregular practices, and the criminals were to be tried by a jury.

The parliament having thus surrendered their ecclesiastical privileges, next proceeded to surrender their civil ones also. They gave to the king's proclamations the same force as to statutes enacted by parliament, and thus by one blow made a total subversion of the English constitution; and to render the matter worse, if possible, they framed this law as if it were only declaratory, and intended to explain the natural extent of the royal authority.—Notwithstanding this, however, they afterwards pretended to make some limitations in the regal power, and they enacted, that no proclamation should deprive any person of his lawful possessions, liberties, inheritances, &c. nor yet infringe any common law or laudable custom of the realm.

As soon as the act of the six articles had passed, the Catholics were extremely vigilant to inform against offenders; and, in a short time, no fewer than 500 persons were thrown into prison. But some of the chief officers of state remonstrating against the cruelty of punishing such a number of delinquents, they were all of them set at liberty; and soon after this, Henry, as if he had resolved to give each party the advantage by turns, granted every one permission to have a translation of the Bible, which had been newly made, in his family.

In 1540, the king again complained to parliament of the great diversity of religious tenets which prevailed among his subjects; a grievance, he affirmed, which ought the less to be endured, because the scriptures were now published in England, and ought universally to be the standard of belief to mankind. But he had appointed, he said, some bishops and divines to draw up a list of tenets; and he was determined that Christ and the truth should have the victory; whence he seems to have expected more from this new book of his doctors, than had ensued from the publication of the scriptures. Cromwell, as vicar-general, also made a speech in the upper house; and the peers in return told him, that he deserved to be vicar-general to the universe: To such a degree of mean and servile submission was the English parliament at this time reduced.

273 Suppression of the knights of Malta,

This year also the king suppressed the only religious order remaining in England; namely, the knights of St John of Jerusalem, or the *knights of Malta*, as they are commonly called. This order had by their valour done great service to Christendom; and had very much retarded, at Jerusalem, Rhodes, and Malta, the rapid progress of the barbarians. During the general surrender of the religious houses in England, they had obstinately refused to give up their revenues to the king; and Henry who would endure no society that professed obedience to the pope, was obliged to have recourse to parliament for the dissolution of this order. Their revenues were large, and formed a considerable addition to the acquisitions which the king had already made. But he had been such a bad economist, that, notwithstanding the immense plunder afforded him by the church, he now demanded from parliament a very considerable supply. The commons, however, though lavish of the blood of their fellow-subjects, were extremely frugal of their money; and it was not without murmuring that the grant could be obtained, even by this absolute and dreaded monarch.

The king all this time continued to punish with unrelenting severity the Protestants who offended against the law of the six articles, and the Papists who denied his supremacy; which gave occasion to a foreigner at that time to say, that those who were against the pope were burned, and those who were for him were hanged. The king even seemed to display in an ostentatious manner his tyrannical justice and impartiality, which reduced both parties to subjection. This year he executed three Protestants and three Papists coupled together. The latter declared, that the most grievous part of their punishment was the being coupled to such heretical miscreants as suffered with them.

274 and of many colleges, hospitals, &c.

In 1542, Henry proceeded to the further dissolution of colleges, hospitals, and other foundations of that nature. The courtiers had been dealing with the presidents and governors to make a surrender of their revenues to the king; and they had succeeded with eight. But there was an obstacle to their farther progress: it had been provided by the local statutes of most of these foundations, that no president nor any fellows could make such a deed without the unanimous consent of all the fellows. This consent would not have been easily obtained; but the parliament proceeded in a summary manner to annul all these statutes: by which means the revenues of those houses were exposed to the rapacity of the king and his favourites. Henry also now extorted from many bishops a surrender of their chapter-lands; by which means he pillaged the sees of Canterbury, York, and London, and enriched his favourites with their spoils. He engaged the parliament to mitigate the penalties of the six articles, as far as regarded the marriage of priests, which was now only subjected to a forfeiture of goods, chattels, and lands during life: he was still equally bent on maintaining a rigid purity in speculative principles. He had appointed a commission consisting of two archbishops and several bishops of both provinces, together with a considerable number of doctors of divinity; and by virtue of his ecclesiastical supremacy he had charged them to choose a religion for his people. Before the commissioners, however, had made any progress in this arduous undertaking, the parliament had passed a law by which they ratified all the tenets which these divines should establish with the king's consent; and thus they were not ashamed of declaring expressly that they took their religion upon trust, and had no other rule either in religious or temporal concerns than the arbitrary will of their master. One clause of the statute, however, seems to savour somewhat of the spirit of liberty. It was enacted, that the ecclesiastical commissioners should establish nothing repugnant to the laws and statutes of the realm. But in reality this proviso was inserted by the king, to serve his own purposes. By introducing a confusion and contradiction into the laws, he became more the master of every one's life and property; and as the ancient independence of the church still gave him jealousy, he was well pleased, under colour of such a clause, to introduce appeals from spiritual to civil courts. For the same reason he would never promulgate a body of canon law; and he encouraged the judges on all occasions to interpose in ecclesiastical causes, wherever they thought the law or the prerogative concerned. Being thus armed by the authority of parliament, or rather by their acknowledgement of his spiritual supremacy, the king employed his commissioners to select a system of tenets for the assent and belief of the nation. A small volume was published, under the title of *The Institution of a Christian Man*, which was received by the convocation, and made the infallible standard of orthodoxy. In this book the points of justification, faith, free-will, good works, and grace, were discussed in a manner somewhat favourable to the opinions of the reformers. The sacraments, which a few years before were only allowed to be three, were now increased to seven, conformably to the sentiments of the Catholics. Throughout the whole of this book the king's caprice is very discernible; and the book is in reality to be regarded as his composition. For Henry, while he made his opinion a rule for the nation, would himself submit to no authority whatever; not even to any which he had formerly established. The same year the people had a farther instance of the king's inconsistency. He ordered a new book to be composed, called *The Erudition of a Christian Man*; and without asking the consent of the convocation, he published by his own authority this new model of orthodoxy. He was no less positive in his new creed than he had been in the old one; but though he required the faith of the nation to veer about at his signal, he was particularly careful to inculcate the doctrine of passive obedience in all his books, and he was no less careful to retain the nation in the practice.

275
Extreme absurdity of the king's conduct.

But while the king was thus spreading his own books among the people, both he and the clergy seem to have been very much perplexed with regard to the scriptures. A review had been made by the ecclesiastical synod of the new translation of the Bible; and Bishop Gardiner had proposed, that instead of employing English expressions throughout, several Latin words should still be preserved, because they contained, as he pretended, such peculiar energy and significance, that they had no correspondent terms in the English tongue. Among these were *ecclesia*, *pœnitentia*, *pontifex*, *contritus*, &c. But as this mixture would appear extremely barbarous, and was plainly calculated for no other purpose than to retain the people in their ancient ignorance, the proposal was rejected. The knowledge of the people, however, seemed to be still more dangerous than their ignorance; and the king and parliament, soon after the publication of the scriptures, retracted the concession which they had formerly made, and prohibited all but gentlemen and merchants to peruse them. Even that liberty was not granted without an apparent hesitation, and dread of the consequences. These persons were allowed to read, *so it be done quietly and with good order*. And the preamble to the act sets forth, "That many seditious and ignorant persons had abused the liberty granted them of reading the Bible; and that great diversity of opinion, animosities, tumults, and schisms, had been occasioned by perverting the sense of the scriptures." The mass book also passed under the king's examination; but little alteration was yet made in it. Some doubtful or fictitious saints only were struck out; and the name of the pope was erased. The latter precaution was also used with every new book that was printed, and even every old one that was sold. The word *pope* was carefully omitted or blotted out; as if that precaution could abolish the term from the language, or cause the people forget that such a person existed. About this time also, the king prohibited the acting of plays, interludes, and farces, in derision of the popish superstitions; which the Protestants had been in use to practise: and this prohibition was in the highest degree pleasing to the Roman Catholics.

In this tyrannical and headstrong manner Henry proceeded with regard to ecclesiastical affairs. In other respects his conduct was equally violent. With regard to his domestic concerns, history scarce affords his parallel. We have already taken notice of his extreme love for Anne Boleyn, whom he married, contrary even to his own principles, before the marriage with Catharine was dissolved. His affection for the former was carried to such a height, that he even procured an act excluding from the succession the issue of Queen Catharine, in favour of the children of Anne

Anne Boleyn; and failing them, to the king's heirs for ever. An oath to this purpose was likewise enjoined, under penalty of imprisonment during the king's pleasure, and forfeiture of goods and chattels.

276 The succession settled on the children of Anne Boleyn.

All slander against the king and his new queen or their issue was subjected to the penalty of treason or misprision of treason. The reason given for this extreme severity towards his own child was, that her mother had obstinately refused to quit the kingdom, notwithstanding all the methods he could take to induce her to do so. The oath was generally taken throughout the kingdom; Sir Thomas More the chancellor, and Fisher bishop of Rochester, being the only persons who refused; for which both of them were imprisoned, and soon after executed. The unfortunate Queen Catharine died in her retreat at Amphthill, in the year 1536. On her death-bed she wrote a most pathetic letter to the king, in which she forgave him all the injuries she had received, and recommended to him in the strongest terms their daughter the princess Mary.

277 Indecent behaviour of the new queen on hearing of the death of Catharine.

This letter affected Henry so much, that he could not read it without tears; but the new queen is said to have exulted in such a manner on hearing of the death of her rival, as was quite inconsistent with either decency or humanity. Her triumph, however, was of short duration.

278 The king's affection declines.

Henry had no sooner possessed her, secure from every disquieting thought, by the death of Queen Catharine, than his passion began to decline; and to this her delivery of a dead son did not a little contribute; for so impetuous and absurd were his passions, and such was his desire for male issue, that the disappointment in this respect alone was sufficient to alienate his affection from his wife. The levity of her temper, and her extreme gaiety of behaviour, bordering upon licentiousness, as related under the article BOLEYN, also gave an opportunity to her enemies of inflaming the king's jealousy against her.

279 She is accused of infidelity to the king.

The viscountess of Rochford, in particular, a woman of profligate manners, and who was married to the queen's brother, had the cruelty to report to the king that her husband committed incest with his own sister; and, not content with this, she interpreted every instance of favour shown by her to a man, as proof of a criminal intercourse between them.

280 Henry's love for Jane Seymour the true cause of Anne Boleyn's death.

At the same time it must not be forgot, that he who insisted on such rigid fidelity from his wives, was himself the most faithless of mankind. He had doubts, it may be allowed, about the legality of his marriage with Queen Catharine, but his doubts were evidently confirmed by the charms of Anne Boleyn. After being satiated with the possession of her for six years, perhaps he really doubted her fidelity; but here again his doubts were confirmed by the beauty of Jane Seymour, with whom he had now fallen in love. It may easily be believed, that from this consideration alone there was no reason to hope that ever the unfortunate Anne would be able to exculpate herself. Had she really been guilty, her monster of a husband might have allowed her to live; but his cruelty was as unbounded and insatiable as his other perverse passions. She was condemned; and the sentence pronounced against her was, that she should be burned or beheaded at the king's pleasure. On hearing this dreadful denunciation she exclaimed, "O Father! O Creator! thou who art the way, the truth, and the life! thou knowest that I have not deserved this fate." She then made the most solemn protestations of innocence before her judges; but these, as they had been from the beginning ineffectual, so it was not to be supposed that they could now avail any thing.

281 Execution of Anne Boleyn, and third marriage of Henry.

Anne was beheaded by the executioner of Calais, who was reckoned more expert than any in England; and Henry enjoyed the pleasure of marrying his beloved Jane Seymour.

282 Queen Jane dies in child-bed of Edward VI.

His satisfaction, however, was of no long continuance; for the queen, becoming pregnant immediately after marriage, died in two days after the birth of the child; who being a son, was baptized by the name of Edward VI. As this lady had been more beloved by Henry than any of his other wives, his grief for her loss was extreme.

283 Extravagant behaviour of the king concerning his fourth marriage.

However, it did not hinder him from entering very soon afterwards into a new matrimonial scheme; in which he met with many difficulties. His first proposals were made to the duchess dowager of Milan, niece to the emperor and to Catharine his own former queen; but as he had behaved so indifferently to the aunt, it is scarcely to be supposed that his addresses could prove agreeable to the niece. On this he demanded the duchess-dowager of Longueville, daughter of the duke of Guise; but on making the proposal to the French monarch, Francis I. he was informed that the princess had been already betrothed to the king of Scotland. Henry, however, would take no refusal. He had learned that the object of his affection was endowed with many accomplishments, was very beautiful, and of a large size, which last property he looked upon to be necessary for him who was now become somewhat corpulent himself. Francis, to prevent any more solicitations on this subject, sent the princess to Scotland, but at the same time made Henry an offer of Mary of Bourbon, daughter of the duke of Vendosme. This princess was rejected by Henry, because he had heard of her being formerly refused by the king of Scotland. He was then offered his choice of the two younger sisters of the queen of Scotland, both of them being equal in merit as well as size to the one whom he had desired: but Henry, unwilling to trust to any reports concerning the beauty of those ladies, or even to their pictures, proposed to Francis, that they should have a conference at Calais under pretence of business, and that the latter should bring with him the two princesses of Guise, with the finest ladies of quality in France, that he might make a choice. This indelicate proposal shocked Francis: he returned for answer that he was too much impressed with regard to the fair sex to carry ladies of the first quality, like geldings, to a market, to be chosen or rejected according to the humour of the purchaser. Henry remonstrated and stormed as usual; but though Francis at this time earnestly wished to oblige him, he at last totally rejected the proposal.

284 Marriage with Anne o Cleves.

Negotiations were then entered into for a German match; and the princess of Cleves was proposed by Cromwell, on account of the great interest her father had with the Protestant princes of Germany. Henry had also become enamoured of her person from a picture of her he had seen: but this, though drawn by an eminent artist, was unluckily done so much to the advantage, that when the negotiation was quite finished, and the bride arrived in England, he lost all patience, swearing that she was a great Flanders mare, and that he could never bear her the smallest affection. The matter was still worse, when he found that she could

285
The marriage annulled, and Cromwell put to death.

286
Henry falls in love with Catharine Howard.

could speak no language but Dutch, of which he was entirely ignorant. Notwithstanding all these objections, however, he resolved to complete the marriage, telling Cromwell, that, since he had gone so far, he must now put his neck into the yoke. The reason of this was, that the friendship of the German princes was now more than ever necessary for Henry; and it was supposed that the affront of sending the princess back to her own country might be resented. Cromwell, who knew that his own life depended on the event of the matter, was very anxious to learn from the king how he liked his spouse after having passed a night with her; but was struck with terror when he replied that he now hated her more than ever; that he was resolved not to cohabit with her, and even suspected that she was not a virgin; a matter in which he pretended to be a *connoisseur*, and about which he was extremely scrupulous. In a little time his aversion increased to such a degree, that he determined at any rate to get rid of his queen and prime minister both at once. Cromwell had long been an object of aversion to the nobility, who hated him on account of his obscure birth; his father being no other than a blacksmith, though the son had obtained the first employments in the kingdom. By his office of vicar-general, he had an almost absolute authority over the clergy; he was also lord privy-seal, lord chamberlain, and master of the wards. He had also been invested with the order of the Garter, and was created cal of Essex. This was sufficient to raise the envy of the courtiers: but he had also the misfortune to fall under the displeasure of both Protestants and Papists; the former hating him on account of his concurrence with Henry in their persecution, and the latter looking upon him as the greatest enemy of their religion. To these unfortunate circumstances on the part of Cromwell was added the usual situation of Henry himself, who had now fallen in love with Catharine Howard, niece to the duke of Norfolk; to enjoy whom, he now determined to divorce Anne of Cleves. By the insinuations of this lady and her uncle, Cromwell's ruin was accomplished: and he was condemned, not only without any trial, but even without examination. The charge was of heresy and high treason; but the instances of the latter were quite absurd and ridiculous. He submitted, however, to his sentence without murmuring, as knowing that his complaints on this subject would be revenged on his son. He was terribly mangled by the executioner before his head could be struck off. His death was soon followed by the dissolution of the marriage with the princess of Cleves, which was annulled by the consent of both parties. The princess parted from him with great indifference; and accepted of 3000l. a-year as a compensation, but refused to return to her own country after the affront she had received.

287
Infidelity and death of the new queen.

The king's marriage with Catharine Howard soon followed the dissolution of that with Anne of Cleves; but the event may surely be regarded as a providential punishment upon this tyrant, whose cruelty, lust, and other bad qualities, can scarcely be matched in history. We have already mentioned his insinuations against the virtue of the unfortunate princess of Cleves: these were amply repaid by the actual infidelities of his new queen, whom we must suppose he believed to be a pure and perfect virgin at the time he married her. So happy indeed did he imagine himself in this new marriage, that he publicly returned thanks for his conjugal felicity, when a most unfortunate information concerning the queen's incontinence was given to Cranmer by one of the name of Lascelles, whose sister had been servant to the duchess-dowager of Norfolk. He not only gave intelligence of her amours before marriage, but affirmed that she had continued the same criminal practices ever since. Two of her paramours were arrested, and confessed their crimes: the queen herself also confessed guilt before marriage, but denied having ever been false to the king's bed; which, however, had very little probability. She was beheaded on Tower-hill, along with the viscountess of Rochford, who had been a confidant in her amours. The latter, as has already been observed, was a principal instrument in procuring the destruction of the unhappy Anne Boleyn, and therefore died unpitied; while the virtuous character of that unfortunate lady received an additional confirmation from the discovery of this woman's guilt.

288
Absurdity of the king.

To secure himself from any farther disasters of this kind, Henry passed a most extraordinary law, enacting, that any one who should know, or strongly suspect, any guilt in the queen, might, within 20 days, disclose it to the king or council, without incurring the penalty of any former law against defaming the queen; though at the same time every one was prohibited from spreading the matter abroad, or even privately whispering it to others. It was also enacted, that if the king married any woman who had been incontinent, taking her for a true maid, she should be guilty of treason if she did not previously reveal her guilt to him.

289
Sixth marriage with Catharine Parr, whom he intends also to put to death.

These laws afforded diversion to the people, who now said that the king must look out for a widow; as no reputed maid would ever be persuaded to incur the penalty of the statute. This in truth happened to be the case at last; for about a year after the death of Catharine Howard, he married, for his sixth wife, Catharine Parr, widow of Nevil Lord Latimer. This lady, being somewhat inclined to the doctrines of the reformation, and having the boldness to tell her husband her mind upon the subject, had like to have shared the fate of the rest. The furious monarch, incapable of bearing the least contradiction, instantly complained to Bishop Gardiner, who inflamed the quarrel as much as possible; so that at last the king consented that articles of impeachment should be drawn up against her. But these were rendered abortive by the prudence and address of the queen, as related under the article Parr.

290
Monstrous cruelty of the king.

At this time Henry had tyrannized over his nobility in the most cruel manner. The old countess of Salisbury, last of the house of Plantagenet, was executed with circumstances of great cruelty. She had been condemned, as usual, without any trial; and when she was brought to the scaffold, refused to lay her head on the block in obedience to a sentence, to the justice of which she had never consented. She told the executioner, therefore, that if he would have her head, he must win it the best way he could; and thus she ran about the scaffold, pursued by the executioner,

tioner, who aimed many fruitless blows at her neck before he was able to put an end to her life. Soon after her, the lord Leonard Grey was likewise executed for treason, but we have very little account of this transaction.

291 Attainder of Norfolk and Surry.

The last instances of the king's injustice and cruelty were the duke of Norfolk and his son the earl of Surry. The former had served the king with fidelity, and the latter was a young man of the most promising hopes. His qualifications, however, were no security against the violence of Henry's temper. He had dropped some expressions of resentment against the king's ministers, who had displaced him from the government of Boulogne; and the whole family had become obnoxious on account of the late queen Catharine Howard. From these motives, orders were given to arrest both the father and son; and accordingly they were arrested both on the same day, and confined to the Tower. The duchess-dowager of Richmond, Surry's own sister, was among the number of his accusers; and Sir Richard Southwell also, his most intimate friend, charged him with infidelity to the king. Surry denied the charge, and challenged his accuser to a single combat. This favour was denied him; and, notwithstanding his eloquent and spirited defence, he was condemned and executed at Tower-hill.—The duke of Norfolk vainly endeavoured to mollify the king by letters and submissions. An attainder was found against him, though the only crime his accusers could allege was, that he had once said that the king was sickly, and could not hold out long; and that the kingdom was likely to be torn between the contending parties of different persuasions. Cranmer, though engaged for many years in an opposite party to that of Norfolk, and though he had received many and great injuries from him, would have no hand in such an unjust prosecution; but retired to his seat at Croydon. The death-warrant, however, was made out, and immediately sent to the lieutenant of the Tower; but a period was put to the cruelties and violence of the king by his death, which happened on the 14th of January 1547, the night before Norfolk was to have been executed.

292 Henry dies, and is succeeded by Edward VI.

Henry was succeeded by his only son Edward, a boy of nine years of age. The most remarkable transactions of his reign are those with regard to religion. The restraint which Henry VIII. had laid upon the Protestants was now taken off; and they not only maintained their doctrines openly, but soon became the prevailing party. Henry had fixed the majority of his son at 18 years of age; and, in the mean time, appointed 16 executors of his will, to whom, during the minority, he entrusted the government of the king and kingdom. This will, he imagined, would be obeyed as implicitly after his death as though he had been alive. But the first act of the executors was to choose the earl of Hertford, afterwards duke of Somerset, protector of the realm; and in him was lodged all the regal power, together with a privilege of naming whom he pleased for his privy council.

293 Reformation completed.

The duke of Somerset had long been reckoned a secret partisan of the reformers; and immediately on his elevation to his present high dignity, began to express his intention of reforming the abuses of the ancient religion. Under his direction and that of Cranmer, therefore, the reformation was carried forward and completed. The only person of consequence who opposed the reformers was Gardiner bishop of Winchester; and, to the disgrace of their own principles, the reformers now showed that they could persecute as severely as the Papists had formerly persecuted them. Gardiner was committed to the Fleet prison, where he was treated with great severity. He was afterwards sent to the Tower; and having continued there two years, he was commanded to subscribe several articles, among which was one confessing the justice of his own imprisonment. To all the articles but this he agreed to subscribe; but that did not give satisfaction. He was then committed to close custody; his books and papers were seized; all company was denied him, and he was not even permitted the use of pen and ink. The bishops of Chichester, Worcester, and Exeter, were in like manner deprived of their offices; but the bishops of Llandaff, Salisbury, and Coventry, escaped by sacrificing the most considerable share of their revenues. The libraries of Westminster and Oxford were ordered to be ransacked, and purged of the Romish legends, missals, and other superstitious volumes; in which search, great devastation was made even in useful literature. Many volumes clasped in silver were destroyed for the sake of their rich bindings; many of geometry and astronomy were supposed to be magical, and destroyed on that account; while the members of the university, unable to put a stop to these ravages, trembled for their own safety.

294 The reformers persecute the Catholics.

The reformers, however, were not contented with severities of this kind. A commission was granted to the primate and others, to search after all Anabaptists, heretics, or contemners of the new liturgy. Among the numbers who were found guilty upon this occasion, was one Joan Boucher, commonly called *Joan of Kent*; who was so very obstinate, that the commissioners could make no impression upon her. She maintained an abstruse metaphysical sentiment, that Christ, as man, was a sinful man; but, as the Word, he was free from sin, and could be subject to none of the frailties of the flesh with which he was clothed. For maintaining this doctrine, the poor woman was condemned to be burnt to death as a heretic. The young king, who it seems had more sense than his teachers, refused at first to sign the death-warrant; but at last, being overcome by the importunities of Cranmer, he reluctantly complied; declaring, that if he did wrong, the sin should be on the head of those who had persuaded him to it. The primate, after making another unsuccessful effort to reclaim the woman from her opinions, committed her to the flames. Some time after, one Van Paris, a Dutchman, was condemned to death for Arianism. He suffered with so much satisfaction, that he hugged and caressed the faggots that were consuming him.

The rest of this reign affords only the history of intrigues and cabals of the courtiers one against another. The protector was first opposed by his own brother Admiral Sir Thomas Seymour, who had married Catharine Parr the late king's widow. She died soon after the marriage; and he then made his addresses to the princess Elizabeth, who is said not to have been averse to the match. His brother the duke, who was at that time in the north, being informed of his

295 Lady Jane Grey declared heir to the crown.

his ambitious projects, speedily returned; had him attainted of high treason, and at last condemned and executed. The duke of Somerset himself, however, was some time afterwards deprived of his office by Dudley duke of Northumberland; who at last found means to get him accused of high treason, and executed. Not satisfied with the office of protector, which he assumed on the death of Somerset, this ambitious nobleman formed a scheme of engrossing the sovereign power altogether. He represented to Edward, who was now in a declining state of health, that his sisters Mary and Elizabeth, who were appointed by Henry's will to succeed, in failure of direct heirs, to the crown, had both been declared illegitimate by parliament; that the queen of Scots his aunt stood excluded by the king's will; and, being an alien also, lost all right of succeeding. The three princesses being thus excluded, the succession naturally devolved to the marchioness of Dorset, eldest daughter of the French queen, Henry's sister, who had married the earl of Suffolk after her first husband's death. The next heir to the marchioness was Lady Jane Grey, a lady universally respected, both on account of the charms of her person, and the virtues and endowments of her mind. The king, who was accustomed to submit to the politic views of this minister, agreed to have the succession submitted to council, where Northumberland hoped to procure an easy concurrence. The judges, however, who were appointed to draw up the king's letters patent for this purpose, warmly objected to the measure; and gave their reasons before the council. They begged that a parliament might be summoned, both to give it force, and to free its partisans from danger: they said that the form was invalid, and would not only subject the judges who drew it, but every counsellor who signed it, to the pains of treason. Northumberland could not brook their demurs; he threatened them with his authority, called one of them a *traitor*, and said he would fight with any man in his shirt in such a just cause as that of Lady Jane's succession. A method was therefore found out of screening the judges from danger, by granting them the king's pardon for what they should draw up; and at length the patent for changing the succcession was completed, the princesses Mary and Elizabeth were set aside, and the crown settled on the heirs of the duchess of Suffolk (for she herself was contented to forego her claim).

296 Death of Edward VI.

For some time the king had languished in a consumption. After this settlement of the crown, his health visibly declined every day, and little hopes were entertained of his recovery. To make matters worse, his physicians were dismissed by Northumberland's advice, and by an order of council; and he was put into the hands of an ignorant old woman, who undertook in a little time to restore him to health. After the use of her medicines all his bad symptoms increased to the most violent degree. He felt a difficulty of speech and breathing; his pulse failed, his legs swelled, his colour became livid, and many other signs of approaching death made their appearance. He expired at Greenwich on the 6th of July 1553, in the 16th year of his age and 7th of his reign.

297 Lady Jane Grey placed on the thone, but is forced to resign it.

After the death of King Edward, very little regard was paid to the new patent by which Lady Jane Grey had been declared heir to the throne. The undoubted title of Mary, notwithstanding the scandalous behaviour of her father and his servile parliaments, was acknowledged by the whole nation. Northumberland, however, was resolved to put the late king's will in execution. He therefore carefully concealed the death of Edward, in hopes of securing the person of Mary, who by an order of council had been required to attend her brother during his illness; but she being informed of his death, immediately prepared to assert her right to the crown. Northumberland then, accompanied by the duke of Suffolk, the earl of Pembroke, and some other noblemen, saluted Lady Jane Grey queen of England. Jane was in a great measure ignorant of these transactions, and it was with the utmost difficulty she was persuaded to accept of the dignity conferred upon her. At least she complied, and suffered herself to be conveyed to the Tower, where it was then usual for the sovereigns of England to pass some days after their accession. Mary, however, who had retired to Kenning-hall in Norfolk, in a very few days found herself at the head of 40,000 men; and Lady Jane resigned the sovereignty in ten days, with much more pleasure than she had received it. She retired with her mother to their own habitation; and Northumberland finding his affairs quite desperate, attempted to quit the kingdom. But he was stopped by the band of pensioner guards, who informed him that he must stay to justify their conduct in taking arms against their lawful sovereign. He therefore surrendered himself to Mary; and was soon after executed, together with Sir John Gates and Sir Thomas Palmer, two infamous tools of his power. Sentence was also pronounced against Lady Jane Grey and her husband Lord Guildford; but without any intention of putting it in execution against them at present, as their youth and innocence pleaded so strongly in their favour, neither of them having yet reached their 17th year.

298 Mary declared queen.

Mary now entered London, and was peaceably settled on the throne without any effusion of blood. The English, however, soon found reason to repent their attachment to her cause. Though she had at first solemnly promised to defend the religion and laws of her predecessor, she no sooner saw herself firmly established on the throne, than she resolved to restore the Popish religion, and give back their former power to the clergy. Gardiner, Bonner, and the other bishops who had been imprisoned or suffered loss during the last reign, were taken from prison, reinstated in their sees, and now triumphed in their turn. On pretence of discouraging controversy, the queen by her prerogative silenced all preachers throughout England, except such as should obtain a particular license, and this she was resolved to give only to those of her own persuasion. The greater part of the foreign Protestants took the first opportunity of leaving the kingdom; and many of the arts and manufactures, which they had successfully introduced, fled with them. Soon after the queen called a parliament, which seemed willing to concur in all her measures. They at once repealed all the statutes with regard to religion that had passed during the reign of Edward VI. and the national religion was again placed on the same footing in which it had been at the death of Henry VIII.

To strengthen the cause of the Catholics, and give the

299 Proposals of marriage to Queen Mary.

the queen more power to establish the religion to which she was so much attached, a proper match was to be sought for her; and it was supposed that three had already been proposed as candidates for her favour. Her affection seemed to be engaged by the earl of Devonshire; but as he was rather attached to the princess Elizabeth, he received the overtures which were made him from the queen with neglect. The next person mentioned as a proper match for her was Cardinal Pole, a man greatly respected for his virtues; but as he was now in the decline of life, Mary soon dropped all thoughts of that alliance. At last she cast her eye on Philip II. of Spain, son to the emperor Charles V. He was then in the 27th year of his age, and consequently agreeable in that respect to Mary, who was in her 48th year; but when her intentions with regard to this match became known, the greatest alarm took place throughout the whole nation.

300 Alliance with Spain generally disagreeable.

The commons presented such a strong remonstrance against a foreign alliance, that the queen thought proper to dissolve the parliament in order to get quit of their importunity. To obviate, however, all clamour, the articles of marriage were drawn up as favourably as possible for the interests of England. It was agreed, that though Philip should have the title of king, the administration should be entirely in the queen; that no foreigner should be capable of holding any office in the kingdom; nor should any innovation be made in the laws, customs, and privileges of the people; that Philip should not carry the queen abroad without her consent, or any of her children, without the consent of the nobility. Sixty thousand pounds a-year were to be settled upon her as a jointure; and the male issue of this marriage were to inherit Burgundy and the Low Countries as well as the crown of England: and in case of the death of Don Carlos, Philip's son by his former marriage, without any heir, the queen's issue should inherit all the rest of the Spanish dominions also.

All these concessions, however, were not sufficient to quiet the apprehensions of the people: they were considered merely as words of course, which might be retracted at pleasure; and the whole nation murmured loudly against a transaction so dangerous to its ancient liberty and independence.

301 Wyatt's insurrection.

An insurrection was raised by Sir Thomas Wyatt, a Roman Catholic, at the head of 4000 men, who set out from Kent to London, publishing a declaration against the Spanish match and the queen's evil counsellors. Having advanced as far as Southwark, he required that the queen should put the tower of London into his hands; that she should deliver four counsellors as hostages; and, in order to ensure the liberty of the nation, should marry an Englishman. But his force was at present by far too small to support such magnificent pretensions; and he unluckily wasted so much time without attempting any thing of importance, that the popular ferment entirely subsided, his followers abandoned him gradually, and he was at last obliged to surrender himself to Sir Maurice Berkeley near Temple-bar.

302 He is condemned and executed with many of his followers.

His followers were treated with great cruelty: no fewer than 400 of them suffered by the hand of the executioner; 400 more were conducted with ropes about their necks into the queen's presence, and there received their pardon. Wyatt himself was condemned and executed.

303 Princess Elizabeth harshly treated.

This rebellion had almost proved fatal to the Princess Elizabeth, who for some time past had been treated with great severity by her sister. Mary, who possessed a most malignant and cruel heart, had never forgot the quarrel between their mothers; and when a declaration was made after her own accession, recognising Queen Catharine's marriage as legal, she was thus furnished with a pretence for accounting Elizabeth illegitimate. She was likewise obnoxious on account of her religion, which Elizabeth at first had not prudence sufficient to conceal; though afterwards she learned full well to disguise her sentiments. But, above all, her standing so high in the affection of the earl of Devonshire, was a crime not to be forgiven: and Mary made her sensible of her displeasure by numberless mortifications. She was ordered to take place at court after the duchess of Suffolk and the countess of Lennox; to avoid which, and other indignities, Elizabeth at last retired from court altogether into the country. After the suppression of Wyatt's rebellion she was committed to the Tower, and underwent a strict examination before the council; but as Wyatt had made a declaration on the scaffold that she was in no manner of way concerned, the queen found herself under a necessity of releasing her. To get rid of such a troublesome rival, however, she was offered in marriage to the duke of Savoy; and on Elizabeth's declining the proposal, she was committed close prisoner to Woodstoke. The rebellion proved fatal, however, to many persons of distinction, and gave the queen an opportunity of manifesting that unbounded cruelty which reigned in her heart. The Tower, and all the prisons in the kingdom, were filled with nobility and gentry, who became objects of royal vengeance, more on account of their credit and interest with the people than any concern they were supposed to have had with Wyatt. Sir Nicholas Throgmorton was tried in Guildhall; but as no satisfactory evidence appeared against him, the jury gave a verdict in his favour. The queen was so much enraged at this disappointment, that she recommitted him to the Tower, summoned the jury before the council, and at last sent them all to prison, fining them afterwards some of 1000l. and others of 2000l. each. Sir John Throgmorton, brother to Sir Nicholas just mentioned, was condemned and executed upon evidence which had been already rejected as insufficient.

304 Execution of Lady Jane Grey and her husband.

But of all those who perished on this occasion, none excited more universal compassion than the unfortunate Lady Jane Grey and her husband Lord Guildford Dudley. They had already received sentence of death, as has been mentioned; and two days after the execution of Wyatt, they received orders to prepare for eternity. Lady Jane, who had been in expectation of this blow, was no way intimidated, but received the news with the most heroic resolution. The place intended at first for their execution was Tower-hill; but the council, dreading the effects of the people's compassion for their youth, beauty, and innocence, gave directions that they should be beheaded within the verge of the Tower. The duke of Suffolk was soon after tried, condemned, and executed; but would have met with more compassion, had not his

305 The people disarmed.

ambition been the cause of his daughter's unhappy fate just mentioned. Sir Thomas Grey also lost his life on the same account; but the cruel spirit of Mary was still unsatisfied; and finding herself universally odious, that she might free herself from any apprehensions for what was past, as well as tyrannize with the more freedom in time to come, she disabled the people from resistance, by ordering general musters, and causing the commissioners seize their arms and lay them up in forts and castles.

306 Marriage with Philip solemnized.

Notwithstanding this unpopularity, however, the rebellion of Wyatt had so strengthened the hands of government, that a parliament was assembled in hopes of gratifying the queen's wishes in regard to her marriage with Philip of Spain. To facilitate this purpose also, the emperor of Germany sent over to England 400,000 crowns to be distributed among the members of parliament in bribes and pensions; a practice of which there had hitherto been no example in England. The queen, notwithstanding her bigotry, resumed the title of *Supreme Head of the Church*, which she had dropped three months before. Gardiner made a speech, in which he proposed, that they should invest the queen with a legal power of disposing of the crown, and appointing her successor; but the parliament, however obsequious in other respects, did not choose to gratify their sovereign in a measure by which the kingdom of England might become a province of the Spanish monarchy. They would not even declare it treason to imagine or attempt the death of the queen's husband during her life time, though they agreed to ratify the articles of marriage. Finding therefore that the parliament even yet was not sufficiently obsequious, it was thought most proper to dissolve them. Soon after this the marriage with Philip was solemnized; but as the latter had espoused his queen merely with a view to become king of England, he no sooner found himself disappointed in this than he showed a total want of affection for her as a wife. He passed most of his time at a distance from her in the Low Countries; and seldom wrote to her except when he wanted money, with which Mary would at all times gladly have supplied him, even had it been at the expence of her kingdom, if in her power.

307 Protestants persecuted.

The enemies of the state being supposed to be suppressed, those of the Protestant religion were next persecuted. The old sanguinary laws which had been rejected by a former parliament were now revived. Orders were given, that the priests and bishops who had married should be ejected; that the mass should be restored, and the pope's authority established; and that the church and its privileges, all but their goods and estates, should be put on the same footing on which they were before the commencement of the reformation. But as the gentry and nobility had already divided the church-lands among them, it was thought inconvenient, and indeed impossible, to make a restoration of these. The persons who chiefly promoted these measures were Gardiner bishop of Winchester, and Cardinal Pole, who was a kinsman of Henry VIII. but had been long in Italy, and was now returned from it. The latter was for tolerating the Protestants; but the former, perceiving that rigorous measures would be most agreeable to the king and queen, declared himself against it. He was too prudent, however, to appear in person at the head of the persecution; and therefore consigned that office to Bonnar bishop of London, a man of a very abandoned character. The bloody scene began by the execution of Hooper bishop of Gloucester, and Rogers prebendary of St Paul's. These were quickly followed by others, of whom the principal were Archbishop Cranmer, Ridley bishop of London, and Latimer bishop of Worcester *. These persecutions soon became odious to the whole nation, and the perpetrators of them were all willing to throw the blame from themselves upon others. Philip endeavoured to fasten the whole reproach upon Bonnar; but that bishop would not take the whole, and therefore retorted on the court. A bold step was now taken to introduce a court similar to the Spanish inquisition, that should be empowered to try heretics, and condemn them without any other law but its own authority. But even this was thought a method too dilatory in the present exigence of affairs. A proclamation issued against books of heresy, treason, and sedition, declared, that whosoever had such books in his possession, and did not burn them without reading, should suffer as a rebel. This was attended with the execution of such numbers, that at last the magistrates who had been instrumental in these cruelties refused to give their assistance any longer. It was computed, that during this persecution, 277 persons suffered by fire, besides those punished by imprisonments, fines, and confiscations. Among those who suffered by fire were 5 bishops, 21 clergymen, 8 lay-gentlemen, 84 tradesmen, 100 husbandmen, 55 women, and 4 children.

308 Mary dies, and is succeeded by Elizabeth.

The only remarkable transaction which happened during this reign with regard to the temporal affairs of the kingdom was the loss of Calais, which had been in the possession of the English for upwards of 200 years †. This loss filled the whole kingdom with complaints, and the queen with grief. She was heard to say, that, when dead, the name of *Calais* would be found engraven on her heart. She did not long survive this loss; but died in the year 1558, of a lingering illness, after a reign of five years four months and eleven days.

After the death of Mary, the princess Elizabeth succeeded to the throne without opposition. She was at Hatfield when news of her sister's death were brought her; upon which she hastened up to London, where she was received with great joy. This princess was well qualified for government. She had judgment sufficient to make choice of proper ministers, and authority enough to keep her subjects in awe. The restraints also, to which she had been subjected during her sister's reign, had taught her so well to conceal her sentiments, that she had become a perfect mistress of dissimulation; which, though no commendable part of her character, proved occasionally of great service to her government. She perfected the reformation, and put the religion of England upon the same plan which subsists at present. This was accomplished without the least difficulty; for the persecution in Mary's reign had served only to give the whole nation an aversion for popery. In the time of Edward VI. the people had been compelled to embrace the Protestant religion, and their fears induced them to conform; but now, almost the whole nation were Protestants from inclination. The reformation was confirmed by act of parliament in 1559, and thus

* See *Cranmer*, &c.

† See *Calais*.

thus England was seen to change its religion four times in the space of 32 years.

309 Peace with France.

During the time that the queen and her counsellors were employed in settling the religious affairs of the nation, negotiations were likewise carried on for a peace between England and France; which was at last concluded on the following terms, viz. that Henry should restore Calais at the expiration of eight years; that in case of failure, he should pay 500,000 crowns, and Elizabeth's title to Calais still remain; that for the payment of this sum he should find the security of eight foreign merchants, not natives of France; and until that security were provided he should deliver five hostages. If during this interval Elizabeth should break the peace with France or Scotland, she should forfeit all title to Calais; but if Henry made war on Elizabeth, he should be obliged to restore the fortress immediately. This pacification was soon followed by an irreconcileable quarrel with Mary queen of Scotland; which was not extinguished but by the death of the Scottish princess; and that with such circumstances of accumulated treachery, hypocrisy, and dissimulation, as have stamped an indelible disgrace on the memory of Elizabeth. See the articles **Mary** and **Scotland**.

310 Preparations for war with Spain.

Elizabeth having at last got rid of her rival in the year 1587, began to make preparations for resisting the Spanish invasion. Hearing that Philip was secretly fitting out a great navy to attack her, she sent Sir Francis Drake with a fleet to pillage his coasts and destroy his shipping. On this expedition he set sail with four capital ships furnished by the queen, and 26 others of various sizes furnished him by the merchants of London in hopes of sharing the plunder.

311 Exploits of Sir Francis Drake.

Having learned that a Spanish fleet richly laden was lying at Cadiz in readiness to set sail for Lisbon, he directed his course towards the former port, where he boldly attacked the enemy. Six galleys were obliged to take shelter under the cannon of the forts: he burned about 100 vessels laden with ammunition and naval stores; and destroyed a great ship belonging to the marquis de Santa Croce. Thence setting sail for Cape St Vincent, he took by assault the castle situated on that promontory, with three other fortresses. Having next insulted Lisbon, he sailed to the island Tercera, one of the Azores, where, after lying in wait for some time, he took a rich prize, and then returned to England; having by this short expedition taught the English to despise the huge and unwieldy ships of the enemy, and thus prepared them to act with more resolution against the formidable armament that now threatened to invade them.

312 Miscarriage of Philip's scheme of an invasion.

But though the expedition of Sir Francis Drake had retarded the intended invasion of England for a twelvemonth, it had not by any means induced Philip to abandon his design. During that interval he continued his preparations with the greatest assiduity, the more especially as the invasion of England seemed to be a necessary preparative for regaining his authority over the Netherlands, the revolted provinces having been strongly supported by Elizabeth. The fleet prepared at this time was superior to any thing then existing in the world; and no doubt being entertained of its success, it was ostentatiously styled the *Invincible Armada*. The miserable event of this expedition, and the total failure of all the mighty hopes of Philip, are related under the article **Armada**. The spirit and courage of the English were now excited to attempt invasions in their turn; which they executed in numerous descents on the Spanish coasts; though these were only temporary, and designed not for permanent conquest, but to harass the enemy. It would be endless to relate all the advantages obtained over the enemy at sea, where the capture of every ship must have been a separate narrative. It is sufficient to observe, that the sea-captains of that reign are still considered as the boldest and most enterprising set of men that England ever produced; and among this number we are to reckon Raleigh and Howard, Drake, Cavendish, and Hawkins. The English navy then began to take the lead; and has since continued irresistible in all parts of the ocean.

Elizabeth continued to reign with great glory till the year 1603; but all her greatness could not prevent her from being extremely miserable before her death. She had caused her greatest favourite, and probably her lover, the earl of Essex †, to be executed. Though this execution could not be called unjust, the queen's affection (on being informed that he had at last thrown himself entirely on her clemency) returned to such a degree, that she thenceforth gave herself entirely over to despair.

313 Grief and misery of Elizabeth.

She refused food and sustenance; she continued silent and gloomy; sighs and groans were the only vent she gave to her despondence; and she lay for ten days and nights upon the carpet, leaning on cushions, which her maids brought her. Perhaps the faculties of her mind were impaired by long and violent exercise; perhaps she reflected with remorse on some past actions of her life, or perceived, but too strongly, the decays of nature, and the approach of her dissolution. She saw her courtiers remitting in their assiduity to her, in order to pay their court to James the apparent successor. Such a concurrence of causes was more than sufficient to destroy the remains of her constitution; and her end was now visibly seen to approach. Feeling a perpetual heat in her stomach, attended with an unquenchable thirst, she drank without ceasing, but refused the assistance of her physicians. Her distemper gaining ground, Cecil and the lord admiral desired to know her sentiments with regard to the succession. To this she replied, that as the crown of England had always been held by kings, it ought not to devolve upon any inferior character, but upon her immediate heir the king of Scotland. Being then advised by the archbishop of Canterbury to fix her thoughts upon God, she replied, that her thoughts did not in the least wander from him. Her voice soon after left her; she fell into a lethargic slumber, which continued some hours; and she expired gently without a groan, in the 70th year of her age, and 45th of her reign. She was succeeded by James I. king of Scotland; since which time, the history of both England and Scotland is comprehended under the article **Britain**.

314 Her death.

315 England, how divided.

Since the Norman conquest, England has been divided into six circuits, each circuit containing a certain number of counties. Two judges are appointed for each circuit, which they visit in the spring and autumn, for administering justice to the subjects who are at a distance from the capital. In holding the lent (or spring) assizes, the northern circuit extends only to York and Lancaster; the assizes at Durham, Newcastle, Carlisle, and Appleby, being held only in autumn,

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† See *Devereux*.

tumn, and distinguished by the appellation of the *long circuit*. These circuits and counties are:

1. *Home Circuit* contains the counties of Essex, Hertford, Kent, Surry, and Sussex.
2. *Norfolk Circuit* contains those of Bucks, Bedford, Huntingdon, Cambridge, Suffolk, and Norfolk.
3. *Oxford Circuit.* Oxon, Berks, Gloucester, Worcester, Monmouth, Hereford, Salop, and Stafford.
4. *Midland Circuit.* Warwick, Leicester, Derby, Nottingham, Lincoln, Rutland, and Northampton.
5. *Western Circuit.* Hants, Wilts, Dorset, Somerset, Devon, and Cornwall.
6. *Northern Circuit.* York, Durham, Northumberland, Lancaster, Westmoreland, and Cumberland.

Middlesex and Cheshire are not comprehended in the above circuits; the former being the seat of the supreme courts of justice, and the latter a county palatine. There is still a court of chancery in Lancaster and Durham, with a chancellor; and there is a court of exchequer at Chester, of a mixed kind, both for law and equity, of which the chamberlain of Chester is judge: there are also other justices in the counties palatine, to determine civil actions and pleas of the crown.

Besides the 40 counties into which England is divided, there are counties corporate, consisting of certain districts, to which the liberties and jurisdictions peculiar to a county have been granted by charter from the throne. Thus the city of London is a county distinct from Middlesex; the cities of York, Chester, Bristol, Norwich, Worcester, and the towns of Kingston upon Hull and Newcastle upon Tyne, are counties of themselves, distinct from those in which they lie. The same may be said of Berwick upon Tweed, which lies in Scotland, and has within its jurisdiction a small territory of two miles on the north side of the river. Under the name of a *town*, boroughs and cities are contained: for every borough or city is a town, though every town is not a borough or city.—An account of the English constitution and government is given under the articles KING, LORDS, COMMONS, PARLIAMENT, LAW, LIBERTY, RIGHTS, &c.

316 Religion.

The established religion of England is Episcopacy. Since the reign of Henry VIII. the sovereigns of England have been called, in public writs, the supreme heads of the church; but this title conveys no spiritual meaning, as it only denotes the regal power to prevent any ecclesiastical differences, or, in other words, to substitute the king in place of the pope before the reformation, with regard to temporalities and the internal economy of the church. The kings of England never intermeddle in ecclesiastical disputes, and are contented to give a sanction to the legal rights of the clergy.

The church of England, under this description of the monarchical power over it, is governed by two archbishops, and 24 bishops, besides the bishop of Sodor and Man, who, not being possessed of an English barony, does not sit in the house of peers. See ARCHBISHOP and BISHOP.

England contains about 60 archdeacons. Subordinate to them are the rural deacons, formerly styled *archpresbyters*, who signify the bishop's pleasure to his clergy, the lower class of which consists of parish-priests (who are called *rectors* or *vicars*) deacons and curates. See the articles CURATE, DEACON, PARSON, and VICAR.

317 Revenues of the clergy.

The following is a list of the English bishoprics, with their revenues, as charged in the king's books: though that sum is far from being the real annual value of the see, yet it assists in forming a comparative estimate between the revenues of each see with those of another.

| ARCHBISHOPRICS. | *L.* | *s.* | *d.* |
|---|---|---|---|
| Canterbury, - - - - | 2682 | 12 | 2 |
| York - - - - - | 1610 | 0 | 0 |
| BISHOPRICS. | | | |
| London, - - - - | 2000 | 0 | 0 |
| Durham, - - - | 1821 | 1 | 3 |
| Winchester, - - - | 3124 | 12 | 8 |

These three bishops take precedency of all others in England, and the others according to the seniority of their consecrations.

| | | | |
|---|---|---|---|
| Ely, - - - - | 2134 | 18 | 6 |
| Bath and Wells, - - - | 533 | 1 | 3 |
| Hereford, - - - - | 768 | 11 | 0 |
| Rochester, - - - | 358 | 4 | 9 |
| Litchfield and Coventry, - | 559 | 17 | 3 |
| Chester, - - - - | 420 | 1 | 8 |
| Worcester, - - - | 929 | 13 | 3 |
| Chichester, - - - - | 677 | 1 | 3 |
| St Asaph, - - - - | 187 | 11 | 8 |
| Salisbury, - - - | 1385 | 5 | 0 |
| Bangor, - - - - | 131 | 16 | 3 |
| Norwich, - - - - | 834 | 11 | 7 |
| Gloucester, - - - - | 315 | 7 | 3 |
| Llandaff, - - - - | 154 | 14 | 2 |
| Lincoln, - - - | 894 | 18 | 1 |
| Bristol, - - - - | 297 | 11 | 0 |
| Carlisle, - - - - | 531 | 4 | 9 |
| Exeter, - - - | 500 | 0 | 0 |
| Peterborough, - - - | 414 | 14 | 8 |
| Oxford, - - - | 381 | 11 | 0 |
| St Davids, - - - - | 426 | 2 | 1 |

The ecclesiastical government of England is, properly speaking, lodged in the convocation; which is a national representative or synod, and answers pretty nearly to the ideas which we have of a parliament. They are convoked at the same time with every parliament; and their business is to consider of the state of the church, and to call those to an account who have advanced new opinions, inconsistent with the doctrines of the church of England. Some high-flying clergymen during the reign of Queen Anne, and in the beginning of that of George I. raised the powers of the convocation to a height that was inconsistent with the principles of religious toleration, and indeed of civil liberty: so that the crown was obliged to exert its prerogative of calling the members together, and of dissolving them; and ever since they have not been permitted to sit for any time, in which they could do business.

The following table exhibits a view of the population of England, taken from the returns made to the house of commons in consequence of an act of parliament which was passed in 1801, for the purpose of ascertaining the number of inhabitants in the kingdom. From this table it appears that the total number of persons in England amounts to 8,331,434.

Published by A. Constable & Co Edinburgh, 1819.

Engraved by Sidy Hall

| COUNTIES. | 1801. | | 1811. | |
|---|---|---|---|---|
| | Houses. | Persons. | Houses. | Persons. |
| Bedford - | 11,888 | 63,393 | 13,505 | 70,213 |
| Berks - | 20,573 | 109,215 | 22,667 | 118,277 |
| Buckingham - | 20,443 | 107,444 | 22,386 | 117,650 |
| Cambridge - | 16,139 | 89,346 | 17,489 | 101,109 |
| Chester - | 34,482 | 191,751 | 42,426 | 227,037 |
| Cornwall - | 32,906 | 188,269 | 39,371 | 216,667 |
| Cumberland - | 21,573 | 117,230 | 24,552 | 133,744 |
| Derby - | 31,822 | 161,142 | 36,854 | 185,487 |
| Devon - | 57,955 | 343,001 | 64,793 | 383,308 |
| Dorset - | 21,437 | 115,319 | 24,051 | 124,693 |
| Durham - | 27,195 | 160,361 | 29,923 | 177,625 |
| Essex - | 38,371 | 226,437 | 43,841 | 252,473 |
| Gloucester - | 46,457 | 250,809 | 54,040 | 285,514 |
| Hereford - | 17,003 | 89,191 | 19,296 | 94,073 |
| Hertford - | 17,681 | 97,577 | 20,781 | 111,654 |
| Huntingdon - | 6,841 | 37,568 | 7,719 | 42,208 |
| Kent - | 51,585 | 307,624 | 63,734 | 373,095 |
| Lancaster - | 114,270 | 672,731 | 148,552 | 828,309 |
| Leicester - | 25,992 | 130,081 | 30,649 | 150,419 |
| Lincoln - | 41,395 | 208,557 | 47,467 | 237,891 |
| Middlesex - | 112,912 | 818,129 | 134,939 | 953,276 |
| Monmouth - | 8,948 | 45,582 | 12,127 | 62,127 |
| Norfolk - | 47,617 | 273,371 | 52,807 | 291,999 |
| Northampton - | 26,665 | 131,757 | 28,857 | 141,353 |
| Northumberland | 26,518 | 157,101 | 29,384 | 172,161 |
| Nottingham - | 25,611 | 140,350 | 32,298 | 162,900 |
| Oxford - | 20,599 | 109,620 | 23,201 | 119,191 |
| Rutland - | 3,274 | 16,356 | 3,402 | 16,380 |
| Salop - | 31,182 | 167,639 | 36,635 | 194,298 |
| Somerset - | 48,040 | 273,750 | 54,134 | 303,180 |
| Southampton - | 38,345 | 219,656 | 44,240 | 245,080 |
| Stafford - | 45,198 | 239,153 | 56,617 | 295,153 |
| Suffolk - | 32,233 | 210,431 | 37,851 | 234,211 |
| Surry - | 46,072 | 269,043 | 57,124 | 323,851 |
| Sussex - | 25,272 | 159,311 | 30,680 | 190,083 |
| Warwick - | 40,847 | 208,190 | 45,849 | 228,735 |
| Westmoreland - | 7,897 | 41,617 | 9,019 | 45,922 |
| Wilts - | 29,462 | 185,107 | 38,281 | 193,828 |
| Worcester - | 26,711 | 139,330 | 31,010 | 160,546 |
| York - | 168,439 | 858,892 | 193,480 | 973,113 |
| | 1,467,870 | 8,331,434 | 1,726,031 | 9,538,827 |

| | 1801 | 1811 |
|---|---|---|
| Inhabitants in towns, | 3,661,549 | 4,221,814 |
| in the country, | 4,669,885 | 5,317,013 |

See ENGLAND, SUPPLEMENT.

NEW ENGLAND, late a province of the British empire in America, is bounded on the north by Canada, on the east by Nova Scotia and the Atlantic ocean, on the south by the Atlantic and Long Island sound, and on the west by New York. It lies in the form of a quarter of a circle. It includes the five states of Connecticut, Rhode Island, Massachusetts, Vermont, and New Hampshire; and extends from 41° to 46° of north latitude, and from 68° to 74° of west longitude.

When first discovered.

This country was discovered in the beginning of the 16th century, and called *North Virginia;* but no Europeans settled there till the year 1608. The first colony, which was weak and ill-directed, did not succeed; and, for some time, there were only a few adventurers who came over at times in the summer, built

New England.

themselves temporary huts for the sake of trading with the savages, and like them, disappeared again for the rest of the year. At last some Brownists, headed by Mr Robinson, whom Neal styles the Father of the Independents, who in 1610 had been driven from England by persecution, fled to Holland, and settled at Leyden; but in 1621 determined, with Mr Brewster assistant-preacher to Mr Robinson, to found a church for their sect in the new hemisphere. They therefore purchased, in 1521, the charter of the English North Virginia company. Forty-one families, making in all 120 persons, landed in the beginning of a very hard winter, and found a country entirely covered with wood, which offered a very melancholy prospect to men already exhausted with the fatigues of their voyage. Near one half perished either by cold, the scurvy, or other distress. The courage of the rest was beginning to fail; when it was revived by the arrival of 60 savage warriors, who came to them in the spring, headed by their chief. The old tenants assigned for ever to the new ones all the lands in the neighbourhood of the settlement they had formed, under the name of *New Plymouth;* and one of the savages who understood a little English staid to teach them how to cultivate the maize, and instruct them in the manner of fishing upon their coast.

This kindness enabled the colony to wait for the companions they expected from Europe with seeds, with domestic animals, and with every assistance they wanted. At first these succours arrived but slowly; but the persecution of the Puritans in England increased the number of proselytes to such a degree in America, that in 1630 they were obliged to form different settlements, of which Boston soon became the principal. These first settlers were not merely ecclesiastics, who had been deprived of their preferments on account of their opinions; nor those sectaries influenced by new opinions, that are so frequent among the common people. There were among them several persons of high rank, who, having embraced Puritanism, had taken the precaution to secure themselves an asylum in these distant regions. They had caused houses to be built, and lands to be cleared, with a view of retiring there, if their endeavours in the cause of civil and religious liberty should prove abortive.

*Raynal's History of European Settlements.*

The inhabitants of New England lived peaceably for a long time, without any regular form of policy. Their charter had indeed authorized them to establish any mode of government they might choose; but these enthusiasts were not agreed among themselves upon the plan of their republic, and government did not pay sufficient attention to them to urge them to secure their own tranquillity. At length they grew sensible of the necessity of a regular legislation; and this great work, which virtue and genius united have never attempted but with diffidence, was boldly undertaken by blind fanaticism. It bore the stamp of the rude prejudices on which it had been formed. There was in this new code a singular mixture of good and evil, of wisdom and folly. No man was allowed to have a share in the government except he were a member of the established church. Witchcraft, perjury, blasphemy, and adultery, were made capital offences; and children were also punished with death, either for cursing or striking their parents. Marriages, however, were to be solemnized by the magistrate. The price of corn was fixed at 2s. 11¾d. per bushel. The savages who neglected to cultivate their lands were to be deprived of them; and Europeans were forbidden under a heavy penalty to sell them any strong liquors or warlike stores. All those who were detected either in lying, drunkenness, or dancing, were ordered to be publicly whipped. But at the same time that amusements were forbidden equally with vices and crimes, one might be allowed to swear by paying a penalty of 11½d. and to break the sabbath for 2l. 19s. 9¼d. Another indulgence allowed was, to atone, by a fine, for a neglect of prayer, or for uttering a rash oath. But it is still more extraordinary, that the worship of images was forbidden to the Puritans on pain of death; which was also inflicted on Roman Catholic priests, who should return to the colony after they had been banished; and on Quakers who should appear again after having been whipped, branded, and expelled. Such was the abhorrence for these sectaries, who had themselves an aversion for every kind of cruelty, that whoever either brought one of them into the country, or harboured him but for one hour, was liable to pay a considerable fine.

2 First code of laws.

3 Quakers persecuted.

Those unfortunate members of the colony, who, less violent than their brethren, ventured to deny the coercive power of the magistrate in matters of religion, were persecuted with still greater rigour. This was considered as blasphemy by those very divines who had rather chosen to quit their country than to show any deference to Episcopal authority. This system was supported by the severities of the law, which attempted to put a stop to every difference in opinion, by inflicting capital punishment on all who dissented. Those who were either convicted, or even suspected, of entertaining sentiments of toleration, were exposed to such cruel oppressions, that they were forced to fly from their first asylum, and seek refuge in another. They found one on the same continent; and as New England had been first founded by persecution, its limits were extended by it.

This intemperate religious zeal extended itself to matters in themselves of the greatest indifference. A proof of this is found in the following public declaration, transcribed from the registers of the colony.

4 Laws against wearing long hair.

"It is a circumstance universally acknowledged, "that the custom of wearing long hair, after the "manner of immoral persons and of the savage In"dians, can have been introduced into England only "in sacrilegious contempt of the express command of "God, who declares that it is a shameful practice for "any man who has the least care for his soul to wear "long hair. As this abomination excites the indig"nation of all pious persons; we, the magistrates, in "our zeal for the purity of the faith, do expressly "and authentically declare, that we condemn the im"pious custom of letting the hair grow; a custom "which we look upon to be very indecent and disho"nest, which horribly disguises men, and is offensive "to modest and sober persons, in as much as it cor"rupts good manners. We therefore, being justly "incensed against this scandalous custom, do desire, "advise, and earnestly request all the elders of our "continent, zealously to show their aversion for this "odious practice, to exert all their power to put a "stop to it, and especially to take care that the mem"bers of their churches be not infected with it; in "order

“ order that those persons who, notwithstanding these “ rigorous prohibitions, and the means of correction “ that shall be used on this account, shall still persist “ in this custom, shall have both God and man at the “ same time against them.”

This severity soon exerted itself against the Quakers. They were whipped, banished, and imprisoned. The behaviour of these new enthusiasts, who in the midst of tortures and ignominy praised God, and called for blessings upon men, inspired a reverence for their persons and opinions, and gained them a number of proselytes. This circumstance exasperated their persecutors, and hurried them on to the most atrocious acts of violence; and they caused five of them, who had returned clandestinely from banishment, to be hanged. This spirit of persecution was, however, at last suppressed by the interposition of the mother-country, from whence it had been brought. Charles II. moved with the sufferings of the Quakers, put a stop to them by a proclamation in 1661; but he was never able totally to extinguish the spirit of persecution that prevailed in America.

The colony had placed at their head Henry Vane, the son of that Sir Henry Vane who had such a remarkable share in the disturbances of his country. This obstinate and enthusiastic young man had contrived to revive the questions of grace and free will. The disputes upon these points ran very high; and would probably have plunged the colony into a civil war, if several of the savage nations united had not happened at that very time to fall upon the plantations of the disputants, and to massacre great numbers of them. The colonists, heated with their theological contests, paid at first very little attention to this considerable loss. But the danger at length became so urgent and so general, that all took up arms. As soon as the enemy were repulsed, the colony resumed its former dissensions; and the frenzy which they excited broke out in 1692 in a way marked with as many atrocious instances of violence as any ever recorded in history.

5 Extraordinary persecution of witches.

There lived in a town of New England, called *Salem*, two young women who were subject to convulsions, accompanied with extraordinary symptoms. Their father, minister of the church, thought that they were bewitched; and having in consequence cast his suspicions upon an Indian girl who lived in his house, he compelled her by harsh treatment to confess that she was a witch. Other women, upon hearing this, immediately believed, that the convulsions, which proceeded only from the nature of their sex, were owing to the same cause. Three citizens, casually named, were immediately thrown into prison, accused of witchcraft, hanged, and their bodies left exposed to wild beasts and birds of prey. A few days after, 16 other persons, together with a counsellor, who, because he refused to plead against them, was supposed to share in their guilt, suffered in the same manner. From this instant, the imagination of the multitude was inflamed with these horrid and gloomy scenes. Children of ten years of age were put to death, young girls were stripped naked, and the marks of witchcraft searched for upon their bodies with the most indecent curiosity; and those spots of the scurvy which age impresses upon the bodies of old men were taken for evident signs of the infernal power. In default of these, torments were employed to extort confessions dictated by the executioners themselves. If the magistrates, tired out with executions, refused to punish, they were themselves accused of the crimes they tolerated; the very ministers of religion raised false witnesses against them, who made them forfeit with their lives the tardy remorse excited in them by humanity. Dreams, apparitions, terror, and consternation of every kind, increased these prodigies of folly and horror. The prisons were filled, the gibbets left standing, and all the citizens involved in gloomy apprehensions. The most prudent quitted the country stained with the blood of its inhabitants; and nothing else than the total and immediate subversion of the colony was expected, when, on a sudden, all eyes were opened at once, and the excess of the evil awakened the minds which it had at first stupified. Bitter and painful remorse was the immediate consequence; the mercy of God was implored by a general fast, and public prayers were offered up to ask forgiveness for the presumption of having supposed that Heaven could have been pleased with sacrifices with which it could only have been offended.

Posterity will probably never know exactly what was the cause or remedy of this dreadful disorder. It had, perhaps, its first origin in the melancholy which those persecuted enthusiasts had brought with them from their own country, which had increased with the scurvy they had contracted at sea, and had gathered fresh strength from the inconveniences and hardships inseparable from a change of climate and manner of living. The contagion, however, ceased like all other epidemical distempers, exhausted by its very communication. A perfect calm succeeded this agitation; and the Puritans of New England have never since been seized with so gloomy a fit of enthusiasm.

But though the colony has renounced the persecuting spirit which hath stained all religious sects with blood, it has preserved some remains, if not of intoleration, at least of severity, which remind us of those melancholy days in which it took its rise. Some of its laws are still too severe.

New England had, however, some remedy against bad laws, in the constitution of its mother-country, where the people who have the legislative power in their own hands are at liberty to correct abuses; and it has others derived from its situation, which open a vast field to industry and population.

6 Manner of settlement in this colony.

The clearing of the lands in this colony was not directed by chance as in the other provinces. This matter from the first was subjected to laws which are still religiously observed. No citizen whatever had the liberty of settling even upon unoccupied land. The government, desirous of preserving all its members from the inroads of the savages, and of placing them in a condition to share in the protection of a well-regulated society, had ordered that whole villages should be formed at once. As soon as 60 families offered to build a church, maintain a clergyman, and pay a schoolmaster, it was usual for the general assembly to allot them a situation, and permit them to have two representatives in the legislative body of the colony. The district assigned them always bordered upon the lands already cleared. These new people choose the situation most convenient for their habitation, which is

usually

usually of a square figure. The church is placed in the centre; the colonists divide the land among themselves, and each incloses his property with a hedge. Some woods are reserved for a common; and thus New England constantly enlarged its territory. Such was the mode of forming new settlements while it was a British province.

7 Division, &c. The country was at first divided into four states, which had no connexion with one another. The necessity of maintaining an armed force against the savages, obliged them to form a confederacy in 1643, when they took the name of the *United Colonies.* In consequence of this league, two deputies from each establishment used to meet in a stated place to deliberate upon the common affairs of New England, according to the instructions they had received from the assembly by which they were sent. This association laid no constraint upon the right of every individual to act entirely as he pleased, without either the permission or approbation of the mother-country. All the submission required of these provinces was merely to acknowledge the kings of England for their sovereigns. Charles II. wished to make them more dependent. The province of Massachuset's bay, which, though the smallest, was the richest and the most populous of the four, being guilty of some misdemeanour against government, the king seized that opportunity of taking away its charter in 1684: and it remained without one till the revolution; when it received another, which, however, did not answer its claims or expectations. The crown reserved to itself the right of nominating the governor, and appointing to all military employments, and to all principal posts in the civil and juridical departments: it allowed the people of the colony their legislative power, and gave the governor a negative voice and the command of the troops, which secured him a sufficient influence to enable him to maintain the prerogative of the mother-country in all its force. The provinces of Connecticut and Rhode-Island, by timely submission, prevented the punishment which that of Massachusets had incurred, and retained their original charter. That of New-Hampshire had been always regulated by the same mode of administration as the province of Massachuset's-bay. The same governor presided over the whole colony, but with regulations adapted to the constitution of each province. To the above states, another has been added since the revolution, viz. VERMONT. These states are subdivided into counties, and the counties into townships.

8 Face of the country, mountains, &c. New England is a high, hilly, and in some parts a mountainous country, formed by nature to be inhabited by a hardy race of free, independent republicans. —The mountains are comparatively small, running nearly north and south in ridges parallel to each other. Between these ridges flow the great rivers in majestic meanders, receiving the innumerable rivulets and larger streams which proceed from the mountains on each side. To a spectator on the top of a neighbouring mountain, the vales between the ridges, while in a state of nature, exhibit a romantic appearance. They seem an ocean of woods, swelled and depressed in its surface like that of the great ocean itself. A richer though less romantic view is presented, when the valleys, by industrious husbandmen, have been cleared of their natural growth; and the fruit of their labour appears in loaded orchards, extensive meadows, covered with large herds of sheep and neat cattle, and rich fields of flax, corn, and the various kinds of grain. These valleys, which have received the expressive name of *interval lands*, are of various breadths, from two to 20 miles; and by the annual inundations of the rivers which flow through them, there is frequently an accumulation of rich fat soil left upon their surface when the waters retire.

There are four principal ranges of mountains, passing nearly from north-east to south-west through New England. These consist of a multitude of parallel ridges, each having many spurs, deviating from the course of the general range; which spurs are again broken into irregular hilly land. The main ridges terminate, sometimes in high bluff heads, near the sea-coast, and sometimes by a gradual descent in the interior part of the country. One of the main ranges runs between Connecticut and Hudson's rivers. This range branches and bounds the vales through which flows the Housatonick river. The most eastern ridge of this range terminates in a bluff head at Meriden; a second ends in like manner at Willingford, and a third at New Haven. In Lyme, on the east side of Connecticut river, another range of mountains commences, forming the eastern boundary of Connecticut vale. This range trends northerly, at the distance, generally, of about 10 or 12 miles east from the river, and passes through Massachusets, where the range takes the name of *Chickabee Mountain;* thence crossing into New Hampshire, at the distance of about 20 miles from the Massachusets line, it runs up into a very high peak, called *Monadnick*, which terminates this ridge of the range. A western ridge continues, and in about latitude 43° 20′ runs up into Sunipee mountains. About 50 miles further, in the same ridge, is Mooscoog mountain. A third range begins near Stonington in Connecticut. It takes its course north-easterly, and is sometimes broken and discontinued; it then rises again, and ranges in the same direction into New Hampshire, where, in latitude 43° 25′, it runs up into a high peak called *Cowsawaskog.* The fourth range has a humble beginning about Hopkinton in Massachusets. The eastern ridge of this range runs north by Watertown and Concord, and crosses Merrimack river at Pantucket Falls. In New Hampshire, it rises into several high peaks, of which the White mountains are the principal. From these White mountains a range continues north-east, crossing the east boundary of New Hampshire, in latitude 44° 30′, and forms the height of land between Kennebek and Chaudiere rivers. These ranges of mountains are full of lakes, ponds, and springs of water, that give rise to numberless streams of various sizes, which, interlocking each other in every direction, and falling over the rocks in romantic cascades, flow meandering into the rivers below. No country on the globe is better watered than New England.

On the sea-coast the land is low, and in many parts level and sandy. In the valleys, between the forementioned ranges of mountains, the land is generally broken, and in many places rocky, but of a strong rich soil, capable of being cultivated to good advantage, which also is the case with many spots even on the tops of the mountains.

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The principal river in New England is Connecticut. See CONNECTICUT.

9 Soil, productions, &c. The soil, as may be collected from what has been said, must be very various. Each tract of different soil is distinguished by its peculiar vegetation, and is pronounced good, middling, or bad, from the species of trees which it produces: and from one species generally predominating in each soil, has originated the descriptive names of oak land, birch, beech, and chesnut lands, pine, barren, maple, ash, and cedar swamps, as each species happens to predominate. Intermingled with those predominating species are walnut, firs, elm, hemlock, magnolia, moose-wood, sassafras, &c. &c. The best lands produce walnut and chesnut; the next, beech and oak; lands of the third quality produce fir and pitch-pine; the next whortleberry and barberry bushes; and the poorest produce nothing but marshy imperfect shrubs. Among the flowering trees and shrubs in the forests are the red-flowering maple, the sassafras, the locust-tree, the tulip-tree, honeysuckle, wild rose, dogwood, elm, leather-tree, laurel, hawthorn, &c. which in the spring of the year give the woods a most beautiful appearance, and fill them with a delicious fragrance. Among the fruits which grow wild, are the several kind of grapes; which are small, sour, and thick skinned. The vines on which they grow are very luxuriant, often overspreading the highest trees in the forests; and without doubt, may be greatly meliorated by proper cultivation. Besides these, are the wild cherries, white and red-mulberries, cranberries, walnuts, hazel nuts, chesnuts, butter nuts, beech nuts, wild plums and pears, whortle-berries, bilberries, gooseberries, strawberries, &c.

The soil in the interior country is calculated for the culture of Indian corn, rye, oats, barley, flax, and hemp (for which the soil and climate are peculiarly proper), buck wheat, beans, pease, &c. In many of the inland parts wheat is raised in large quantities; but on the sea-coast it has never been cultivated with success, being subject to blasts. The fruits which the country yields from culture, are apples in the greatest plenty; of these cyder is made, which constitutes the principal drink of the inhabitants; also pears of various sorts, quinces, peaches (from which is made peach brandy), plums, cherries, apricots, &c. The culinary plants are such as have already been enumerated. New England is a fine grazing country; the valleys between the hills are generally intersected with brooks of water, the banks of which are lined with a tract of rich meadow or interval land. The high and rocky ground is, in many parts, covered with honeysuckle, and generally affords the finest of pasture. It will not be a matter of wonder, therefore, that New England boasts of raising some of the finest cattle in the world; nor will she be envied, when the labour of raising them is taken into view. Two months of the hottest season in the year the farmers are employed in procuring food for their cattle; and the cold winter is spent in dealing it out to them. The pleasure and profit of doing this, is however a satisfying compensation to the honest and industrious farmer.

10 Population, manners, customs, and diversions. New England is the most populous part of the United States. It contained 1,461,391 freemen, freemen in 1810, and 418 slaves. New England then, should any great and sudden emergency require it, could furnish an army of 200,000 men. The great body of these are land-holders and cultivators of the soil. The former attaches them to their country; the latter, by making them strong and healthy, enables them to defend it. The boys are early taught the use of arms, and make the best of soldiers. Few countries on earth, of equal extent and population, can furnish a more formidable army than this part of the union.

New England may, with propriety, be called a nursery of men, whence are annually transplanted, into other parts of the United States, thousands of its natives. The state of Vermont, which is but recently formed, and contained 217,000 souls in 1810, has received more inhabitants from Connecticut than from any other state; and yet between the years 1774 and 1810, notwithstanding her numerous emigrations to Vermont, Susquehannah, and other places, and the depoulation occasioned by a seven years bloody war, it is found, from an actual census of the inhabitants in the years before mentioned, that they have increased from 197,856, their number in 1774, to 261,942, their number in 1810. Vast numbers of the New Englanders, since the war, have emigrated into the northern parts of New York, into Kentucky and the Western Territory, and into Georgia; and some are scattered into every state, and every town of note in the union.

The New Englanders are generally tall, stout, and well built. They glory, and perhaps with justice, in possessing that spirit of freedom which induced their ancestors to leave their native country, and to brave the dangers of the ocean and the hardships of settling in a wilderness. Their education, laws, and situation, serve to inspire them with high notions of liberty. Their jealousy is awakened at the first motion toward an invasion of their rights. They are indeed often jealous to excess; a circumstance which is a frightful source of imaginary grievances, and of innumerable groundless suspicions and unjust complaints against government. A law, respecting the descent of estates which are generally held in fee simple, which for substance is the same in all the New England states, is the chief foundation and protection of this liberty. By this law, the possessions of the father are to be equally divided among all the children, excepting the eldest son, who has a double portion. In this way is preserved that happy mediocrity among the people, which, by inducing economy and industry, removes from them temptations to luxury, and forms them to habits of sobriety and temperance. At the same time, their industry and frugality exempt them from want, and from the necessity of submitting to any encroachment on their liberties.

In New England, learning is more generally diffused among all ranks of people than in almost any other part of the globe; arising from the excellent establishment of schools in every township. Another source of information to the people is the newspapers, of which not less than 200,000 are printed every week in New England, and circulated in almost every town and village in the country. A person of mature age, who cannot both read and write, is rarely to be found. By means of this general establishment of schools, the extensive circulation of newspapers, and the consequent spread of learning, every township throughout the country is furnished with men capable of conduct-

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ing the affairs of their town with judgment and discretion. These men are the channels of political information to the lower class of people; if such a class may be said to exist in New England, where every man thinks himself at least as good as his neighbour, and believes that all mankind are, or ought to be, equal. The people from their childhood form habits of canvassing public affairs, and commence politicians. This naturally leads them to be very inquisitive. This desire after knowledge, in a greater or lesser degree, prevails throughout all classes of people in New England; and from their various modes of expressing it, some of which are blunt and familiar, bordering on impertinence, strangers have been induced to mention impertinent inquisitiveness as a distinguishing characteristic of New England people.—Each man also has his independent system of politics; and each assumes a dictatorial office. Hence originates that restless, litigious, complaining spirit, which forms a dark shade in the character of New Englandmen.

Before the American war, which introduced into New England a flood of corruptions, with many improvements, the Sabbath was observed with great strictness; no unnecessary travelling, no secular business, no visiting, no diversions, were permitted on that sacred day. They considered it as consecrated to divine worship, and were generally punctual and serious in their attendance upon it. Their laws were strict in guarding the Sabbath against every innovation. The supposed severity with which these laws were composed and executed, together with some other traits in their religious character, have acquired, for the New Englanders, the name of a superstitious bigotted people. But superstition and bigotry are so indefinite in their significations, and so variously applied by persons of different principles and educations, that it is not easy to determine how far they deserved that character. Leaving every person to enjoy his own opinion in regard to this matter, we will only observe, that, since the war, a catholic tolerant spirit, occasioned by a more enlarged intercourse with mankind, has greatly increased, and is becoming universal; and if they do not break the proper bound, and liberalize away all true religion, of which there is much danger, they will counteract that strong propensity in human nature, which leads men to vibrate from one extreme to its opposite.

There is one distinguishing characteristic in the religious character of this people, which we must not omit to mention; and that is, the custom of annually celebrating fasts and thanksgivings. In the spring, the several governors issue their proclamations, appointing a day to be religiously observed in fasting, humiliation, and prayer, throughout their respective states, in which the predominating vices, that particularly call for humiliation, are enumerated. In autumn, after harvest, that gladsome era in the husbandman's life, the governors again issue their proclamations, appointing a day of public thanksgiving, enumerating the public blessings received in the course of the foregoing year. This pious custom originated with their venerable ancestors, the first settlers of New England; and has been handed down as sacred through the successive generations of their posterity. A custom so rational, and so happily calculated to cherish in the minds of the people a sense of their dependence on the great Benefactor of the world for all their blessings, it is hoped will ever be sacredly preserved.

The people of New England generally obtain their estates by hard and persevering labour: They of consequence know their value, and spend with frugality. Yet in no country do the indigent and unfortunate fare better. Their laws oblige every town to provide a competent maintenance for their poor; and the necessitous stranger is protected and relieved from their humane institutions. It may in truth be said, that in no part of the world are the people happier, better furnished with the necessaries and conveniences of life, or more independent, than the farmers in New England. As the great body of the people are hardy independent freeholders, their manners are, as they ought to be, congenial to their employment, plain, simple, and unpolished. Strangers are received and entertained among them with a great deal of artless sincerity and friendly unformal hospitality. Their children, those imitative creatures, to whose education particular attention is paid, early imbibe the manners and habits of those around them; and the stranger, with pleasure, notices the honest and decent respect that is paid him by the children as he passes through the country.

As the people, by representation, make their own laws and appoint their own officers, they cannot be oppressed; and living under governments which have few lucrative places, they have few motives to bribery, corrupt canvassings, or intrigue. Real abilities and a moral character unblemished, are the qualifications requisite in the view of most people for offices of public trust. The expression of a wish to be promoted is the direct way to be disappointed.

The inhabitants of New England are generally fond of the arts, and have cultivated them with great success. Their colleges have flourished beyond any others in the United States. The illustrious characters they have produced, who have distinguished themselves in politics, law, divinity, the mathematics and philosophy, natural and civil history, and in the fine arts, particularly in poetry, evince the truth of these observations.

Many of the women in New England are handsome. They generally have fair, fresh, and healthful countenances, mingled with much female softness and delicacy. Those who have had the advantages of a good education (and they are considerably numerous) are genteel, easy, and agreeable in their manners, and are sprightly and sensible in conversation. They are early taught to manage domestic concerns with neatness and economy. Ladies of the first rank and fortune make it a part of their daily business to superintend the affairs of the family. Employment at the needle, in cookery, and at the spinning-wheel, with them is honourable. Idleness, even in those of independent fortunes, is universally disreputable. The women in the country manufacture the greatest part of the clothing of their families. Their linen and woollen cloths are strong and decent. Their butter and cheese are not inferior to any in the world.

Dancing is the principal and favourite amusement in New England; and of this the young people of both sexes are extremely fond. Gaming is practised by none but those who cannot or rather will not find a reputable employment. The gamester, the horse-jockey, and the knave, are equally despised, and their company is

New England, English.

avoided by all who would sustain fair and irreproachable characters. The odious and inhuman practices of duelling, gouging, cock-fighting, and horse-racing, are scarcely known here.—The athletic and healthy diversions of cricket, football, quoits, wrestling, jumping, foot-races, &c. are universally practised in the country, and some of them in the most populous places, and by people of almost all ranks. Squirrel-hunting is a noted diversion in country places, where this kind of game is plenty. Some divert themselves with fox-hunting, and others with the more profitable sports of fishing and duck-hunting; and in the frontier settlements, where deer and fur-game abound, the inhabitants make a lucrative sport of hunting them. In the winter season, while the ground is covered with snow, which is commonly two or three months, sleighing is the general diversion. A great part of the families throughout the country are furnished with horses and sleighs.

11 Trade.

New England has no one staple commodity. The ocean and the forests afford the two principal articles of export. Cod-fish, mackarel, shad, salmon, and other fish, whale-oil and whale-bone, masts, boards, scantling, staves, hoops, and shingles, have been and are still exported in large quantities. The annual amount of cod and other fish for foreign exportation, including the profits arising from the whale-fishery, is estimated at upwards of half a million.—Besides the articles enumerated, they export from the various parts of New England ships built for sale, horses, mules, live stock, pickled beef and pork, pot-ash, pearl-ash, flax-seed, butter and cheese, rum, &c. From a view of the annual imports into New England, it appears that the greatest part of them consists of the luxuries, or at best the dispensable conveniences of life; the country affords the necessaries in great abundance. See the articles CONNECTICUT, RHODE ISLAND, MASSACHUSETTS, VERMONT, and NEW HAMPSHIRE.

ENGLISH, or the *ENGLISH Tongue*, the language spoken by the people of England, and, with some variation, by those of Scotland, as well as part of Ireland, and the rest of the British dominions.

The ancient language of Britain is generally allowed to have been the same with the Gallic, or French; this island, in all probability, having been first peopled from Gallia, as both Cæsar and Tacitus affirm, and prove by many strong and conclusive arguments, as by their religion, manners, customs, and the nearness of their situation. But now we have very small remains of the ancient British tongue, except in Wales, Cornwall, the islands and highlands of Scotland, part of Ireland, and some provinces of France; which will not appear strange, when what follows is considered.

Julius Cæsar, some time before the birth of our Saviour, made a descent upon Britain, though he may be said rather to have discovered than conquered it; but about the year of Christ 45, in the time of Claudius, Aulus Plautius was sent over with some Roman forces, by whom two kings of the Britons, Togodumnus and Caractacus, were both overcome in battle: whereupon a Roman colony was planted at Malden in Essex, and the southern parts of the island were reduced to the form of a Roman province: after that, the island was conquered as far north as the friths of Dunbarton and Edinburgh, by Agricola, in the time of Domitian; whereupon a great number of the Britons, in the conquered part of the island, retired to the west part called *Wales*, carrying their language with them.

English.

The greatest part of Britain being thus become a Roman province, the Roman legions, who resided in Britain for above 200 years, undoubtedly disseminated the Latin tongue; and the people being afterwards governed by laws written in Latin must necessarily make a mixture of languages. This seems to have been the first mutation the language of Britain suffered.

Thus the British tongue continued, for some time, mixed with the provincial Latin, till the Roman legions being called home, the Scots and Picts took the opportunity to attack and harass England: upon which King Vortigern, about the year 440, called the Saxons to his assistance; who came over with several of their neighbours, and having repulsed the Scots and Picts, were rewarded for their services with the isle of Thanet, and the whole county of Kent; but growing too powerful, and not being content with their allotment, dispossessed the inhabitants of all the country on this side of the Severn [*]: thus the British tongue was in a great measure destroyed, and the Saxon introduced in its stead.

What the Saxon tongue was long before the Conquest, about the year 700, we may observe in the most ancient manuscript of that language, which is a gloss on the Evangelists, by Bishop Edfrid, in which the three first articles of the Lord's prayer run thus:

"Uren fader thic arth in heofnas, sic gehalgud thin noma, so cymeth thin ric. Sic thin willa sue is heofnas, and in eortho," &c.

In the beginning of the ninth century the Danes invaded England; and getting a footing in the northern and eastern parts of the country, their power gradually increased, and they became sole masters of it in about 200 years. By this means the ancient British obtained a tincture of the Danish language; but their government being of no long continuance, did not make so great an alteration in the Anglo-Saxon as the next revolution, when the whole land, A. D. 1067, was subdued by William the Conqueror, duke of Normandy in France: for the Normans, as a monument of their conquest, endeavoured to make their language as generally received as their commands, and thereby rendered the British language an entire medley.

About the year 900, the Lord's prayer, in the ancient Anglo-Saxon, ran thus:

"Thue ur fader the eart on heofenum, si thin nama gehalgod; cume thin rice sithin will æ on eorthan swa, swo on heofenum," &c.

About the year 1160, under Henry II. it was rendered thus by Pope Adrian, an Englishman, in rhyme:

"Ure fader in heaven rich,
"Thy name be halyed ever lich,
"Thou bring us thy michel blesse:
"Als hit in heaven y doe,
"Evar in yearth been it also," &c.

Dr Hicks gives us an extraordinary specimen of the English, as spoken in the year 1385, upon the very subject of the English tongue.

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[*] See *England*, N° 13—42.

"As it is knowe how meny maner peple beeth in this lond; ther beeth also so many dyvers longages and tonges. Notheless Walschemen and Scots that beeth nought medled with other nation, holdeth wel nyh hir firste longage and speche; but yit the Scottes, that were sometime confederate and woned with the Pictes, drawe somewhat after hir speche; but the Flemynges, that woneth on the west side of Wales, haveth lost her strange speche, and speketh Sexonliche now. Also Englishemen, they had from the begynnynge thre maner speche; northerne, southerne, and middel speche in the middel of the lond, as they come of thre maner of peple of Germania: notheless by commyxtion and mellynge first with Danes, and afterwards with Normans, in meny the contrary longage is apayred *corrupted*.)

"This apayrynge of the burth of the tunge is bycause of tweie things; oon is for children in scole agenst the usuage and maner of all other nations, beeth compelled for to leve hir own longage, and for to construe hir lessons and here things in Frensche, and so they haveth sethe Normans come first into Engelond. Also gentlemen children beeth taught to speke Frensche from the tyme that they beeth roked in here cradel, and kunneth speke and play with a childe's broche; and uplondissche men will lykne hymself to gentilmen, and fondeth with great besynesse for to speak Frensche to be told of.—Hit seemeth a great wonder how Englischemen and hir own longage and tonge is so dyverse of sown in this oon iland; and the longage of Normandie is comlynge of another lond, and hath oon maner sown amonge alle men that speketh hit arigt in Engelond. Also of the foresaid Saxon tonge that is deled (*divided*) a three, and is abide scarceliche with fewe uplondissche men is greet wonder. For men of the est, with men of the west, is, as it were, undir the same partie of hevene accordeth more in sownynge of speche, than men of the north with men of the south. Therefore it is that Mercii, that beeth men of myddel Engelond, as it were, parteners of the endes, understondeth bettre the side longes, northerne and southerne, than northerne and southerne understondeth either other.—All the longage of the Northumbers and specihalliche at York, is so scharp, slitting, and frotynge, and unschape, that we southerne men may that longage unethe understonde," &c.

In the year 1537, the Lord's prayer was printed as follows: "O oure father which arte in heven, hallowed be thy name: let thy kingdome come, thy will be fulfilled as well in erth as it is in heven; geve us this daye in dayly bred," &c. Where it may be observed, that the diction is brought almost to the present standard, the chief variations being only in the orthography. By these instances, and many others that might be given, it appears, that the English Saxon language, of which the Normans despoiled us in a great measure, had its beauties, was significant and emphatical, and preferable to what they imposed on us. "Great, verily (says Camden), was the glory of our tongue before the Norman conquest, in this, that the old English could express, most aptly, all the conceptions of the mind in their own tongue, without borrowing from any. Of this he gives several examples.

Having thus shewn how the ancient British language was in a manner extirpated by the Romans, Danes, and Saxons, and succeeded by the Saxon, and after that the Saxon blended with the Norman French, we shall now mention two other causes of change in the language. The first of these is owing to the Britons having been a long time a trading nation, whereby offices, dignities, names of wares, and terms of traffic, are introduced, which we take with the wares from the persons of whom we have them, and form them anew, according to the genius of our own tongue; and besides this change in the language, arising from commerce, Britain's having been a considerable time subject to the see of Rome, in ecclesiastical affairs, must unavoidably have introduced some Italian words among us. Secondly, As to the particular properties of a language, our tongue has undergone no small mutation, or rather has received no small improvement upon that account: for, as to the Greek and Latin, the learned have, together with the arts and sciences now rendered familiar among us, introduced abundance; nay, almost all the terms of art in the mathematics, philosophy, physic, and anatomy; and we have entertained many more from the Latin, French, &c. for the sake of neatness and elegancy: so that, at this day, our language, which, about 1800 years ago, was the ancient British, or Welsh, &c. is now a mixture of Saxon, Teutonic, Dutch, Danish, Norman, and modern French, embellished with the Greek and Latin. Yet this, in the opinion of some, is so far from being a disadvantage to the English tongue as now spoken (for all languages have undergone changes, and do continually participate with each other), that it has so enriched it, as now to render it the most copious, significant, fluent, courteous, and masculine language in Europe, if not in the world.

ENGRAFTING, in *Gardening*. See GRAFTING, GARDENING *Index*.

ENGRAILED, or INGRAILED, in *Heraldry*, a term derived from the French *gresly*, "hail;" and signifying a thing the hail has fallen upon and broke off the edges, leaving them ragged, or with half rounds, or semicircles, struck out of their edges.

ENGRAVING, the art of cutting metals and precious stones, and representing thereon figures, letters, or whatever device or design the artist fancies.

Engraving, properly a branch of sculpture, is divided into several other branches, according to the matter whereon it is employed, and the manner of performing it. For the rudest branch, that of

*ENGRAVING on Wood*, see WOOD, *Engraving on*.

*ENGRAVING on Copper*, the making, correspondently to some delineated figure or design, such concave lines on a smooth surface of copper, either by cutting or corrosion, as render it capable, when charged properly with any coloured fluid, of imparting by compression an exact representation of the figure or design to paper or parchment.

Whether we consider the art of engraving, with regard to the utility and pleasure it affords, or the difficulty that attends its execution, we cannot but confess, that on every account it deserves a distinguished rank among the polite arts†. It is by means of this art that the cabinets of the curious are adorned with the portraits of the greatest men of all ages and all nations;

† See Polite Arts, N° 13.

tions; that their memories, their most remarkable and most glorious actions, are transmitted to the latest posterity. It is by this art also, that the paintings of the greatest masters are multiplied to a boundless number; and that the lovers of the polite arts, diffused over the face of the whole earth, are enabled to enjoy those beauties from which their distant situations seemed to have for ever debarred them; and persons of moderate fortune are hereby enabled to become possessed of all the spirit, and all the poetry, that are contained in those miracles of art, which seemed to have been reserved for the temples of Italy, or the cabinets of princes. When we reflect, moreover, that the engraver, beside the beauties of poetic composition, and the artful ordinance of design, is to express, merely by the means of light and shade, all the various tints of colour and clair obscure; to give a relief to each figure, and a truth to each object; that he is now to paint a sky serene and bright, and then loaded with dark clouds; now the pure tranquil stream, and then the foaming, raging sea; that here he is to express the character of the man, strongly marked in his countenance, and there the minutest ornament of his dress; in a word, that he is to represent all, even the most difficult objects in nature; we cannot sufficiently admire the vast improvements in this art, and that degree of perfection to which it is at this day arrived. See the article PRINTS.

Engraving is an art, for the greatest part, of modern invention; having its rise no earlier than the middle of the 15th century. The ancients, it is true, practised engraving on precious stones and crystals with very good success; and there are still many of their works remaining equal to any production of the later ages. But the art of engraving on plates and blocks of wood, to afford prints or impressions, was not known till after the invention of painting in oil.

The different modes of engraving are the following:

In strokes cut through a thin wax, laid upon the copper, with a point, and these strokes bitten or corroded into the copper with aquafortis. This is called *etching*.

In strokes with the graver alone, unassisted by aquafortis. In this instance, the design is traced with a sharp tool, called a *dry point*, upon the plate; and the strokes are cut or ploughed upon the copper with an instrument distinguished by the name of a *graver*.

In strokes first etched and afterwards finished with the graver: by this expedient the two former methods are united.

In dots without strokes, which are executed with the point upon the wax or ground, bitten in with the aquafortis, and afterwards harmonized with the graver, by the means of which instrument small dots are made; or with the graver alone, as in the flesh and finer parts, unassisted with the point.

In dots first etched and afterwards harmonized with the dry point, performed by a little hammer, called *opus mallei*, or *the work of the hammer*, as practised by Lutma and others.

In mezzotinto, which is performed by a dark barb or ground being raised uniformly upon the plate with a toothed tool. The design being traced upon the plate, the light parts are scraped off by instruments for that purpose, in proportion as the effect requires.

In aquatinta, a newly invented method of engraving. The outline is first etched, and afterwards a sort of wash is laid by the aquafortis upon the plate, resembling drawings in Indian ink, bister, &c.

On wood, performed with a single block, on which the design is traced with a pen, and those parts which should be white carefully hollowed out; and this block is afterwards printed by the letter-press printers, in the same manner as they print a book.

On wood, performed with two, three, or more blocks, the first having the outlines cut upon it; the second is reserved for the darker shadows; and the third for the shadows which terminate upon the lights; and these are substituted in their turn, each print receiving an impression from every block. This mode of engraving is called *chiaro-scuro*, and was designed to represent the drawings of the old masters.

On wood and on copper: in these the outline is engraved in a bold dark style upon the copper; and two or more blocks of wood are substituted to produce the darker and lighter shadows, as before.

Of all those modes of engraving, the most ancient is that on *wood*; or, to speak more properly, the first impressions on paper were taken from carved wooden blocks. From this invention it appears that we are indebted to the brief-malers or makers of playing-cards, who practised the art in Germany about the beginning of the 15th century. From the same source may perhaps be traced the first idea of moveable types, which appeared not many years after: for these brief-malers did not entirely confine themselves to the printing and painting of cards, but produced also subjects of a more devout nature; many of which, taken from holy writ, are still preserved in different libraries in Germany, with the explanatory text facing the figures; the whole engraved in wood. In this manner they even formed a species of books; such as, *Historia sancti Johannis, ejusque Visiones Apocalypticæ; Historia Veteris et Novi Testamenti*, known by the name of the *Poor Man's Bible*. These short momentos were printed only on one side; and two of them being pasted together, had the appearance of a single leaf. The earliest date on any of these wooden cuts is 1423. The subject is *St Christopher carrying the Infant Jesus over the Sea*, preserved in a convent at Buxheim near Menningen. It is of a folio size, illuminated in the same manner as the playing cards; and at the bottom is this inscription, *Christoferi faciem die quacunque tueris. Illa nempe die morte mala non morieris. Millesimo CCCC° XX° tertio.*

*Strutt's Hist of Engraving.*

Upon the invention of moveable types, that branch of the brief-malers business, so far as it regarded the making of books, was gradually discontinued; but the art itself of engraving on wood continued in an improving state; and towards the end of the 15th and beginning of the 16th century, it became customary for almost every one of the German engravers on copper to engrave on wood also. The works of Albert Durer in this style of engraving are justly held in the highest esteem. Italy, France, and Holland, have produced many capital artists of this kind; but for boldness and spirit, we must see the prints of Christopher Jegher, who worked under the direction of Rubens, and was without doubt assisted by that great master.

The invention of that species of engraving distinguished by the appellation of *chiaro-scuro*, seems also to be justly claimed by the Germans, and first practised by Mair; one of whose prints of this kind is dated 1499. Many excellent works in chiaro-scuro have been produced in France; and in Italy it was honoured with the performances of Titian and Parmegiano; but the attempts of Jackson, Kirkall, and others in England, have not been equally successful. A set of excellent prints in this way have lately been published by J. Skippe, Esq. a connoisseur and dillettante.

*Strutt's Hist. of Engraving.*

In Germany, about the year 1450, prints from engraved *copper* first made their appearance. The earliest date of a copperplate print is indeed only 1461; but however faulty this print may be with respect to the drawing, or defective in point of taste, the mechanical part of the execution of it has by no means the appearance of being one of the first productions of the graver. We have also several other engravings, evidently the work of the same master; in which the impressions are so neatly taken from the plates, and the engravings so clearly printed in every part, that according to all appearance they could not be executed in a much better manner in the present day, with all the conveniences which the copperplate printers now possess, and the additional knowledge they must necessarily have acquired in the course of more than three centuries. Hence we may fairly conclude, that if they were not the first specimens of the engraver's workmanship, they were much less the first efforts of the copperplate printer's ability. It is likewise to be observed, that Martin Schoen, who is said, with great appearance of truth, to have worked from 1460 to 1486, was apparently the scholar of Stoltzhirs; for he followed his style of engraving, and copied from him a set of prints, representing the passion of our Saviour. Now, allowing Stoltzhirs to have preceded his disciple only ten years, this carries the era of the art back to 1450, as was said above. There is no ground to suppose that it was known to the Italians till at least ten years afterwards. The earliest prints that are known to be theirs are a set of the seven planets, and an almanack by way of frontispiece; on which are directions for finding Easter from the year 1465 to 1517 inclusive: and we may be well assured, that the engravings were not antedated, for the almanack of course became less and less valuable every year. In all probability, therefore, these prints must have been executed in the year 1464, which is only four years later than the Italians themselves lay any claim to. The three earliest Italian engravers are, Finiguerra, Boticelli, and Baldini. If we are to refer these prints to any of the three, we shall naturally conclude them to be the work of Finiguerra or Baldini; for they are not equal either in drawing or composition to those ascribed to Boticelli, which we know at least were designed by him; and as Baldini is expressly said to have worked from the designs of Boticelli, it will appear most probable that they belong to Finiguerra.

With respect to the invention of *etching*, it seems to be not well known to whom it is to be ascribed. One of the most early specimens is that print by Albert Durer, known by the name of the *Canon*, dated 1518, and thought by some, with little foundation, to have been worked on a plate of iron. Another etching by the same artist is Moses receiving the Tables of the Law, dated 1524. It was also practised in Italy soon after this by Parmegiano, in whose etchings we discover the hand of the artist working out a system as it were from his own imagination, and striving to produce the forms he wanted to express. We see the difficulty he laboured under; and cannot doubt, from the examination of the mechanical part of the execution of his works, that he had no instruction; and that it was something entirely new to him. If the story is true, that he kept an engraver by profession in his house, the novelty of the art is rendered so much the more probable. He died in 1540.

As to that species of engraving in which the modes of *etching* and *cutting* with the graver are united, it must have been found necessary immediately upon the invention of etching; it was, however, first carried to perfection by G. Audran, and is now almost universally practised, whether the work is in strokes or in dots.

Engraving in *dots*, the present fashionable method, is a very old invention, and the only mode discovered by the Italians. Agostina de Musis, commonly called *Augustine of Venice*, a pupil of Marc Antonio, used it in several of his earliest works, but confined it to the flesh, as in the undated print of An Old Man seated upon a Bank, with a cottage in the back ground. He flourished from 1509 to 1536. We also find it in a print of "A single figure standing, holding a cup and looking upwards," by Giulio Campagnola, who engraved about the year 1516. The back ground is executed with round dots, made apparently with a dry point. The figure is outlined with a stroke deeply engraved, and finished with dots, in a manner greatly resembling those prints which Demarteau engraved at Paris in imitation of red chalk. The hair and beard are expressed by strokes. Stephen de Laulne, a native of Germany, followed the steps of Campagnola; and many of his slight works are executed in dots only. John Boulanger, a French artist, who flourished in the middle of the last century, and his cotemporary Nicholas Van Plattenberg, improved greatly on this method, and practised it with much success. It is only, however, of late, that it has been considered as an object worthy of general imitation. John Lutma executed this kind of work with a hammer and a small punch or chissel.

The method of engraving in *mezzotinto* was invented about the middle of the 17th century; and the invention has generally been attributed to Prince Rupert, though it has also been asserted that he learnt the secret from another. See MEZZOTINTO.

Of the method of engraving in aquatinta, a short and general account has already been given under that word. See AQUATINTA. But as some farther information relating to this branch of the art of engraving has fallen in our way, we embrace this opportunity of laying it before our readers.

Engraving in aquatinta, was originally invented by Le Prince, a French artist. For a long time, his process was kept secret; and his prints, it is said, were at first sold for drawings. As a proof that the art rose at once to perfection, as has already been mentioned, the prints which were executed by him, are still admired as the finest and best specimens of the art. It appears, however, that he was only acquainted with the powdered grain, and the common method of stopping out. The first who practised this art in England, was Mr Paul Sandby. By him, we are informed, it was communicated to Mr Jukes, whose works afford excellent examples to what perfection the art has been carried; and although it is now generally practised all over Europe, yet in no country with greater success than in Britain.

The principle of this process consists in corroding the copper in such a manner, that an impression from it exhibits the appearance of a tint laid on paper, or a drawing in Indian ink. This is accomplished by covering the copper with some substance which assumes a granulated form, and prevents the acid from acting where the particles adhere; and thus the copper is only partially corroded. The more minute the particles are, it is obvious the impression from the plate will more nearly resemble a wash of Indian ink, or a drawing; but the larger the particles are, the granulation becomes more distinct. The powder or granulation is called the *aquatinta grain*. It is produced in two ways.

The process for using the powdered grain, which was first employed, is the following. The outline being etched on a copperplate, some substance which easily melts with heat, adheres to the plate when cold, and resists the action of the aquafortis, is to be finely powdered and sifted. Besides asphaltum, rosin, and gum sandaric, the substances which have been mentioned in the article already referred to, Burgundy pitch, gum copal, gum mastic, as well as some other resins and gum resins, may be employed. Gum copal, it is observed, produces a grain which resists the aquafortis extremely well. Whatever the substance is which is to be employed, the great object of the artist in its application is, to have it equally distributed over the plate. This is an essential part of the operation, and requires considerable attention. The usual method is, to tie up a quantity of the powder in a piece of muslin, and to strike it against a stick held at a considerable height above the plate. Thus managed, the powder settles equally over it, in the same uniform manner that hair powder settles on the furniture of an apartment, where the operations of the hair-dresser are performed. The plate being thus covered equally with the dust or powder, it is to be fixed upon it by the application of a gentle heat, to melt the particles. This is usually done by holding lighted pieces of brown paper, rolled up, and moving them about till the whole of the powder is melted, which is known by its changing to a brown colour. It is now allowed to cool, and after being examined with a magnifying glass, if the particles appear to be uniformly distributed, the artist proceeds to the next part of the process.

Those parts of the design or drawing to be engraved, which are perfectly white, are to be observed and marked, and the corresponding parts of the plate must be covered or stopped out. This is best done by means of mastic varnish, diluted to such a consistence with turpentine as to work freely with the pencil. To give it colour, lamp-black should be mixed with it, that the touches of the pencil may be distinctly seen. When those parts of the plate which are stopped out, are sufficiently dry, a border of wax is raised round the plate, in the same manner as in etching, and the aquafortis diluted with water is poured on. This being the most precarious part of the process, requires the greatest experience. When it is supposed that the aquafortis has remained on the plate for such a length of time, that when an impression is taken, it will produce the lightest shade in the drawing, it is poured off, and the plate is washed with water and dried. The lightest tints are then stopped out, and the aquafortis is again poured on; and this process is repeated as often as there are tints or shades to be produced in the plate.

Many plates are entirely etched in this way, by alternately stopping out and biting in. It is, however, found to be extremely difficult, and indeed impossible, to produce impressions of minute and complicated objects with the requisite degree of delicacy and freedom. To obviate this difficulty, another process has been proposed, by which the touches are laid on the plate, with equal ease and expedition as on drawings with Indian ink. Fine washed whitening is mixed with treacle or sugar, and diluted with water in the pencil, that it may work freely. This is laid on the plate covered with the aquatint ground, in the same way as ink on the drawing. When this is dry, the whole of the plate is varnished over with a thin turpentine or mastic varnish, and when this is dry, the aquafortis is poured on. The varnish immediately breaks up in those parts of the plate where the treacle mixture was laid, and thus they are exposed to the action of the acid, while the other parts of the plate remain untouched. Thus the touches or places of the plate where the treacle has been applied, are bit in deeper than the rest, and have the precision of touches done with Indian ink. The plate being thus completely bit in, the bordering wax is removed, by gently heating it, with a piece of lighted paper. It is then cleared from the ground, and varnished by means of oil of turpentine; and being wiped clean with a rag and a little fine whitening, it is ready for the printer.

But in this method of aquatinting, it is found difficult to produce the necessary degree of coarseness or fineness in the grain; and plates which are engraved in this manner afford but a small number of impressions before they are worn out. On this account it is now more rarely followed.

The other method of producing the aquatint ground, which is more generally adopted, is the following. A resinous substance, as common resin, Burgundy pitch, or mastic, is dissolved in spirits of wine. This solution is poured all over the plate, which is inclined, till the whole of the superfluous fluid drains off, and what adheres to the plate becomes quite dry in a few minutes. The plate being then examined with a magnifying glass, it will appear that the whole of the spirit having evaporated, the resinous matter is left in a granulated state, or is cracked in every direction, and adheres strongly to the copper. In this way a regular and beautiful grain is easily produced, which will be found preferable, at least for most purposes, to that which is produced by the former method. The grain being thus formed, the other parts of the process are conducted in the same manner as before described.

Such are the usual methods of conducting this process. We shall add a few hints which the young artist may find useful in the different parts of it. With regard to the materials which are employed, it is to be observed, that the spirits of wine should be rectified, and of the best quality. Resinous matters, as common resin, Burgundy pitch, and gum mastic, yield grains of a different appearance and form; so that advantage may be taken of this circumstance, by using them sometimes separately, and sometimes mixed in different proportions, according to the views and taste of the artist. Different proportions of resin may be employed, to produce grains of different kinds. When a coarse grain is intended, a greater proportion is to be employed; and when a fine grain is wanted, a smaller proportion of resin only is required. The proper proportions may be ascertained by providing a number of spare pieces of copper; on these the liquid may be poured, and the grain examined, before it is applied to the plate which is to be engraved. After the solution is made, it should remain undisturbed for a day or two, till the impurities of the resin have subsided, and the liquid becomes quite limpid. This is the best method of freeing it from impurities; for if it is strained through linen or muslin, it is mixed with hairs, which are extremely injurious to the grain. It may be added, that the apartment in which the fluid is poured on the plate, should be perfectly still, and entirely free from dust; for if any fall on the plate while it is wet, the grain forms a white spot which cannot be removed. Great care should be observed in cleaning the plate. This is done with a bit of rag and whitening. The smallest stain or particle of grease produces a streak or blemish in the grain. Still, however, with all the attention which can be employed, and with the utmost delicacy in the management, it is necessary to observe, that the process is extremely precarious and uncertain; and even the most experienced artists find themselves frequently subject to very unaccountable accidents.

Phil. Mag. vol. xxiii. 137.

Artists have frequently complained of the inconvenience from the fumes which proceed from the action of the acid upon the copper, when the plate is large. "To remedy this inconvenience, the following arrangement, which seems well calculated to answer the purpose, has been suggested by Mr Cornelius Varley, a young artist who distinguishes himself no less by his mechanical abilities than by the exquisite productions of his pencil in water colours.—Get a frame made of common deal or any kind of wood, three or four inches deep, covered with a plate of glass, and open at one side; and let the side opposite to this have a round opening communicating, by means of a common iron pipe, with the ash-pit of any little stove or other fire-place, shut up from all other access of air but what must pass through the pipe. It is obvious that any fumes rising from a copper-plate laid under such a frame will be carried backward into the iron-pipe by the current of air required to maintain combustion in the stove, and will by this means be carried up the chimney in place of being allowed to fly about in the apartment. The pipe may be very conveniently used by carrying it down through the table to the floor, and so along to the place where the chimney may chance to stand; and when the frame is not wanted, the pipe at one of the joinings may be made to answer the purpose of a hinge, by which to turn up the frame against the wall, where it may be secured, while out of use, by a button or any other contrivance."

This method of engraving in aquatinta seems to be chiefly adapted for slight subjects in general, for imitations of sketches and washed drawings. But for the production of prints from finished pictures, it is by no means calculated; because it is not susceptible of that accuracy in the nice management of the tints which is necessary for this purpose. It is equally unsuitable for book plates; because, without retouching the plates, the number of impressions that can be thrown off is very small. On these accounts, therefore, it is to be considered greatly inferior to the other modes of engraving. But as it is more expeditious, and may be attained with more facility, it is undoubtedly useful when it is confined to those subjects for which it is peculiarly calculated. This rapidity of execution, however, and facility in acquiring the practice of the art, are followed with the unfortunate circumstance, that they favour the production of an indiscriminate multitude of prints, which, it is to be feared, may rather tend to vitiate the public taste.

Engraving with the tool was the kind originally practised, and it is yet retained for many purposes. For though the manœuvre of etching be more easy, and other advantages attend it; yet where great regularity and exactness of the stroke or lines are required, the working with the graver is much more effectual: on which account it is more suitable to the precision necessary in the execution of portraits: as there every thing the most minute must be made out and expressed, according to the original subject, without any licence to the fancy of the designer in deviating from it, or varying the effect either by that masterly negligence and simplicity in some parts, or those bold sallies of the imagination and hand in others, which give spirit and force to history painting.

The principal instruments used in engraving with the tool are, gravers, scrapers, a burnisher, an oil-stone, and a cushion for bearing the plates.

Gravers are made in several forms with respect to the points, some being square, others lozenge; the square graver for cutting broad and deep, and the lozenge for more delicate and fine strokes and hatches. La Bosse recommends, as the most generally useful, such as are of a form betwixt the square and lozenge: and he advises, that they should be of a good length: small towards the point, but stronger upwards, that they may have strength enough to bear any stress there may be occasion to lay upon them: for if they be too small and mounted high, they will bend: which frequently causes their breaking, especially if they be not employed for very small subjects.

The burnisher is used to assist in the engraving on some occasions, as well as to polish the plates. It is seven inches in length, and made of fine steel well polished. The burnisher is formed at one end, and a scraper on the other, each about an inch and a half long from the point: betwixt them, about four inches of the instrument is made round, and serves as a handle; and is thicker in the middle than at the necks, where the burnisher and scraper begin, which necks are only one quarter of an inch in diameter. The principal

pal application of it in engraving, besides its use in polishing the plates, is to take out any scratches or accidental defacings that may happen to the plates during the engraving; or to lessen the effect of any parts that may be too strongly marked in the work, and require to be taken down.

A cushion, as it is called, is likewise generally used for supporting the plate in such a manner, that it may be turned every way with ease. It is a bag of leather filled with sand, which should be of the size that will best suit the plates it is intended to bear. They are round, and about nine inches over, and three inches in thickness.

The cushion, made as above directed, being laid on the table, the plate must be put upon it; and the graver being held in the hand in a proper manner, the point must be applied to the plate, and moved in the proper direction for producing the figures of the lines intended: observing, in forming straight lines, to hold the plate steady on the cushion; and where they are to be finer, to press more lightly, using greater force where they are to be broader and deeper. In making circular or other curve lines, hold your hand and graver steadily; and as you work, turn your plate upon the cushion against your graver, otherwise it will be impossible for you to make any circular or curved line with that neatness and command of hand you by this means may. After part of the work is engraved, it is necessary to scrape it with the scraper or graver, passed in the most level direction over the plate, to take off the roughness formed by the cutting of the graver; but great care must be taken not to incline the edge of the scraper or tool used, in such a manner that it may take the least hold of the copper, as it would otherwise produce false strokes or scratches in the engraving: and that the engraved work may be rendered more visible, it may afterwards be rubbed over with a roll of felt dipped in oil. In using the graver, it is necessary to carry it as level as possible with the surface of the plate; for otherwise, if the fingers slip betwixt them, the line that will be produced, whether curve or straight, will become deeper and deeper in the progress of its formation; which entirely prevents strokes being made at one cut, that will be fine at their extremities, and larger in the middle; and occasions the necessity of retouching to bring them to that state. For this reason, it is very necessary for those who would learn to engrave in perfection, to endeavour, by frequent trials, to acquire the habit of making such strokes both straight and curving, by lightening or sinking the graver with the hand, according to the occasion. If, after finishing the design, any scratches appear, or any part of the engraving be falsely executed, such scratches, or faulty parts, must be taken out by the burnisher, and further polished, if necessary, by the above-mentioned roll.

The plate being thus engraved, it is proper to round off the edges, by using first a rough file, and afterwards a smoother; and to blunt the corners a little by the same means: after which, the burnisher should be passed over the edges to give it a farther polish.

The dry point, or needle, which has been of late much used in engraving, is a tool like an etching point, which being drawn hard on the copper, cuts a stroke, and raises a burr; the burr is scraped off, and there remains a stroke more soft and delicate than can be produced in any other way.

In the conduct of the graver and dry point consists all the art; for which there are no rules to be given; all depending on the habitude, disposition, and genius, of the artist. However, besides the explanations already given, some general observations and directions may not be improper. As the principles of engraving are the same with those of painting, a person cannot expect to attain any considerable degree of perfection in this art who is not a good master of design; and therefore he ought to be well acquainted both with perspective and architecture: for the former, by the proper degradations of strong and faint colours, will enable him to throw backwards the figures and other objects of the picture or design which he proposes to imitate; and the latter will teach him to preserve the due proportion of its several orders, which the painter often entrusts to the discretion of the engraver. In order to preserve equality and union in his works, the engraver should always sketch out the principal objects of his piece before he undertakes to finish them. In working, the strokes of the graver should never be crossed too much in a lozenge manner, particularly in the representation of flesh, because sharp angles produce the unpleasing effect of lattice-work, and take from the eye the repose which is agreeable to it in all kinds of picturesque designs: we should except the case of clouds, tempests, waves of the sea, the skins of hairy animals, or the leaves of trees, where this method of crossing may be admitted. But in avoiding the lozenge, it is not proper to get entirely into the square, which would give too much of the hardness of stone. In conducting the stroke, the action of the figures, and of all their parts, should be considered; and it should be observed how they advance towards, or recede from the eye; and the graver should be guided according to the risings or cavities of the muscles or folds, making the strokes wider and fainter in the light, and closer and firmer in the shades. Thus the figures will not appear jagged; and the hand should be lightened in such a manner, that the outlines may be formed and terminated without being cut too hard; however, though the strokes break off where the muscle begins, yet they ought always to have a certain connection with each other, so that the first stroke may often serve by its return to make the second, which will show the freedom of the engraver.

In engraving the flesh, the effect may be produced in the lighter parts and middle tints by long pecks of the graver, rather than by light lines; or by round dots; or by dots a little lengthened by the graver; or, best of all, by a judicious mixture of these together.

In engraving the hair and the beard, the engraver should begin his work by laying the principal grounds, and sketching the chief shades in a careless manner, or with a few strokes; and he may finish it at leisure with finer and thinner strokes to the extremities. When architecture or sculpture is to be represented, except it be old and ruinous buildings, the work ought not to be made very black; because, as edifices are commonly constructed either of stone or white marble, the

the colour, being reflected on all sides, does not produce dark or brown shades as in other substances. White points must not be put in the pupils of the eyes of figures, as in engravings after paintings; nor must the hair or beard be represented as in nature, which makes the locks appear flowing in the air; because in sculpture there can be no such appearances.

In engraving cloths of different kinds, linen should be done with finer and closer lines than any other sorts, and be executed with single strokes. Woollen cloth should be engraved wide, in proportion to the coarseness or fineness of the stuff, and with only two strokes; and when the strokes are crossed, the second should be smaller than the first, and the third than the second. Shining stuffs, which are generally of silk or satin, and which produce flat and broken folds, should be engraved more hard and more straight than others, with one or two strokes, as their colours are bright or brown; and between the first strokes other smaller must be joined, which is called interlining. Velvet and plush are expressed in the same manner, and should always be interlined. Metals, as armour, &c. are also represented by interlining, or by clear single strokes. In architecture, the strokes which form the rounding object should tend to the point of sight; and when whole columns occur, it is proper to produce the effect as much as possible by perpendicular strokes. If a gross stroke is put, it should be at right angles, and wider and thinner than the first stroke. In engraving mountains, the strokes ought to be frequently discontinued and broken, for sharp and craggy objects; and they should be straight, in the lozenge manner, and accompanied with longer points or dots; and rocks should be represented by cross strokes more square and even. Objects that are distant towards the horizon should be kept very tender, and slightly charged with black. Waters that are calm and still are best represented by strokes that are straight, and parallel to the horizon, interlined with those that are finer: omitting such places as, in consequence of gleams of light, exhibit the shining appearance of water; and the form of objects reflected from the water at a small distance upon it, or on the banks of the water, are expressed by the same strokes, retouched more strongly or faintly as occasion may require, and even by some that are perpendicular. For agitated waters, as the waves of the sea, the first strokes should follow the figure of the waves, and may be interlined, and the cross strokes ought to be very lozenge. In cascades, the strokes should follow the fall, and be interlined. In engraving clouds, the graver should sport when they appear thick and agitated, in turning every way according to their form and their agitation. If the clouds are dark, so that two strokes are necessary, they should be crossed more lozenge than the figures, and the second strokes should be rather wider than the first. The flat clouds, that are lost insensibly in the clear sky, should be made by strokes parallel to the horizon, and a little waving; if second strokes are required, they should be more or less lozenge; and when they are brought to the extremity, the hand should be so lightened, that they may form no outline. The flat and clear sky is represented by parallel and straight strokes, without the least turning. In landscapes, the trees, rocks, earth, and herbage, should be etched as much as possible; nothing should be left for the graver but perfecting, softening, and strengthening. The dry point produces an effect more delicate than the graver can, and may be used to great advantage in linen, skies, distances, ice, and often in water, especially in small engravings. In most things it is proper to etch the shadows, only leaving the lighter tints for the dry point, graver, &c.

To imitate *chalk-drawings*, a mixture of varied and irregular dots are used, made more or less soft, so as to resemble the grain produced by the chalks on paper. Every stroke of the chalks on paper may be considered as an infinite number of adjoining points, which are the small eminences of the grain of the paper touched by the chalk in passing over it. When the copperplate has been polished and varnished, or properly prepared, as in the common method of engraving, the drawing to be imitated may be counterproved on the varnish of the plate. If this cannot be conveniently done, black lead pencil, or red chalk, must be applied to varnished or oiled paper; and by means of this chalk or pencil, all the traces of the original will be transmitted to the varnish. The outlines of the object must be formed in the etching by points, whose magnitude and distance must be determined by the quality of the strokes in the original drawing. The artist may be provided with pointed instruments or needles of various sizes with single or double points. In forming the light and shade, he should distinguish between those hatches which serve to express the perspective of the object and those which form the ground of it. The principal hatches should be more strongly marked; the middle tints, if etched, should be marked lightly, or they may be left till the varnish is taken off, and be perfected with a greater degree of softness by needles or the point of the graver, as the original may require. There is nothing peculiar in the method of applying the aquafortis in this kind of engraving; but it may be observed, that it should not be left so long as to corrode the lighter parts too much: if the light parts are sufficiently corroded, they must be stopped up with turpentine varnish and lamp-black mixed together, and the aquafortis may be applied again to the stronger parts; for it will be no detriment to them, if the points which compose the shade burst into one another, provided the extreme be avoided. When the work of the aquafortis is finished, and the varnish taken off the copper, it will be necessary in the softest parts, such as the flesh, &c. to interstipple with proper points; as an effect will be thus produced more delicate than it is possible to attain with the aquafortis only; and the strongest shades will require additional strength to be given them with small strokes of the graver. Drawings made with chalks of different colours may be imitated in this manner, if a plate be provided for every colour. This method of engraving is intended to form a kind of deception, so that the connoisseur may not be able, on the first inspection, to distinguish between the original drawing and the engraving made in imitation of it; and it is extremely useful, as it serves to multiply copies of drawings left by those masters who excelled in the use of chalks, and thus to form and improve young artists, who could not have access to the originals in the practice of drawing.

To this account of the history and practice of the art of engraving, we shall annex the following ingenious observations by an eminent living artist (A). We present them to our readers without alteration or abridgement.

On the linear art in general.

When compared with painting, the art of engraving is but a recent invention, being coeval only with that of printing; and like that noble art, it possesses not only a similar but a greater power, of multiplying and extending the productions of genius over the world; for its language is universally understood.

It would have been well for the arts, if it could boast of a more remote date, as we might then have had many more of the finest designs of the first painters of antiquity, now doomed to oblivion, saved from the rude ravages of time.

But this invention seemed to be reserved for the fourteenth century, and its improvements for the age of Louis XIV. an age in which a number of artists, who may be said to have invigorated the art, and invested it with beauty, arose both in France and Italy.

Lines, in the first state of the art, like every other pursuit, whose excellence is progressive, were comparatively rude and unmeaning, and had nothing more to recommend them, than merely representing a particular sort of markings, or slight hatchings with the pen, without any other apparent degree of execution or expression. Although it is our pride to acknowledge, that it has not been a little beholden to the elegant etchings of the great masters in painting, as well as to their drawings in pen and ink, in its early stages, by which means an eminent degree of taste was introduced into the art, particularly in the department of linear disposition. Amongst those, the drawings of a Raphael, Michael Angelo, and the learned da Vinci; some of which we have occasionally seen and admired. Some by da Vinci were hatched in a square but delicate manner, with a white fluid, on a dark-coloured paper. Those of Michael Angelo and Raphael inclined more to the lozenge, in black or brown pink. They even carried this style of hatching with the pencil into their pictures, some of which adorn the Vatican; and in the famous cartoons in his majesty's collection by Raphael. Baccio Bandinelli generally hatched his lines in one direction, particularly a Taking down from the Cross, which was sold in London at the sale of the late Sir Joshua Reynolds's drawings. Vicenzio Dante, hatched in a similar way about the year 1550. Julio Romano used also to draw in this style with the pen, severals of which are still to be found in the most select cabinets of men of taste; and for near a century and a half after the invention of etching, it is rare to mention a person of eminence, who was distinguished in drawings who did not annex this art to that of painting. But with the application of the burin, the art has been gradually improving till the present period. (B) Linear engraving is nothing more than drawing elegantly on copper. It became more studied as it was found capable of representing the various appearances of nature. The texture or surface of objects became proportionally discriminated by such peculiar modifications of the line, as seemed most suitable to the subject represented, although, at the same time, it rendered it much more arduous in the execution. Hence arose that diversity of style, and that scope for succeeding excellence, which, by combining elegance with simplicity and beauty, distinguished those artists who have been most conspicuous in its improvement.

It has been said, that we are indebted for the origin of this art to an ingenious Florentine, Masso Finiguerra, the sculptor. He was succeeded by a number of other ingenious men, among whom we rank Botticelli, Andrea Mantigna, and other able designers;—and in Germany, Albert Durer, Aldgrave, and Lucas Van Leyden, who severally contributed their labours. But in the fifteenth century, the works of the divine Raphael began to be multiplied by the correct graver of Marc Antonio, an artist whose prints were the delight of that great painter. Antonio had many imitators, but none who equalled him for justness of contour, for which his works will be very highly appreciated among the early productions of the art.—Having had occasion to mention a few of the principal artists who reared the scaffolding of this elegant art, we shall proceed to those who have so much distinguished themselves in finishing the superstructure. Among those, Augustino of Venice began to introduce a better disposition of line in his shades, as well as the ingenious Bolognese, Augustino Carrachi; whilst Egedius Sadelaer displayed no less zeal in Germany. In the sixteenth century, the art displayed still more vigour and taste, and seemed to have but little more wanting; for all that meagre dryness of line began to disappear, which so manifestly marks the early works of Il Tedesca, Aldegraff, and other artists of a former period. Their works became consequently more rich in style, by embracing the best productions of the pencil; and as they were applied to a greater number of ideas they became still more interesting and successful.

Patrons were numerous and liberal; and it is but proper to remark, that the various artists, on their part actuated by a becoming zeal which was highly creditable to themselves, were indefatigable. This is a circumstance not less worthy of imitation, than the many admirable monuments of the art which they produced. Few but admired the works of Masson, Poilly, Nantueil, and Rousselet; and some time after the death of the ingenious Cornelius Bloemart, who had given a grace to his lines, hitherto unknown at Rome, the matchless Audran and Edelinck displayed their excellent productions at Paris. But arts are liable to fluctuate; and when the art of engraving began to decline abroad, it gradually displayed a high degree of lustre in our own country; and the variety of styles which has since sprung from the original manner of engraving shall be the subject of the following sketch.

We shall therefore treat more particularly of the disposition of the lines and their consequent effects, distinguished

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(A) Francis Legat, Esq. historical engraver to his royal highness the prince of Wales, and F. A. S. E.

(B) The author has taken the liberty of here adopting the word *linear*, from its strict analogy to this mode of engraving, and with the approbation of some of the first professors, both in painting and engraving.

tinguished by the terms, *linear expression*, *imitation*, *disposition* and *harmony*; with a strict investigation of the first and most approved subjects, either in etching or engraving; and of their essential beauties, as far as they may tend to illustrate the subject.

As the great object of this mode of engraving is, to adopt those lines the most expressive of the form and character of whatever happens to be represented, by maturely investigating not only the action but the cause and correspondent effects of the original picture; in order that the artist may avail himself of all that is most beautiful in his translation, and efficient in the aggregate either with respect to the expression, spirit, or sentiment.

On linear expression and disposition.

When historical subjects consist of several figures where there is generally a variety of draperies, some of them appearing thick and cumbersome, others more thin and flexible, sitting close and elegant on the limbs, being composed of a finer texture, or thread; the coarse stuffs are consequently more effectually respresented by a bolder line, as the thinner sort, by the application of a fine line, gives a more lively representation; a discrimination which has been observed of late, by the most approved modern artists in linear engraving. Observations of this description, when treated in a liberal manner, not only superadd a degree of truth, but even render the subjects sweeter to the eye of fancy. In the early stages of the art, some excellent artists have been led into particular and limited systems. In the works of such as have affected to describe every subject in the same line indiscriminately, even the arms of the most delicate women are often engraven as if perfectly polished, by approaching to a metallic appearance, a mode not uncommon among the second or third class of artists about the beginning of the last century; by which manner, all that softness and delicacy was neglected, which is so happily effected in the linear productions of Bartolozzi, Morgan, Sharp, Heath and others, at present of the first masters in Europe. Those who are acquainted with the works of the ingenious Chaffury, must with pleasure have perceived in his foliage, how even the texture of flowers are imitated from the delicate line-like fibres of which they are composed, issuing from the stem, and spreading their silken beauties in the sun: and in this class of imitation, the clear transparency of glass, the rough texture of woollen, the thinness of lawn, the flickerings of satin, or the lightnings of steel, as well as the rude rock, the lucid lake, or the flashing of the torrent, are all admirably adapted to linear effect by the almost infinite diversity of their construction, and general constituent principles, strictly observing on what laws the beauty of lines consists, by ever keeping in view the due balance of taste, and a noble simplicity of style throughout. It is the business of the skilful artist to overpower and subdue the difficulties in his profession; for no excellence of art is of cheap or vulgar acquisition. Let it be remembered that with forming steel, even the enchanting graces of the Venus de Medicis were hewn from a rock, and the almost breathing Apollo, from a block of Parian stone.

An elegant English poet, in a critical essay on poetry, observes, that the sound should seem an echo to the sense; so should the lines in a fine print seem to harmonize with the subject, by flowing with the external cast of the features, and the predominant passion expressed in the original picture; for the same character and disposition of the lines that suit the action of the muscles in one passion, will be found to appear more vacant and less expressive when applied to others, however graceful they may appear.

As this is a point of view to which the art has never yet been fully extended, perhaps it may meet with some degree of attention, as it will be found of utility in forming a principle respecting disposition, more particularly in historical subjects, where the passions are required to be nicely expressed; and although it may admit of some slight exceptions, it is a principle that will in general be found to be true.

For example, let it be supposed that the passion of the figure represented, is that of joy; the lines should seem to expand and swell, with every acting muscle, in the most delicate manner possible.

But, on the contrary, if the subject displays deep sorrow, they should rather incline downward, partaking somewhat of the half straight, seeming to act apparently in perfect unison and conformity with the features of the face, with all due subordination to the general effect of light and shadow.

Various observations may be made in this manner on the principal passions expressed in the human countenance, which are but few comparatively, even from the slightest movement to the boldest action. We often find, on examining the works of those masters who are not so conspicuous for great clearness of execution, that they have been occupied by the disposition and energy of the lines, as in the magnificent and masterly prints of the Battles of Alexander, from the pictures of Carlo le Brun, engraved by Gerrard Audran; where the executive department is no less conspicuous from the burin of the Chevalier Edelinck in the fine print of the tent of Darius: whilst Audran displays the true spirit of art, but rarely avails himself of much of the mechanical principles. The field, and tumult of battle, seemed admirably calculated to call forth his rapid powers, particularly in works of magnitude.

The less active scenery of the tent of Darius, was equally appropriated to the splendid talents of Edelinck, as he seems to have been better qualified to display subjects of that nature in general. This is sufficiently obvious from the beautiful and interesting groupe of the queen mother, and her illustrious family, kneeling at the feet of the conqueror; his impressive print of the magdalene, or his most admirable portraits of the dignified clergy, distinguished authors, and eminent artists. These, in point of engraving, are no less remarkable for taste in the execution, than for truth and nature in expression.

In one of the Battles of Alexander, the groupe where Porus is wounded and supported by the soldiers, the rough discrimination of line finely accords with that bold deportment of character in the grim visage of that gigantic prince, whilst a more delicate line marks the youthful countenance of Alexander; a discrimination which is totally lost in the large Dutch copy by de Vos.

In the same print, the figures of Alexander and Clytus, are finely relieved from the distant scenery by the varied description of engraving on their armour, drapery, and horses. The latter are managed with such freedom and spirit, that it is difficult to say whether the horses or figures teem the most with masterly execution;

particularly the white war-horse on the right extremity of the print (c).

Had Audran superadded a still greater portion of the delicacy and clearness of handling so conspicuous in Edelinck and other eminent artists since that period, it would undoubtedly have given an additional beauty to his other transcendent acquisitions; namely, the vast spirit of his lines, and power in drawing.

But it is seldom the lot of an individual to combine every excellence. Arts too have their infancy; for they generally require the labour of ages to bring them to maturity and perfection, and it yet remained to unite and ameliorate the polish of Edelinck, to the spirited style of Audran. Without prejudice or partiality, a considerable degree of this excellence will be found in the best works of British art, as we shall hereafter exemplify.

Another fine specimen of lineal engraving, and of a different class, is the celebrated Storm of Balechow, from a picture of the famous Vernet. In this print he has transmitted with the graver a certain fluidity and action in representing the liquid element, to which the art had never before attained. To a grandeur of style in the bold swelling of the waves, he has superadded the utmost transparency of line; at the same time, having attended to all that light restless spray which seems sporting to the gales as they roll along. In a fanciful mood, one might almost imagine they heard the motion of the water: so finely did this discriminating artist translate, (if I may be allowed the expression) this admirable picture.

When we consider the period in which this distinguished work was engraved, and that little or nothing had been previously done in that department of a similar excellence; it is hoped it will be a sufficient apology for the degree of admiration here expressed: for, as Lord Verulam truly observes, "we are too prone to pass those ladders by which the arts are reared, and generally reflect all the merit to the last new performer." We have already observed, they are seldom reared with rapidity, and oftentimes that which is considered an invention, is only a long succession of trials and experiments, which have gradually followed each other, and ought rather to be considered as a series of human mind than the knowledge of an individual, being the works of ages. In any point of view, the present subject will ever be considered as a high improvement and an elegant acquisition in the annals of the linear art. But in historical subjects this artist is by no means equal in point of taste or discrimination. His print of St Genevive undoubtedly ranks high in the first classes of engraving. Had his taste in other respects been equal to his powerful clearness of execution, it would have been almost unparalleled; but it betrays a want of that essential, even in his mode of thinking. Patience and labour are everywhere too prevalent. It remained for Woollet to excel both in figures and in landskip.

In the various styles and modifications of this expressive art, from the NEAT to the FEEBLE, and from the BOLD to the EXTRAVAGANT, *Taste* stands sole arbitress: in brief, it is she who distributes variety with spirit, and conceals the appearance of intricacy and labour; who, by a due modification of line, unites clearness to softness, arresting the hand of the skilful artist from every effort inconsistent with her powers; producing at once to the mind all that agreeable finished combination or harmony which ever accompanies and constitutes the perfection of true art.

In the execution of subjects of imagination, there is a perpetual scope for calling forth the fancy of the engraver, as the various combinations of lines are inexhaustible, uncommon effects, such as aerial spirits, or celestial beings blended with the light, or ghosts commingled with the gloom, or fairy elves by moonlight, who trip the sands, and yet no footing seen; or wood-nymphs, laving their taper limbs in the limpid element. Such subjects, in point of style, depend entirely upon the beauty, lightness, and transparency of execution; for those that are merely ornamental or grotesque, demand a style of a different cast from that of the serious or historical, as they require a less degree of truth even from the burin. In these cases the style may be as capricious as the subjects. Those of Raphael, in the Vatican, display an uncommon degree of taste, and particularly in the elegant flow of line with which they are composed.

In all works of taste and genius, those which may appear the most simple at a transient glance, will be often found to contain the most art on a more mature investigation. The first impression may strike the fancy, but the second generally calls up the discriminating powers of the judgment.

Arts generally rise in our esteem according to the degree of exertion of the mental powers which they require; and, as lines are capable of various styles, those which are most congenial to the subject represented ought to be adhered to in preference to every other consideration. Teniers, and Gerrard Douw, demand all the fidelity and delicacy of the burin in describing the various draperies and individualities which belong to that class of painting; but, in proportion as the contour is composed of fewer parts, and the forms more full and elegant, the beautiful flowing qualities of the graver is increased, and its lines glide more gracefully over the figures, as may be found in the works of Strange and others from Guido and Corregio. This distinction will not appear so obvious on a superficial view of the art. But, on a due investigation, it will be found, that not only a different modification of lines is necessary to the various classes of painting, but that even a different description of style is requisite to characterize some of the masters in each particular class, from the sublime and elevated figures of a Raphael and Michael Angelo, to the simple cottagers of Adrian Ostade.

When we take a more comprehensive view of the art, we often find, that the styles which are adopted in the different countries in Europe by the artists where the art has in any degree been cultivated, are generally regulated by the modes of painting, drawing, and even the colouring respectively in each, whether historical, portrait, or landscape, and is proportionably appreciated according to the effective beauty and elegance of the execution.

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(c) Whenever M. Bartolozzi happened to speak of those prints to me, he always expressed himself with a great degree of enthusiasm, thinking himself extremely fortunate in having works of such excellence in his possession.

It is not improbable that the clear mode, which at present constitutes the modern German school, is a refinement on the simple style of Cornelius Bloemart.

In Italy, Jachimo Frey, that astonishing Swiss, from his masterly expertness in drawing, and a rapid use of the etching steel and the nitre, almost produced an entire revolution in the art. The unprecedented richness and ease, the freedom and energy of his style, and the number and magnitude of his works, attracted all Italy, and tended greatly to improve the Roman school. About the year 1672, we find him working jointly with the nervous Dorigny Frezza, and Vanauden Aird. From this source we can perceive the style of Wagner, of Cars in France, and various masters now living; namely Francisco Bartolozzi, Giovanni Volpato, Dominicus Cunigo, and some of the early works of the excellent Raphael Morghen.

In many instances Frey indicates, that if he had considered it of sufficient consequence to the art, he could have engraved with more clearness, particularly by his curious copy from the celebrated print by Edelinck, of the Madona and Child, with St John and Angels, from Raphael; and although but an imitation of another style, tends to shew the versatility of his talents, when the judgment is for a while suspended to know which is the original. We find a performance of Frey's, entitled *La Charité Humaine*, dated 1723; a print was afterwards engraved from the same subject at Paris by Daulle, dated 1763, in which he has rather been too profuse in the more mechanical part of the art, and destitute of that ardour which a well engraved work should not only inspire but maintain.

It is not enough for lines to be only well disposed, but also full of expression: neither is it enough for a line to be only clearly cut, but it must also be free; for in a certain free light spirited lines convey an idea of animation, and are suited to subjects of that description, while the long sweeping and bold lines are better adapted to the solemn and majestic productions of the pencil.

A fine print, like a miniature picture, ought to be viewed near the eye: as in itself, from the nature of the art, will be found a due subordination of effect, ever receding from the bold and articulated lines in the fore ground to those which are more evanescent and remote.

The graceful birch, the mountain ash, and the oak, have each their peculiar bark and texture; and these, when freely indicated, stamp their mark and character most completely to the eye. Much of this, as has been formerly mentioned, depends upon, and is regulated by, the peculiar style of the picture and the skill of the engraver.

As lines seem to partake of motion, in proportion as they deviate in gentle bendings from the straight and precise; even so also, is the motion of water seemingly increased, whether they undulate with the simplest wave, or swell with the fierce and tempest-curled surge. This character is sufficiently illustrated in the works of Balechow and Woollet.

In the late Mr Brown's large print of St John preaching in the wilderness, no engraver has ever more fully displayed the true spirit of Salvator Rosa, particularly in the original mode of treating the rocks, and the bold style of the surrounding scenery; in short, in the aggregate it is a chef d'œuvre unparalleled in any country. This is freely acknowledged, not only by every man of taste, but by the first landscape engravers (D).

But Brown was perhaps less happy in the companion to the above, from the celebrated *Both*, by adapting a similar mode to that finished and delicate painter. For the style should ever vary with the subject.

> "Whate'er Lorrain light touched with softening hue,
> Or savage Rosa dash'd, or learned Poussin drew."—
> THOMSON's *Castle of Indolence.*

His admirable etchings of the cottager and its companion, and the Celadon and Amelia, are fine specimens of his discriminating powers, and characterized with so near an approach to truth, that we cannot help exclaiming with the poet,

> "He sees no other, nature's self who sees."

The engraving of the above subjects was finished by the matchless Woollet, with the same happy taste. And it must be acknowledged that it is but seldom that we see so many excellencies united; for it is equally rare to see the finest engraving united to the finest drawing, as to find it in painting combined with the choicest colouring: yet each have their decided fascinations in the gallery, the cabinet, or the portfolio.

Woollet, whose works abound with nerve and intelligence in point of character, his style of landscape is delightfully descriptive; whether rocks, water, trees, or sky; as the Niobe, the Ceyx and Alcyone, and other master-pieces from the great Wilson evince. In the winter scene from Smith of Chichester, he has admirably contrived to convey the effect of the drifted snow, by delicate dotting, and with no less precision he has described the transparent ice with clear lines. Of trees, he was the first that ever faithfully characterized the graceful larch; as may be seen in his views of the noblemen's seats. In the print of the fishery, he is indebted to the masterly etching of John Brown, particularly the shipping, in which there is perhaps no subject more articulate and perspicuous. The engraving of this subject is finished by himself. In his figures he was the founder of a style, most happily adapted for modern dresses, and historical portraiture; a style in which he moved with unrivalled reputation. His print of the death of General Wolfe, painted by Mr West, is an admirable example, and does honour to the British nation. It occupied him no less than four years. The print of the battle at La Hogue is another fine specimen of his knowledge of linear discrimination. In short, when we consider the talents of this artist, it is difficult to decide whether he most excelled in modern history or landscape. The art has to regret that he, who was so eminently qualified to adorn any line of the profession, has left no works in ancient history. We have little doubt, from his knowledge, and a real love of the art, he would have left a sufficient monument in that department also, for the pleasure and contemplation of the

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(D) Were I at liberty to mention eminent living artists, I would have been induced here, among others, to have mentioned the subject of the Tempest in the Twelfth Night, from the late ingenious Wright of Derby, engraved by Mr Middleman, in the Messrs Boydell's large edition of the immortal bard of Avon.

the real connoisseur and of posterity. Engraving in this country sustained a heavy loss when he died; and if the death of so excellent an artist may be considered as a public loss, it is certainly the more felt with respect to Woollet, who died while he was yet improving in that excellence (E).

Chattelaine has been termed a mannerist in his drawings, but he must certainly be allowed to be an excellent one: his etchings are variety itself. Perhaps in the department of etching no artist has so happily translated the pictures of Claude de Lorraine as Francis Vivares; that is, with respect to aerial perspective, the peculiar characteristic of Claude. But his merits are not confined to this master alone; for he followed Ruysdale, Berghem, Gainsborough, and Cuype, with great success. He has such a free delivery of style, that almost every one who examines his works is irresistibly impressed with an idea of performing the very same. Few artists, it has been mentioned, have excelled in the etching department. We cannot, however, omit the name of Perauezzi; who, to originality of style, which is apparently spontaneous, joins a certain grandeur which had never been surpassed. He has transmitted to posterity so spirited a representation of the Greek and Roman edifices and ruins, that travellers have often confessed that they have raised their ideas beyond the magnitude of the superstructures themselves. It is certain that in works of this stupendous nature, a degree of ruggedness in the execution corresponds with the sublimity of the subjects; and thus produces a still greater power over the mind, than if they had been more polished. Some have censured his figures, and not without cause. This defect has been ingeniously palliated by an excellent artist, M. Bartolozzi. "For (said he) if the purchasers of the works of Peranezzi, get so much for their money in the building way, the figures may be supposed to be given for *nothing*." Doubtless those vast piles of perishing grandeur, were never more judiciously presented to the eye, than by this astonishing artist, or better calculated to affect the mind by calling forth its most sublime ideas.

We have another striking instance of spirited etching in a different pursuit of the art, in the works of Ridinger, a name which brings along with it all the savage scenery of nature.

"Assembling wolves in raging troops descend.
———They fasten on the steed and pierce his mighty
heart."

THOMSON's *Winter*.

For we shall ever find some peculiar beauty to admire, even in the slightest productions of genius, as well as in the most perfect productions of the burin.

There are few artists who do not regret, that etching was unknown to Bolswert, who has done so much without its aid; from which we may easily suppose how much more he could have effected with this charming acquisition. For the truth of this remark we may appeal to his landscapes from Rubens, his animated portraits from Vandyke, and his productions from the Flemish school of history, particularly his large print of the Taking down from the Cross from Rubens.

There is a fine instance of linear effect in a print of a Flemish conversation piece by Wille. One of the figures is drinking out of a glass, and the artist has most deceptively described the texture of the drinker's face through the glass. In the same print, a female figure shews great skill in this way, even the floor is characterized by lines; and the whole strongly marks the most proper mode of treating subjects of a mere local nature. The beautiful print of the *Petit Physicien*, is also an admirable imitation, particularly the little pellucid globule which has just mounted from the shell. When lines are engraved in a square acute method of crossing, they generally convey the idea of hardness to the subject represented. The scientific Picart seems to have been so much aware of this, that in a print of his engraving of a large marble group of horses, from the animated chisel of Perriere, he adopted this style in order to heighten the imitation.

Mason's print of Marshal Harcourt is one of the many fine efforts of portrait engraving; and although it was executed at an early period of the art, it abounds with no small degree of taste. The celebrated print (called the Table-cloth) from Titian, of the Last Supper, also contains a considerable degree of linear discrimination, although he sometimes carries it to affectation. He is rather singular in his mode of engraving hair. Yet the portraits of Marshal Harcourt and Brisasiere the secretary may be deemed exceptions.

While, by the magic of his tooling, is too apt at times to give his works indiscriminately the appearance of bronze; and we frequently find the same in the figures of Balechow: but it seems to have been reserved for Strange to give the softness of carnation to copper; and to Woollet, to give force and clearness with discriminating taste. Bartolozzi in his lines elegance delicacy and drawing; while the works of Audran teem with boldness and simplicity. In the prints of Sir Robert Strange, the greatest excellence is perhaps his rich and harmonious tones, as well as the whole effect, which is supported by an expressive style; which he seems in a great measure to have invented for his most favourite painters, Corregio, Titian, Guido, and Guerchino. The softness, the gusto, and the flowing draperies in the works of these masters, were his delight. His sleeping Cupid from Guido, and the prints of the Venus and Danae from Titian, will ever be esteemed as *chef d'œuvres* in the linear art.

Having thus attempted to fulfil our original intention of discriminating the most expressive combinations of lines, and of analyzing and illustrating their various powers and effects in engraving, we shall now conclude these observations; and if, from the nature of the subject, and from the limits of the sketch, we have failed in marking every brilliant star in the galaxy of the art; it must at least be acknowledged, that we have not omitted some of those of the first magnitude.

*ENGRAVING upon Glass.* See *GLASS, Engraving on.*

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(E) Although we are now contemplating linear engraving, it is but proper here to observe, that chalk engraving, mezzotinto, and aquatinta, have also made ample improvements in this country, in their various styles of excellence.

Engraving.

*ENGRAVING on Precious Stones*, is the representing of figures, or devices, in relievo, or indented, on divers kinds of hard polished stones.

The art of engraving on precious stones is one of those wherein the ancients excelled; there being divers antique agates, cornelians, and onyxes, which surpass any thing of that kind the moderns have produced. Pyrgoteles among the Greeks, and Dioscorides under the first emperors of Rome, are the most eminent engravers we read of; the former was so esteemed by Alexander, that he forbade any body else to engrave his head; and Augustus's head, engraven by the latter, was deemed so beautiful, that the succeeding emperors chose it for their seal.

All the polite arts having been buried under the ruins of the Roman empire, the art of engraving on stones met with the same fate. It was retrieved in Italy at the beginning of the 15th century, when one John of Florence, and after him Dominic of Milan, performed works of this kind no way to be despised. From that time such sculptures became common enough in Europe, and particularly in Germany, whence great numbers were sent into other countries: but they came short of the beauty of those of the ancients, especially those on precious stones; for, as to those on crystal, the Germans, and, after their example, the French, &c. have succeeded well enough.

In this branch of engraving, they make use either of the diamond or of emery.

The diamond, which is the hardest of all stones, is only cut by itself, or with its own matter. The first thing to be done in this branch of engraving is, to cement two rough diamonds to the ends of two sticks big enough to hold them steady in the hand, and to rub or grind them against each other till they be brought to the form desired. The dust or powder that is rubbed off serves afterwards to polish them, which is performed with a kind of mill that turns a wheel of soft iron. The diamond is fixed in a brass dish; and, thus applied to the wheel, is covered with diamond dust, mixed up with oil of olives; and when the diamond is to be cut facet-wise, they apply first one face, then another, to the wheel. Rubies, sapphires, and topazes, are cut and formed the same way on a copper wheel, and polished with tripoli diluted in water. As to agates, amethysts, emeralds, hyacinths, granites, rubies, and others of the softer stones, they are cut on a leaden wheel, moistened with emery and water, and polished with tripoli on a pewter wheel. Lapis-lazuli, opal, &c. are polished on a wooden wheel. To fashion and engrave vases of agate, crystal, lapis-lazuli, or the like, they make use of a kind of lathe, like that used by pewterers, to hold the vessels, which are to be wrought with proper tools: that of the engraver generally holds the tools, which are turned by a wheel: and the vessel is held to them to be cut and engraved, either in relievo or otherwise; the tools being moistened from time to time with diamond dust and oil, or at least emery and water. To engrave figures or devices on any of these stones, when polished, such as medals, seals, &c. they use a little iron wheel, the ends of whose axis are received within two pieces of iron, placed upright, as is the turner's lathe; and to be brought closer, or set further apart, at pleasure: at one end of the axis are fitted the proper tools, being kept tight by a screw. Lastly, The wheel is turned by the foot, and the stone applied by the hand to the tool, and is shifted and conducted as occasion requires.

Engraving ‖ Enharmonic.

The tools are generally of iron, and sometimes of brass; their form is various, but it generally bears some resemblance to chisels, gouges, &c. Some have small round heads like buttons, others like ferrels, to take the pieces out, and others flat, &c. When the stone has been engraven, it is polished on wheels of hair-brushes and tripoli.

*ENGRAVING on Steel* is chiefly employed in cutting seals, punches, matrices, and dyes, proper for striking coins, medals, and counters: The method of engraving with the instruments, &c. is the same for coins as for medals and counters: All the difference consists in their greater or less relievo; the relievo of coins being much less considerable than that of medals, and that of counters still less than that of coins.

Engravers on steel commonly begin with punches, which are in relievo, and serve for making the creux or cavities of the matrices and dyes: though sometimes they begin with the creux or hollowness; but then it is only when the intended work is to be cut very shallow. The first thing done, is that of designing the figures; the next is the moulding them in wax, of the size and depth they are to lie, and from this wax the punch is engraven. When the punch is finished, they give it a very high temper, that it may the better bear the blows of the hammer with which it is struck to give the impression to the matrice.

The steel is made hot to soften it, that it may the more readily take the impression of the punch; and after striking the punch on it in this state, they proceed to touch up and finish the strokes and lines, where by reason of their fineness or the too great relievo they are any thing defective, with steel gravers of different kinds; chisels, flatters, &c. being the principal instruments used in graving on steel.

The figure being thus finished, they proceed to engrave the rest of the medal, as the mouldings of the border, the engrailed ring, letters, &c. with little steel punches, well tempered, and very sharp.

ENGUICHE', in *Heraldry*, is said of the great mouth of a hunting horn, when its rim is of a different colour from that of the horn itself.

ENHARMONIC, in *Music*. The Greeks had three different species of music; the *diatonic*, the *chromatic*, and the *enharmonic*. This last was esteemed by much the most agreeable and powerful of the three; but the difficulty of its execution rendered its duration short, and latter artists were upbraided for having sacrificed it to their indolence. It proceeded upon lesser intervals then either the diatonic or chromatic; and as the chromatic semitone is still less than the diatonic, the *enharmonic* intervals must have consisted of that semitone divided into parts more minute. In Rousseau's Musical Dictionary (at the word *Enharmonique*), the reader may see how that interval was found in the tetrachords of the ancients. It is by no means easy for modern ears, inured to intervals so widely different, to imagine how a piece of music, whose transitions were formed either chiefly or solely upon such minute divisions, could have such wonderful effects; yet the melody of speech, which rises or falls by intervals still

more

more minute than the enharmonic, when properly modulated and applied with taste, has an astonishing power over the soul. As to the modern *enharmonic* system, we may likewise refer the reader to the same work for an account of its nature and use; though he will find it accurately and clearly explained by D'Alembert in the Treatise of MUSIC given in the present work, (art. 144, 145, 146.).

ENHYDRUS, in *Natural History*, a genus of siderochitæ or crustated ferruginous bodies, formed in large and in great part empty cases, inclosing a small quantity of an aqueous fluid.

Of this genus there are only two species: 1. The thick-shelled enhydrus, with black, reddish-brown, and yellow crusts. 2. The thinner-shelled kind, with yellowish-brown and purple crusts; neither of which ferments with aquafortis or gives fire with steel.

ENIGMA. See ÆNIGMA.

ENIXUM, among chemists, a kind of neutral salt, generated of an acid and an alkali.

The sal enixum of Paracelsus, is the caput mortuum of spirit of nitre with oil of vitriol, or what remains in the retort after the distillation of this spirit; being of a white colour, and pleasing acid taste.

ENMANCHE', in *Heraldry*, is when lines are drawn from the centre of the upper edge of the chief to the sides, to about half the breadth of the chief; signifying sleeved, or resembling a sleeve, from the French *manche*.

ENNA, in *Ancient Geography*, a town of Sicily, situated on an eminence to the south of the Chrysas; called the *centre of Sicily*. It was famous for a sacred grove, in which the rape of Proserpine happened; for a temple of Ceres, thence surnamed *Ennæa*, and *Ennensis*; and for fine springs, whence the name (Bochart).

ENNEAGON, in *Geometry*, a polygon with nine sides. See POLYGON.

ENNEAHEDRIA, in *Natural History*, a genus of columnar, crystalliform, and double pointed spars, composed of a trigonal column, terminated at each end by a trigonal pyramid.

Of this genus there are several species distinguished by the length or shortness of the column and pyramids, none of which give fire with steel, but all of them ferment with aquafortis.

ENNEANDRIA, in *Botany*, (from *εννεα*, *nine*, and *ανηρ*, a *man* or *husband*), the name of the ninth class in Linnæus's sexual system, consisting of plants which have hermaphrodite flowers, with nine stamina or male organs. See BOTANY *Index*.

ENNIUS, QUINTUS, an ancient Latin poet, born at Rudii, a town in Calabria. He came first to Rome when M. Porcius Cato, was questor, whom he had instructed in the Greek language in Sardinia; and by his genius and behaviour he gained the esteem of the most eminent persons in the city. According to Horace, Ennius never applied himself to writing till he had drank freely of wine. Hence he contracted the gout, of which he died nine years B. C. He was interred in Scipio's sepulchre; who had a great esteem and friendship for him, and caused a statue to be erected to him upon his monument. He endeavoured to introduce the treasures of the Greek tongue among the Latins, and was the first among the Romans who made use of heroic verses. He wrote the *Annals of Rome*; he translated several tragedies from the Greek, and wrote others, besides several comedies. We have only some fragments of his works, which were first collected by the two Stephens, and afterwards published at Naples, with a learned commentary, by Jerom Columna, in quarto, 1590; and reprinted at Amsterdam in 1707, in quarto, with additions by Hesselius.

ENOCH, the son of Cain (Gen. iv. 17.), in honour of whom the first city taken notice of in Scripture was called *Enoch* by his father Cain, who built it. It was situated to the east of the province of Eden.

ENOCH, the son of Jared and father of Methuselah, was born in the year of the world 622. At the age of 65 he begat Methuselah, and lived 300 years after, and had several sons and daughters. Enoch walked with God; and after that he had lived in all 365 years, "he was not, for God took him." Some construe these last words, as if they intimated that Enoch died a natural death, because in reality he lived not near so long as the other patriarchs of those times; as if God, to secure him from corruption, had been pleased to take him early out of this world. But the generality of the fathers and commentators assert that he died not, but was translated out of the sight of men, in like manner as Elijah was. The apostle Paul (Heb. xi. 5.) shows very clearly that Enoch was translated, and did not see death.

The apostle Jude (ver. 14. 15.) cites a passage from the book of Enoch, which has very much exercised interpreters. The question is, whether the apostle took this passage out of any particular book written by Enoch, which might be extant in the first ages of the church; whether he received it by tradition; or lastly, by some particular revelation. It is thought probable, that he read it in the book we have been speaking of, which, though apocryphal, might contain several truths that St Jude, who was favoured with a supernatural degree of understanding, might make use of to the edification of the faithful.

The ancients greatly esteemed the prophecy of Enoch. Tertullian expresses his concern that it was not generally received in the world. That father, on the authority of this book, deduces the original of idolatry, astrology, and unlawful arts, from the revolted angels, who married with the daughters of men. St Augustin allows indeed that Enoch wrote something divine, because he is cited by St Jude; but he says it was not without reason that this book was not inserted in the canon which was preserved in the temple at Jerusalem. This father sufficiently insinuates, that the authority of this book is doubtful, and that it cannot be proved that it was really written by Enoch. Indeed the account it gives of giants engendered by angels, and not by men, has manifestly the air of a fable, and the most judicious critics believe it ought not to be ascribed to Enoch.

This apocryphal book lay a long time buried in darkness, till the learned Joseph Scaliger recovered a part of it. Scaliger, Vossius, and other learned men, attribute this work to one of those Jews who lived between the time of the Babylonish captivity and that of Jesus Christ. Others are of opinion, that it was written after the rise and establishment of Christianity, by one of those fanatics with whom the primitive church was filled, who made a ridiculous mixture of the Platonic philosophy and the Christian divinity.

The eastern people, who call Enoch by the name of *Edris*, believe that he received from God the gift of wisdom and knowledge; and that God sent him 30 volumes from heaven, filled with all the secrets of the most mysterious sciences. The Rabbins maintain, that when Enoch was translated to heaven, he was admitted into the number of the angels, and is the person generally known by the name of *Michael*.

ENORMOUS, something excessive or monstrous, especially in bulk.—The word is formed of the privative *è*, and *norma*, "rule;" q. d. "void of, or contrary to, rule or measure;" *contra normam*. In the corrupt ages of Latinity they used *innormis* and *inormis*.

In the French jurisprudence, *læsio enormis*, "enormous damage," is that which exceeds half the value of the thing sold.

ENOS, the son of Seth and father of Cainan, was born in the year of the world 235. Moses tells us (Gen. iv. 26.), that then, "*men* began to call upon the name of the Lord;" or, as others translate it, that "Enos began to call upon the name of the Lord;" that is to say, that he was the inventor of religious rites and ceremonies in the external worship which was paid to God. This worship was kept up and preserved in Enos's family, while Cain's family was plunged in all manner of irregularities and impieties. Several Jews are of opinion, that idolatry was first introduced into the world in the time of Enos. They translate the Hebrew thus, "Then men began to profane the name of the Lord." Good men, to distinguish themselves from the wicked, began to take upon them the quality of sons or servants of God; for which reason, Moses (Gen. vi. 1, 2.) says that *the sons of God* (that is to say, the descendants of Enos, who had hitherto preserved the true religion), seeing the daughters of men, that they were fair, took them wives of all which they chose. Enos died at the age of 905 years, in the year of the world 1140.

ENS, among metaphysicians, denotes entity, being, or existence: this the schools call *ens reale*, and *ens positivum*; to distinguish it from their *ens rationis*, which is only an imaginary thing, or exists but in the imagination.

ENS, among chemists, imports the power, virtue, and efficacy, which certain substances exert upon our bodies.

ENS, in *Geography*, a city of Germany, situated at the confluence of the Danube and the river Ens, about 80 miles south of Vienna. E. Long. 14. 20. N. Lat. 48. 16.

ENSATÆ, in *Botany*, (from *ensis*, "a sword"); the name of the sixth order in Linnæus's natural method, consisting of plants with sword-shaped leaves. It contains the following genera, viz. Antholyza, Callisia, Commelina, Crocus, Eriocaulon, Ferraria, Gladiolus, Iris, Ixia, Moræa, Pontæderia, Sisyrinchium, Tradescantia, Wachendorffa, Xyris. See BOTANY *Index*.

ENSEELED, in *Falconry*, is said of a hawk that has a thread drawn through her upper eye-lid, and made fast under her beak, to take away the sight.

ENSEMBLE, a French term, sometimes used in our language; literally signifying *together* or *one with another*:—being formed from the Latin *in* and *simul*.

In architecture, we say *the ensemble*, or *tout ensemble*, of a building; meaning the whole work, or composition, considered together, and not in parts; and sometimes also, the relative proportion of the parts to the whole.—"All those pieces of building make a fine *ensemble*."

To judge well of a work, a statue, or other piece of sculpture, one must first examine whether the *ensemble* be good. The *tout ensemble* of a painting, is that harmony which results from the distribution of the several objects or figures whereof it is composed.—"This picture is good, taking the parts separately; but the *tout ensemble* is bad."

ENSIFORMIS CARTILAGO. See XIPHOIDES.

ENSIGN, in the military art, a banner or colours under which soldiers are ranged, according to the different companies or parties they belong to. See FLAG, COLOURS, STANDARD, &c.

The Turkish ensigns are horses tails; those of the Europeans are pieces of taffety, with divers figures, colours, arms, and devices thereon. Xenophon tells us, that the ensign borne by the Persians was a golden eagle on a white flag; the Corinthians bore the winged horse, or Pegasus, in theirs; the Athenians, an owl; the Messenians, the Greek letter M; the Lacedæmonians the A. The Romans had a great diversity of ensigns; the wolf, minotaur, horse, boar, and at length the eagle, where they stopped: this was first assumed in the second year of the consulate of Marius*. A military ensign on a medal of a Roman colony denotes it a colony peopled with old soldiers.

ENSIGN is also the officer that carries the colours, being the lowest commissioned officer in a company of foot, subordinate to the captain and lieutenant. It is a very honourable and proper post for a young gentleman at his first coming into the army: he is to carry the colours both in assault, day of battle, &c. and should not quit them but with his life: he is always to carry them himself on his left shoulder: only on a march he may have them carried by a soldier. If the ensign is killed, the captain is to carry the colours in his stead.

*Naval* ENSIGN, a large standard or banner hoisted on a long pole erected over the poop, and called the *ensign staff*.—The ensign is used to distinguish the ships of different nations from each other, as also to characterize the different squadrons of the navy. The British ensign in ships of war is known by a double cross, viz. that of St George and St Andrew, formed upon a field which is either red, white, or blue.

ENSISHEIM, a town of France, in Upper Alsace. It is a pretty little place, well built, and consists of about 200 houses. E. Long. 7. 30. N. Lat. 47. 58.

ENT, SIR GEORGE, an eminent English physician, born at Sandwich in Kent in 1604. He was educated at Sidney college, Cambridge; and, afterwards travelling into foreign countries, received the degree of doctor of physic at Padua. After his return he obtained great practice, was made president of the college of physicians in London, and at length received the honour of knighthood from King Charles II. He was extremely intimate with Doctor Harvey; whom he

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* See *Eagle*

be learnedly defended, in a piece entitled *Apologia pro Circulatione Sanguinis, contra Æmilium Parisanum.* He also published, *Animadversiones in Malachiæ Thrustoni;* and some observations in the Philosophical Transactions. Glanville, speaking of his *Plus Ultra* of the modern improvements in anatomy, numbers Sir George Ent, Doctor Glisson, and Doctor Wallis, with the most celebrated discoverers in that science. The two former were among the first members of the Royal Society. Sir George Ent died in October 1689.

**ENTABLATURE**, or **Entablement**, in *Architecture*, is that part of an order of a column which is over the capital, and comprehends the architrave, frize, and corniche. See Architecture, chap. i.

**ENTABLER**, in the manege, the fault of a horse whose croupe goes before his shoulders in working upon volts; which may be prevented by taking hold of the right rein, keeping your right leg near, and removing your left leg as far from the horse's shoulder as possible.

This is always accompanied with another fault called *aculer*. See Aculer.

**ENTAIL**, in *Law*, signifies *feetail*, or *fee entailed;* that is, abridged, curtailed, or limited, to certain conditions. See Fee and Tail.

**ENTE'**, in *Heraldry*, a method of marshalling, more frequent abroad than with us, and signifying grafted or ingrafted.

We have indeed one instance of enté in the fourth grand quarter of his majesty's royal ensign, whose blazon is Brunswick and Lunenburg impaled with ancient Saxony, *enté en pointe*, "grafted in point."

**ENTEROCELE**, in *Surgery*, a tumor formed by a prolapsion of the intestines through the rings of the abdomen and processes of the peritonæum, into the scrotum. See Surgery *Index*.

**ENTHUSIASM**, an ecstasy of the mind, whereby it is led to think and imagine things in a sublime, surprising, yet probable manner. This is the enthusiasm felt in poetry, oratory, music, painting, sculpture, &c.

**Enthusiasm**, in a religious sense, implies a transport of the mind, whereby it fancies itself inspired with some revelation, impulse, &c. from heaven. Mr Locke gives the following description of enthusiasm. "In all ages, men in whom melancholy has mixed with devotion, or whose conceit of themselves has raised them into an opinion of a great familiarity with God, and a nearer admittance to his favour than is afforded to others, have often flattered themselves with a persuasion of an immediate intercourse with the Deity, and frequent communications from the Divine Spirit. Their minds being thus prepared, whatever groundless opinion comes to settle itself strongly upon their fancies, is an illumination from the Spirit of God. And whatsoever odd action they find in themselves a strong inclination to do, that impulse is concluded to be a call or direction from heaven, and must be obeyed. It is a commission from above, and they cannot err in executing it. This I take to be properly enthusiasm, which, though arising from the conceit of a warm and overweening brain, works, when it once gets footing, more powerfully on the persuasions and actions of men, than either reason or revelation, or both together; men being most forwardly obedient to the impulses they receive from themselves." Devotion, when it does not lie under the check of reason, is apt to degenerate into enthusiasm. When the mind finds itself inflamed with devotion, it is apt to think that it is not of its own kindling, but blown up with something divine within it. If the mind indulges this thought too far, and humours the growing passion, it at last flings itself into imaginary raptures and ecstasies; and when once it fancies itself under the influence of a divine impulse, no wonder if it slights human ordinances, and refuses to comply with the established form of religion, as thinking itself directed by a much superior guide.

**ENTHUSIAST**, a person possessed with enthusiasm. See the preceding article.

**ENTHYMEME**, in *Logic* and *Rhetoric*, an argument consisting only of two propositions, an antecedent, and a consequent deduced from it. The word is Greek, ενθυμημα, formed of the verb ενθυμεισθαι, "to think, conceive," a compound of εν and θυμος, "mind."

The enthymeme is the most simple and elegant of all argumentations; being what a man, in arguing closely, commonly makes, without attending at all to the form. Thus, that verse remaining of Ovid's tragedy, entitled *Medea*, contains an enthymeme; *Servare potui, perdere an possum rogas:* "I was able to save you; consequently to have destroyed you." All the beauty would have been lost, had all the propositions been expressed; the mind is displeased with a rehearsal of what is nowise necessary.

Sometimes, also, the two propositions of an enthymeme are both included in a single proposition, which Aristotle calls an *enthymematical sentence*, and gives this instance thereof: *Mortal, do not bear an immortal hatred.* The whole enthymeme would be, *Thou art mortal, let not, therefore, thy hatred be immortal.*

**ENTITY**, the same with Ens.

# ENTOMOLOGY.

ENTOMOLOGY, (from εντομος, "an insect," and λογος, "a discourse,") is that part of zoology which treats of insects.

Many are disposed to reckon the study of Entomology trifling. Hunters of butterflies, and catchers of grashoppers, are laughed at by the vulgar, and even by those who are more enlightened. The great numbers and diversity of insects, the beauty and configuration of some of them, and the singular instincts of others, cannot but attract notice, and excite astonishment in those who are fond of contemplating the works of nature, rendering thus the study of Entomology, to them, a source of much pleasure. A collection of the individuals which compose any of the more numerous genera, placed at the same time, before one capable of attending to the striking similarity of the whole, and tracing the

the distinguishing peculiarities of each, cannot fail to create surprise. The great and almost phantastic variety of their forms, the nice adaptation of their parts to the situation in which each happens to be placed, must appear truly wonderful. In every department of nature, which comes within the reach of the human mind, a pleasing and luxuriant variety is discernible. The same Supreme Intelligence, which, by varying the position of the planetary orbs with respect to the sun, and by other seemingly simple but beautiful contrivances, hath produced their different length of day and year, and alternation of seasons, is manifest in the formation of the minutest insect. Each has received that mechanism of body, those peculiar instincts, and is made to undergo those different changes, which fit it for its destined situation, and enable it to perform its proper functions. The utility of many insects, such as the bee, the crab, the silk-worm, the cochineal insect, &c. render them both interesting and important; and a more intimate acquaintance with the class, may enable us to add to the number of those that are useful to man, and to improvements in the management of these already known. The havock many insects make in the vegetable kingdom, the vexation, diseases, and destruction they occasion among animals, should induce those who are engaged in agriculture, and in the rearing and management of animals, to pay attention to Entomology; for the better they are acquainted with their enemies, the abler they must be to attack them with advantage.

Many insects undergo three very distinct changes: which circumstance, joined to the very great difference of appearance which is often met with in the male and female, and even in the neuters of some species, renders their number apparently greater than it really is, and adds considerably to the difficulty of reducing them to order.

Different naturalists have attempted to arrange them into families and genera, particularly the celebrated LINNÆUS, whose arrangement is followed here. He has formed them into seven families or orders, composing his sixth class of animals, INSECTA. He defines an insect, a small animal, breathing through pores on its sides, furnished with moveable *antennæ* and many feet, covered with either a hard crust, or a hairy skin. Before the distinguishing marks of the orders and genera can be understood, it will be necessary to enumerate and explain the terms he has given to the different parts, and the most remarkable of the epithets he has applied to them.

Definition.

The body is divided into *Head*, *Trunk*, *Abdomen*, and *Extremities*.

Head, &c.

I. CAPUT, the *Head*, which is distinguishable in most insects, is furnished with *Eyes*, *Antennæ*, and most frequently with a *Mouth*.

The EYES, 2, 4, 6, or 8 in number, destitute of eye-lids, are either small and simple; or large, compound and hemispherical; or polyedral. They are commonly immoveable. They are called *stipitati* when placed on a stalk.

The ANTENNÆ are two articulated moveable processes, placed on the head.

They are either, 1. *Setaceæ*, setaceous, i. e. like a bristle, when they taper gradually from their base, or insertion into the head, to their point.

2. *Clavatæ*, clavated, i. e. club-shaped, when they grow gradually thicker from their base to their point.

3. *Filiformes*, filiform, i. e. thread-shaped, when they are of an equal thickness throughout the whole of their length.

4. *Moniliformes*, moniliform, i. e, of the form of a necklace, when they are of an equal thickness throughout, but formed of a series of knobs, resembling a string of beads.

5. *Capitatæ*, capitate, i. e. with a head or knob, when they grow thicker towards the point, and terminate in a knob or head.

6. *Fissiles*, fissile, i. e. cleft, when they are capitate, and have the head or knob divided longitudinally into three or four parts or laminæ.

7. *Perfoliatæ*, perfoliated, when the head or knob is divided horizontally.

8. *Pectinatæ*, pectinated, i. e. resembling a comb, when they have a longitudinal series of hairs projecting from them, in form of a comb.

9. *Barbatæ*, barbed, when they have little projections or barbs placed on their sides. They are either, 1. *Longiores*, longer than the body; 2. *Breviores*, shorter than the body; or, 3. *Mediocres*, of the same length with the body.

The MOUTH, in most insects, is placed in the under part of the head; sometimes, however, it is situated in the thorax, and in a few instances, is entirely wanting. It is furnished with, 1. *Palpæ*, or feelers; 2. *Rostrum*, i. e. beak or snout; 3. *Labium*, or lip; 4. *Maxillæ*, or jaws, placed transversely, and moving laterally; 5. *Dentes*, or teeth; 6. *Lingua*, or tongue; 7. *Palatum*, or palate.

*Palpæ*, feelers, which are 4 or 6 in number, are attached to the mouth, and have 2, 3, or 4 articulations.

The *Stemmata* are three prominent shining points on the top of the head.

Trunk.

II. TRUNCUS, the *Trunk*, to which the legs are attached, is situated between the head and the abdomen. It is divided into, 1. The *Thorax*, or chest, which is the superior part; 2. *Scutellum*, i. e. small shield or escutcheon, which is the posterior part; 3. The *Breast* and *Sternum*, which is the inferior part.

Abdomen.

III. The ABDOMEN, that part which contains the stomach, intestines, and other viscera, consists of several annular segments. It is perforated on the sides with *spiracula*, i. e. breathing holes. The upper part of it is termed *Tergum*, or back; the inferior part *Venter*, or belly; the posterior part *Anus*.

Extremities.

IV. ARTUS, the extremities, are, 1. the *Wings*; 2. *Legs*; 3. *Tail*.

I. ALÆ, the wings, are two, or four. They are either,

1. *Planæ*, i. e. plain, such as cannot be folded up by the insect.

2. *Plicatiles*, or folding, such as can be folded up by the insect at pleasure.

3. *Erectæ*, erect, such as have their superior surfaces brought into contact, and stand upright when the insect is at rest.

4. *Patentes*, spreading; such as are extended horizontally.

5. *Incumbentes*, incumbent; such as rest on the upper part of the abdomen.

6. *Deflexæ*, bent down; such as are partly incumbent,

bent, but have their exterior edge inclined towards the sides of the abdomen.

7. *Reversæ*, reversed; such as are incumbent, but inverted.

8. *Dentatæ*, such as have their edges notched or serrated.

9. *Caudatæ*, such as have processes extended from their extremities like a tail.

10. *Reticulatæ*, netted; when the vessels of the wings put on the appearance of net-work.

11. *Pictæ*, painted; such as are marked with coloured spots, bands, streaks, lines or dots.

12. *Notatæ*, marked with specks.

13. *Ornatæ*, adorned with little eyes, or circular spots, containing a spot of a different colour in their centre. The central spot is termed *pupil;* the exterior one is called *iris*. This may happen either in the primary or secondary wings, on their upper or under surfaces. The superior wing is called *primary*, and the inferior *secondary*, to avoid confusion, as they may be at times reversed.

Elytra. The ELYTRA are hard shells, occupying the place of the upper wings. They are, for the most part, moveable, and are either,

1. *Truncata*, truncated, when shorter than the abdomen, and terminated by a transverse line.

2. *Spinosa*, or prickly, when their surfaces are covered with sharp points or prickles.

3. *Serrata*, serrated, when their edges are notched.

4. *Scabra*, rough, when their surface resembles a file.

5. *Striata*, striated, when marked with slender longitudinal furrows.

6. *Porcata*, ridged, when marked with elevated ridges.

7. *Sulcata*, furrowed.

8. *Punctata*, marked with dots.

9. *Fastigiata*, when formed like the roof of a house.

Hemelytra. The HEMELYTRA, as it were half-elytra, partaking partly of the nature of crustaceous shells, and membranaceous wings; being formed of an intermediate substance.

Halteres. HALTERES, or poisers, are small orbicular bodies placed on stalks, situated under the wings of insects of the order *Diptera*.

II. PEDES, the *Legs*. They are divided into, 1. *Femur*, or thigh, that part which is joined to the trunk; 2. *Tibia*, or shank; 3. *Tarsus*, or foot; 4. *Ungues*, hooks or nails; 5. *Manus*, (chela), hands or claws, simple, with a moveable thumb, as in the crab.

The hind-legs are termed, 1. *Cursorii*, formed for running; 2. *Saltatorii*, formed for leaping; 3. *Natatorii*, formed for swimming.

III. CAUDA, the *Tail*, which terminates the abdomen, is, 1. *Solitaria*, i. e. single. 2. *Bicornis*, i. e. two-horned or double. 3. *Simplex*, simple, i. e. unarmed. 4. *Armata*, i. e. furnished, 1. with *Forceps* or *Pincers;* 2. with *Furca*, a fork; 3. with one or more *Setæ* or bristles; 4. with an *Aculeus*, or sting, either smooth or barbed. A sting is a weapon, frequently hollow, with which some insects are furnished, through which they discharge a poison into the wound they inflict.

Sexes. The SEXES of insects are commonly two, *male* and *female*. *Neuters* are to be met with among those insects which live in swarms, such as ants, bees, &c.

Metamorphosis. Most insects undergo three changes. An insect is at first hatched from a very small egg, and becomes a LARVA; a soft succulent animal, without wings, incapable of producing its species, slow in its motions, sometimes without feet, but more frequently with them; consuming greedily the kind of food which is peculiar to it, and which, in proper time, is changed into a *pupa*.

PUPA (*Nympha, Chrysalis*), is firmer and drier than the larva, and is confined either by a naked membrane, or enclosed in a follicle. It is commonly without a mouth; sometimes it has feet, but more frequently none.

1. *Completa*, complete in all their parts, and active; as the aranea, acarus, oniscus, &c.

2. *Semicompleta*, half complete, with only the rudiments of wings; as the gryllus, cicada, cimex, libellula, and ephemera.

3. *Incompleta*, incomplete, with immoveable wings and feet; as the apis, formica, and tipula.

4. *Obtecta*, covered, having the thorax and abdomen enclosed in a skin, and that either naked, or enclosed in a follicle differently composed.

5. *Coarctata*, confined within a globe; as the musca, œstrus.

The pupa is converted into the *imago*, or the perfect insect.

IMAGO, is the perfect insect, active, furnished with antennæ, and capable of generating.

Insects are said to inhabit those plants on which they feed, and not those on which they may be occasionally found, and receive from them many of their specific names.

LINNÆUS has divided the class of insects into seven orders.

Classification. I. COLEOPTERA, (from κολεος, "a sheath," and πτερον, "a wing"), are such insects as have four wings, the upper pair of which are elytra, or crustaceous shells, which, when the animal is at rest, shut, and form a straight suture down the back.

II. HEMIPTERA, (from ἡμισυς, "half," and πτερον, "a wing"), containing such insects as have four wings, the superior part being half crustaceous, and incumbent, and a mouth or beak bent toward the breast.

III. LEPIDOPTERA, (from λεπις, "a scale," and πτερον, "a wing"), containing such insects as have four wings covered with minute imbricated scales, a hairy body, and a mouth furnished with an involuted spiral tongue.

IV. NEUROPTERA, from νευρον, "a nerve," and πτερον, "a wing), containing such insects as have four naked wings, marked with veins crossing one another like net-work; the tail unarmed.

V. HYMENOPTERA, from ὑμην, "a membrane," and πτερον, "a wing"), containing such insects as have four membranaceous wings, and a tail furnished with a sting.

VI. DIPTERA, (from δις, "two," and πτερον, "a wing"), such as have two wings and poisers.

VII. APTERA, (from α, "without," and πτερον, "a wing"), such as have no wings or elytra in either sex.

## CHARACTERS OF INSECTS.

Coleoptera.

### I. COLEOPTERA.

The insects belonging to this order are formed into four divisions. 1. Those that have the antennæ clavated, and thickened towards their exterior side. 2. Those that have the antennæ moniliform. 3. Those which have the antennæ filiform. 4. Those which have the antennæ setaceous.

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|---|---|
| A. *Antennis clavatis, extrorsum incrassatis.* | A. *The Antennæ clavated, becoming thicker towards their exterior side.* |
| a. *Clava lamellata.* | a. *The Clava or Club lamellated.* |
| 1. **Scarabæus.** Tibiæ anteriores dentatæ. | S. The shanks of the fore-legs dentated. |
| 2. **Lucanus.** Penicilli duo sub labio, palpigeri. | L. Two tufts under the lip, to which the feelers are attached. |
| b. *Clava perfoliata.* | b. *The Club perfoliated.* |
| 3. **Dermestes.** Caput inflexum sub thorace, vix marginato. | D. The head bent under the thorax, which is scarcely marginated. |
| 4. **Melyris.** Labium clavatum, emarginatum. | M. The lip clavated and emarginated. |
| 5. **Byrrhus.** Labium porrectum, bifidum. | B. The lip stretched out, and bifid. |
| 6. **Sylpha.** Thorax et elytra marginata. | S. The thorax and elytra marginated. |
| 7. **Tritoma.** Palpi anteriores securiformes. | T. The two anterior feelers hatchet-shaped. |
| 8. **Hydrophilus.** Maxilla bifida. | H. The jaw bifid. |
| c. *Clava solida.* | c. *The Club solid.* |
| 9. **Hister.** Caput retractile intra thoracem. | H. The head capable of being drawn back within the thorax. |
| 10. **Pausus.** Antennæ biarticulatæ. Clava uncinata. | P. The antennæ consisting of two articulations. The club hooked. |
| 11. **Bostrichus.** Caput inflexum sub thorace, vix marginato. | B. The head bent under the thorax, which is slightly marginated. |
| 12. **Anthrenus.** Maxilla bifida. | A. The jaw bifid. |
| 13. **Nitidula.** Thorax et elytra marginata. | N. The thorax and elytra marginated. |
| 14. **Coccinella.** Palpi anteriores securiformes; posteriores filiformes. | C. The anterior feelers hatchet-shaped; the posterior filiform. |
| 15. **Curculio.** Rostrum elongatum corneum. | C. The beak lengthened and horny. |
| B. *Antennis moniliformibus.* | B. *With the Antennæ moniliform.* |
| 16. **Brentus.** Rostrum elongatum, corneum, rectum. | B. The beak elongated, horny and straight. |
| 17. **Attelabus.** Rostrum elongatum, incurvum. | A. The beak elongated and crooked. |
| 18. **Erodius.** Labium corneum, emarginatum. | E. The lip horny and emarginated. |
| 19. **Staphylinus.** Elytra dimidiata, alas tegentia. Vesiculæ duæ supra caudam exserendæ. | S. The elytra half the length of the body, covering the wings. Two vesicles above the tail, which can be pushed out at pleasure. |
| 20. **Scaurus.** Labium truncatum, integrum. | S. The lip truncated, and entire. |
| 21. **Zygia.** Labium elongatum, membranaceum. | Z. The lip elongated and membranaceous. |
| 22. **Meloe.** Thorax subrotundus. Caput gibbum, inflexum. | M. The thorax roundish. The head gibbous, and bent inwards. |
| 23. **Tenebrio.** Thorax marginatus. Caput exsertum. Corpus oblongum. | T. The thorax marginated. The head stretched out. The body oblong. |
| 24. **Cassida.** Corpus ovatum. Elytra marginata. Caput tectum clypeo. | C. The body oblong. The elytra marginated. The head covered with a shield. |
| 25. **Opatrum.** Thorax et elytra marginata. | O. The thorax and elytra marginated. |
| 26. **Mordella.** Laminæ ad basin abdominis. Caput inflexum. | M. Laminæ at the base of the abdomen. Head inflected. |
| 27. **Chrysomela.** Corpus ovatum, immarginatum. | C. The body oval, immarginated. |
| 28. **Horia.** Palpi inæquales. Maxilla bifida. Labium rotundatum. | H. Feelers unequal. Jaw bifid. Lip rounded. |

| C. *Antennis filiformibus.* | C. *Antennæ filiform.* |
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| 29. **Apalus.** Thorax subrotundus. Caput gibbum, inflexum. | A. Thorax roundish. Head turgid, inflected. |
| 30. **Manticora.** Maxillæ exsertæ, dentatæ. Oculi prominuli. | M. Jaws stretched out, furnished with teeth. Eyes rather prominent. |
| 31. **Pimelia.** Thorax marginatus. Caput exsertum. Corpus oblongum. | P. Thorax margined. Head stretched out. Body oblong. |
| 32. **Gyrinus.** Antennæ rigidulæ. Oculi quatuor. | G. Antennæ a little rigid. Eyes 4. |
| 33. **Cucujus.** Labium breve, bifidum, laciniis distantibus. | C. Lip short, bifid, the divisions distant. |
| 34. **Cryptocephalus.** Corpus ovatum immarginatum. | C. Body oval, immarginated. |
| 35. **Bruchus.** Antennæ extrorsum crassiores. | B. Antennæ growing thicker towards the external edge. |
| 36. **Ptinus.** Thorax caput recipiens. Antennæ articulis ultimis longioribus. | P. Thorax receiving the head: last joints of the antennæ longer than the rest. |
| 37. **Hispa.** Antennæ porrectæ, approximatæ, fusiformes. | H. Antennæ stretched forwards, approaching one another, and spindle-shaped. |
| 38. **Buprestis.** Caput dimidium, intra thoracem retractum. | B. Head half retracted within the thorax. |
| 39. **Necydalis.** Elytra dimidiata, alis nudis. | N. Elytra half the length of the body. Wings naked. |
| 40. **Lampyris.** Elytra flexilia. Thoracis clypeus caput obumbrans recipiensque. | L. Elytra flexible. Shield of the thorax shading and receiving the head. |
| 41. **Cantharis.** Elytra flexilia. Abdomen lateribus plicato-papillosum. | C. Elytra flexible. Sides of the abdomen edged with folded papillæ. |
| 42. **Notoxus.** Labium bifidum; laciniis conniventibus obtusis. | N. Lip bifid; the divisions of it obtuse and approaching closely. |
| 43. **Elater.** Pectoris mucro è poro abdominis resiliens. | E. A sharp point proceeding from the breast, springing out at a pore in the abdomen. |
| 44. **Calopus.** Thorax ad latera mucronato-callosus. | C. The thorax callous at the sides, and set with sharp points. |
| 45. **Alurnus.** Maxilla fornicata. | A. Jaw arched. Feelers 6. |
| 46. **Carabus.** Thorax obcordatus, posterius truncatus. | C. The thorax resembling a heart inverted, and terminating abruptly behind. |
| 47. **Lytta.** Thorax subrotundus. Caput gibbum, inflexum. | L. Thorax roundish. Head turgid, inflected. |

| D. *Antennis setaceis.* | D. *Antennæ setaceous.* |
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| 48. **Serropalpus.** Palpi anteriores profundè serrati. | S. The anterior feelers deeply serrated. |
| 49. **Cerambyx.** Thorax ad latera mucronato-callosus. | C. The thorax callous at the sides, and set with sharp points. |
| 50. **Leptura.** Elytra apice attenuata. Thorax teretiusculus. | L. Elytra tapering towards the tip. Thorax roundish. |
| 51. **Rhinomacer.** Antennæ rostro insidentes. | R. Antennæ seated on the snout. |
| 52. **Zonitis.** Labium emarginatum. | Z. Lip emarginated. |
| 53. **Cicindela.** Maxillæ exsertæ, dentatæ. Oculi prominuli. | C. Jaws stretched out, furnished with teeth. Eyes a little prominent. |
| 54. **Dytiscus.** Pedes posteriores ciliati, natatorii. | D. Hind-legs fringed, formed for swimming. |
| 55. **Forficula.** Elytra dimidiata. Alis tectis. Cauda forcipata. | F. Elytra half as long as the body. Wings covered. Tail furnished with pincers. |

Hemiptera.

| II. HEMIPTERA. | II. HEMIPTERA. |
|---|---|
| 56. **Blatta.** Os maxillosum. Alæ coriaceæ, planæ. Pedes cursorii. | B. Mouth furnished with jaws. Wings coriaceous, plane. Legs formed for running. |
| 57. **Pneumora.** Os maxillosum. Alæ membranaceæ, deflexæ. Pedes cursorii. Corpus cavum, inflatum, diaphanum. | P. Mouth furnished with jaws. Wings membranaceous, deflected. Legs formed for running. Body hollow, inflated, and transparent. |
| 58. **Mantis.** Os maxillosum. Pedes anteriores serrati, ungue unico. | M. Mouth furnished with jaws. The anterior legs serrated, and terminated by a single claw. |
| 59. **Gryllus.** Os maxillosum. Pedes posteriores saltatorii. | G. Mouth furnished with jaws. Hind-legs formed for leaping. |

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| 60. Fulgora. Rostrum inflexum. Frons producta, inermis. Antennæ capitatæ. | F. Snout inflected. Fore-head projecting, unarmed. Antennæ capitated. |
| 61. Cicada. Rostrum inflexum. Pedes posteriores saltatorii. | C. Snout inflected. Hind-legs formed for leaping. |
| 62. Notonecta. Rostrum inflexum. Pedes posteriores natatorii (ciliati). | N. Snout inflected. Hind-legs fringed, and formed for swimming. |
| 63. Nepa. Rostrum inflexum. Pedes anteriores cheliferi. | N. Snout inflected. Fore-legs furnished with claws. |
| 64. Cimex. Rostrum inflexum. Pedes cursorii. Antennæ thorace longiores. | C. Snout inflected. Legs formed for running. Antennæ longer than the thorax. |
| 65. Macrocephalus. Rostrum inflexum. Antennæ brevissimæ. | M. Snout inflected. Antennæ very short. |
| 66. Aphis. Rostrum inflexum. Abdomen bicorne. | A. Snout inflected. Abdomen 2-horned. |
| 67. Chermes. Rostrum pectorale. Pedes posteriores saltatorii. | C. Snout placed in the breast. Hind-legs formed for leaping. |
| 68. Coccus. Rostrum pectorale. Abdomen (maribus) posterius setosum. | C. Snout placed in the breast. Abdomen (in the males) terminating in bristles. |
| 69. Thrips. Rostrum obsoletum. Alæ incumbentes, abdomine reflexile. | T. Snout obsolete. Wings incumbent. The abdomen capable of being turned up. |

Lepidoptera.

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| III. LEPIDOPTERA. | III. LEPIDOPTERA. |
| 70. Papilio. Antennæ extrorsum crassiores. Alæ erectæ. | P. Antennæ thicker towards the point. Wings erect. |
| 71. Sphinx. Antennæ medio crassiores. | S. Antennæ thicker in the middle. |
| 72. Phalæna. Antennæ introrsum crassiores. | P. Antennæ thicker towards the base. |

Neuroptera.

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| IV. NEUROPTERA. | IV. NEUROPTERA. |
| 73. Libellula. Cauda forcipata. Os multi maxillosum. Alæ extensæ. | L. Tail forked. Mouth with many jaws. Wings expanded. |
| 74. Ephemera. Cauda setis 2 et 3. Os edentulum. Alæ erectæ. | E. Tail with 2 and 3 bristles. Mouth without teeth. Wings erect. |
| 75. Myrmeleon. Cauda forcipata. Os bidentatum. Alæ deflexæ. | M. Tail forked. Mouth with two teeth. Wings deflected. |
| 76. Phryganea. Cauda simplex. Os edentulum. Alæ deflexæ. | P. Tail simple. Mouth without teeth. Wings deflected. |
| 77. Hemerobius. Cauda simplex. Os bidentatum. Alæ deflexæ. | H. Tail simple. Mouth with two teeth. Wings deflected. |
| 78. Panorpa. Cauda chelata. Os rostratum. Alæ incumbentes. | P. Tail furnished with a claw. Mouth stretched out into a beak. Wings incumbent. |
| 79. Raphidia. Cauda filo 1. Os bidentatum. Alæ deflexæ. | R. Tail ending in a simple thread. Mouth with two teeth. Wings deflected. |

Hymenoptera.

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| V. HYMENOPTERA. | V. HYMENOPTERA. |
| 80. Cynips. Aculeus spiralis! | C. Sting spiral. |
| 81. Tenthredo. Aculeus serratus! bivalvis. | T. Sting serrated, two-valved. |
| 82. Sirex. Aculeus serratus, sub abdominis spina terminali. | S. Sting serrated, under a spine which terminates the abdomen. |
| 83. Ichneumon. Aculeus exsertus! triplex. | I. Sting stretched out, triple. |
| 84. Sphex. Aculeus punctorius. Alæ planæ. Lingua inflexa, trifida. | S. Sting pungent. Wings smooth. Tongue inflected, and divided into three at the extremity. |
| 85. Scolia. Lingua inflexa, trifida. Labium apice membranaceum. | S. Tongue inflected, trifid. Lip membranaceous at the extremity. |
| 86. Thynnus. Lingua brevissima, involuta. Labium trifidum. | T. Tongue very short, involuted. Lip trifid. |
| 87. Leucopsis. Labium maxilla longius, emarginatum. Antennæ clavatæ. | L. Lip longer than the jaw, notched. Antennæ clavated. |
| 88. Tiphia. Labium breve, corneum, tridentatum. | T. Lip short, horny, with three small divisions. |
| 89. Chalcis. Antennæ breves, cylindricæ, fusiformes. | C. Antennæ short, cylindrical, spindle-shaped. |
| 90. Chrysis. Aculeus punctorius. Abdomen subtus fornicatum. | C. Sting pungent. Abdomen arched beneath. |

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| 91. VESPA. Aculeus punctorius. Alæ superiores plicatæ! | V. Sting pungent. Upper wings folded. |
| 92. APIS. Aculeus punctorius. Lingua inflexa! | A. Sting pungent. Tongue inflected. |
| 93. FORMICA. Aculeus obsoletus. Alæ neutris nullæ! | F. Sting obsolete. Neuters without wings. |
| 94. MUTILLA. Aculeus punctorius. Alæ neutris nullæ. | M. Sting pungent. Neuters without wings. |

Diptera.

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|---|---|
| **VI. DIPTERA.** | **VI. DIPTERA.** |
| A. *Proboscide et Haustello.* | A. *With Proboscis and Sucker.* |
| 95. DIOPSIS. Caput bicorne. Oculis terminalibus. | D. Head two-horned. Eyes terminal. |
| 96. TIPULA. Haustellum sine vagina. Palpi 2, porrecti, filiformes. | T. Sucker without a sheath. Feelers 2, projecting, filiform. |
| 97. MUSCA. Haustellum sine vagina, setis instructum. | M. Sucker without a sheath, furnished with bristles. |
| 98. TABANUS, Haustellum vagina univalvi, setisque instructum. | T. Sucker with a single-valved sheath, furnished with bristles. |
| 99. EMPIS. Proboscis inflexa. | E. Proboscis inflected. |
| 100. CONOPS. Proboscis porrecta, geniculata. | C. Proboscis projecting, and bent with an angular flexure. |
| B. *Haustello sine Proboscide.* | B. *With Sucker, but no Proboscis.* |
| 101. OESTRUS. Haustellum retractum intra labia, connata poro pertusa. | O. Sucker drawn back within the lips, which are perforated. |
| 102. ASILUS. Haustellum rectum bivalve, basi gibbum. | A. Sucker straight, with two valves, turgid at the base. |
| 103. STOMOXYS. Haustellum vagina univalve convoluta, basi geniculata. | S. Sucker with a single-valved convoluted sheath, bent at the base, with an angular flexure. |
| 104. CULEX. Vagina exserta, univalvis, flexilis, setis 5. | C. Sheath stretched out, of one flexible valve, with 5 bristles. |
| 105. BOMBYLIUS. Haustellum longissimum, rectum, setaceum, bivalve. | B. Sucker very long, straight, setaceous, with two valves. |
| 106. HIPPOBOSCA. Haustellum breve, cylindricum, rectum, bivalve. | H. Sucker short, cylindrical, straight, with two valves. |

Aptera.

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| **VII. APTERA.** | **VII. APTERA.** |
| A. *Pedibus sex, Capite à Thorace discreto.* | A. *Legs six. Head distinct from the Thorax.* |
| 107. LEPISMA. Cauda setis exsertis. | L. Tail ending in setaceous bristles. |
| 108. PODURA. Cauda bifurca, inflexa, saltatrix. | P. Tail forked, inflected, elastic. |
| 109. TERMES. Os maxillis duabus. Labium corneum, quadrifidum. | T. Mouth with two jaws. Lip horny, cleft into four pieces. |
| 110. PEDICULUS. Os aculeo exserendo. | P. Mouth armed with a sting capable of being pushed out at pleasure. |
| 111. PULEX. Os rostro inflexo, cum aculeo. Pedes saltatorii. | P. Snout inflected, armed with a sting. Feet formed for leaping. |
| B. *Pedibus* 8—14. *Capite Thoraceque unitis.* | B. *Legs* 8—14. *Head and Thorax united.* |
| 112. ACARUS. Oculi 2. Pedes 8. Palpi compressi. | A. Eyes 2. Legs 8. Feelers compressed. |
| 113. HYDRACHNA. Oculi 2—8. Pedes 8, in anteriore corporis parte. Papillæ textoriæ. | H. Eyes 2—8. Legs 8. Abdomen furnished with papillæ, with which the animal spins thread and weaves itself a web. |
| 114. ARANEA. Oculi 8. Pedes 8. Papillæ textoriæ. Palpi clavati. | A. Eyes 8. Legs 8. Abdomen furnished with papillæ, with which the animal spins thread and weaves itself a web. |
| 115. PHALANGIUM. Oculi 4. Pedes 8. Palpi chelati. | P. Eyes 4. Legs 8. Feelers furnished with claws. |
| 116. SCORPIO. Oculi 8. Pedes 8. Palpi chelati. | S. Eyes 8. Legs 8. Feelers furnished with claws. |
| 117. CANCER. Oculi 2. Pedes 10, primo chelato. | C. Eyes 2. Legs 10, the first pair furnished with claws. |

118.

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| 118. Monoculus. Oculi 2. Pedes 12, decem chelatis. | M. Eyes 2. Legs 12, 10 of them furnished with claws. |
| 119. Oniscus. Oculi 2. Pedes 14. | O. Eyes 2. Legs 14. |
| C. *Pedibus pluribus. Capite à Thorace discreto.* | C. *Legs numerous. Head distinct from the Thorax.* |
| 120. Scolopendra. Corpus lineare. | S. Body linear. |
| 121. Julus. Corpus subcylindricum. | J. Body nearly cylindrical. |

N. B.—*In the following classification, some of the more remarkable species only are enumerated. Those marked with an asterisk are natives of Britain.*

## I. COLEOPTERA.

*Elytra covering the wings.*

### Scarabæus. 1. Scarabæus, *Beetle.*

Antennæ clavated, the club lamellated. Feelers 4. Jaws horny, for the most part without teeth. The shanks of the fore-legs generally dentated.

The larvæ of the genus *scarabæus* have six feet, and a body composed of annular segments, furnished with hairs, and with vesicles at the end of the abdomen. Their heads are hard, formed of a substance like horn. They are commonly called *grubs*, and do much mischief, both in the fields and in the garden. They live chiefly under ground, or in dung, on which they frequently feed. The larvæ of the species *cetonia* live on rotten wood, and those of the *melolontha* on the roots of plants. The *pupa* remains under ground.—Grubs are devoured by many kinds of birds, particularly by the rooks, which, on that account, ought not to be destroyed so eagerly as they are in many places; for, though they do much mischief themselves, in spring, and during harvest, yet it is amply compensated by the good they do through the year, in clearing the ground of grubs.

* *Feelers filiform.*

† *Jaw arched.*

a. *Without teeth.*

א. *Thorax horned.*

α. *Scutellati.*

* *hercules.* A horn on the thorax, large, and bent inwards, barbed below with one tooth; a horn on the head bent back, dentated on the upper side with many teeth. *Syst. Nat. Lin.* 1. It is a native of America, and varies in colour, being sometimes black, sometimes azure spotted with black. The female is without horns.

* *centaurus.* The horn on the thorax bent inwards, with two teeth at its base, and bifid at the point; the horn on the head bent back, furnished with one tooth. 92.

*chorinæus.* The horn on the breast bent inwards and very thick at the base, bifid at the point; the horn on the head bent back, very long, bifid. Native of Brazil. 96.

* *typhæus* *Bull-comber.* With three horns on the thorax, the middle ones smaller than the rest, lateral ones projecting as far as the head does, which is without horns. It is a native of Europe; to be met with under cow-dung. It makes its nest in holes, which it digs deep into the ground. It is black. Head depressed, hairy at the sides, narrow. Knob of the antennæ grayish. Thorax smooth. The horns sometimes as long as the head, and sometimes twice as long; in the female hardly visible. Elytra striated. Shanks hairy. 9.

* *mobilicornis.* Thorax with four projections like teeth. The horn of the head bent back, and moveable. 116. Native of England and Germany. Black. Elytra striated. Female without horns on the head, or projections on the breast.

*actæon.* Smooth; thorax with two horns; horn of the head notched with one tooth, bifid at the end; elytra smooth. 3. Native of South America. The largest of all known insects, except crabs and monoculi. Elytra black, or azure spotted with black.

א. *Thorax horned.*

β. *Without Scutellum.*

*violaceus.* Thorax with six spines; jaws prominent; front sloping; body entirely of a violet colour. 117. Native of Siberia; found under stones; small. Elytra marked with deeply excavated spots.

*oedipus.* Horn of the thorax flat, marked with one tooth on the under side; the horn of the head terminating abruptly, with three teeth. 119. Native of the Cape of Good Hope. Middle-sized.

* *lunaris.* Thorax with three horns, the middle one obtuse, and bifid; horn of the head erect; shield emarginated. 10. Native of Europe; on dunghills. The female always without horns on the breast.

*camelus.* Thorax marked with four projections like teeth; posterior part of the shield slightly marked with two horns; body black. 134. Native of Germany. The female with nearly the same marks as the male.

b. *Thorax unarmed; Head horned.*

a. *Furnished with a Scutellum.*

*bilobus.* Thorax prominent, divided into two lobes; horn of the head simple; elytra striated. 12. Native of the south of Europe. Black.

*nasicornis.* A triple prominence on the breast; horn on the head bent back; elytra smooth. 15. Native of Europe; met with in dunghills. Its larva gray, with a reddish head, feet, and spiracula or breathing holes. Swammerdam has supposed it to be the *cossus* of the ancients. Vid. *Plin.* 17. 24. Thorax of the female roundish.

β. *Without Scutellum.*

*jacchus.* Thorax prominent, formed of two lobes; horn on the head bent back, and simple. 156. Native of the Cape of Good Hope. The horn on the head of the female very short, and terminating abruptly.

*carnifex.* Thorax flat, angularly rough; the horn on the head bent

bent inwards: the body of a yellow colour. 22. Native of America. During the whole summer they may be seen in great numbers, rolling about balls which they form out of dung. They mutually assist one another to roll them into holes made for their reception, like the *pilularis*. Their bodies are broad, and depressed; the horn on their heads is placed backwards. It is black, and smooth. In the female it is effaced.

c. *Both Thorax and Head without horns.*

a. *Furnished with a Scutellum.*

* *fimetarius.* *Dunghill-beetle.* Body black; head marked with tubercles, commonly three in number; the elytra reddish. 32. Native of Europe; frequently to be met with in dung.

* *stercorarius.* *Clock-beetle.* Body black, smooth; the elytra furrowed; the head of a rhomboidal figure; fore-head prominent. 42. Native of Europe; to be met with in dung; much infested with some species of the *acarus* and *ichneumon*, and, on that account, frequently called *lousy beetle*. It flies about in the evening with a loud noise, and is said to foretel a fine day. It was consecrated by the Egyptians to the sun. It is sometimes of a greenish blue colour. It is likewise sometimes yellowish below, with dusky-red elytra. This is the *shard-borne beetle* of Shakespeare. The female digs a hole, and kneads a lump of fresh dung, generally of a cylindrical shape, on which she deposits one egg, and then covers it with more dung, attaching it to the root of some grass. In a few days the larva breaks the egg, and feeds on the fresh dung. During the autumn it changes its skin four times.

β. *Without Scutellum.*

*sacer.* The shield of the head marked with six denticulations; the thorax notched; the shanks of the hind-legs fringed; top of the head marked with two slight projections. 18. Native of the southern parts of the old continent. It is frequent in dry situations in the southern parts of Russia, where it rolls about cylinders formed of cow-dung. Its figure is carved by the Egyptians on the ancient pillars at Rome.

*pilularius.* Black, opaque, smooth, yellow underneath; the thorax rounded behind. 40. Native of the south of Europe; of the same size with the lousy beetle. In pairs, they daily roll, like Sisyphus, a ball made of excrement, seven times the bulk of their own body.

*schaefferi.* The thorax round; the shield emarginated; the elytra triangular; the thighs of the hind-legs elongated and dentated. 41. Native of Italy, Germany, and Siberia; to be met with on the sunny hills, where it rolls and buries balls made of cow-dung. It is black.

* *fossor.* Thorax retuse; head marked with three tubercles, the middle one faintly resembling a horn. 31. A native of Europe, in sandy places, and in dunghills.

b. *Jaw arched, furnished with some teeth; the point of the Abdomen naked, and obliquely truncated.* Melolonthæ.

* *fullo.* Of a brick colour, and spotted with white. The scutellum with two notches; the antennæ divided into seven leaves. 57. It inhabits sandy situations in Europe and Barbary, living on the oak, *elymus arenaria*, and *arundo arenaria*. It is hairy below: the hooks at the ends of their legs are furnished, at their base, with a crooked branch. It is the largest coleopterous insect to be met with in Britain, except the stag-beetle. It is but rare in England.

The head and thorax beset with bluish hair; the elytra of a livid colour; the shield bent back at the top. 236. Native of Germany; on the ears of rye. *fruticola.*

The head and thorax beset with bluish hairs; the elytra of a brick colour; the legs black. 59. Native of Europe; to be found in gardens, where its grub proves very destructive to cabbages, &c. and the beetle to the fruit-trees. * *horticola.*

The thorax hairy; the elytra of a livid colour, with a black edge, and black band; the shield turned back at the top. 58. Native of Europe, on grass-fields. *agricola.*

The head and thorax covered with bluish hairs; the elytra reddish; the abdomen white and hairy. 240. Native of Europe; resembles the garden-beetle very much, and is very destructive. *abdominalis.*

Of a shining copper colour; the shield emarginated. 241. Native of Africa, near the equator. *regius.*

Green; the sides of the thorax yellow. 249. A native both of Europe and America: on the vine: very like the *frischii*, differing only from it by the elytra, which are of a brick colour. *vitis.*

Blackish yellow; the elytra of a brick colour. 250. Is a native of Germany; on the vine, and the rose. The elytra, sometimes, are of the same colour with the thorax. *frischii.*

Above smooth, and of a golden colour; the scutellum, and a line on the back of the thorax, of a blood-colour. 253. A native of New Zealand. *lactus.*

*Door-beetle, May-bug, Cockchaffer.* Furnished with a scutellum; without horns; light brown; the thorax hairy; the tail bent inwards; a triangular white spot at each incisure of the abdomen. 60. It inhabits the northern parts of Europe; flies about in the evening, and feeds on the leaves of trees. It is the most destructive of all the European insects. When it happens to be more plentiful than usual, in the autumn, the vulgar entertain an opinion, that some epidemic diseases are to follow. The male is distinguished by a sharp inflected tail. The grub is gray, with reddish brown head and feet. Eats the roots of plants, particularly of corn, frequently laying waste a great tract of country. They remain six years under ground, before they become beetles. Their thorax varies yearly in colour, from brown to black. * *melolontha.*

It is furnished with a scutellum, and is without horns; the thorax is hairy; the elytra are of a pale yellow colour, marked with three white parallel lines. 61. Is a native of Europe, to be met with among trees. The claws at the end of the legs, have one little projection, like a tooth, at their base. They make their appearance somewhat later than the May-bug, and are very frequent about the summer solstice. *solstitialis.*

Body of a brick colour, and woolly below; shield marginated, and bent back; scutellum white. 263. Native of Europe; of the same size with the cockchaffer. *villosus.*

†† *Jaw straight.*

a. *Sharp.* Cetoniæ.

Furnished with a scutellum; without horns; sternum projecting; scutellum one half shorter than the elytra. 49. Native of South America. Of the same size and colour with the golden beetle. *chrysis.*

*fascicularis.* Furnished with a scutellum; thorax marked with four small white lines; elytra green; incisures of the abdomen bearded. 75. Native of the Cape of Good Hope. Covered on the under part of the body with pale red wool, collected into little bundles.

b. *Jaws straight and blunt.* Frischii.

* *fasciatus.* Furnished with a scutellum; body black, covered with yellow down; elytra marked with two yellow bands uniting into one. 70. Native of the north of Europe: feeding on the flowers of the *syringa filipendulu*, and on some umbelliferous plants.

* *hemipterus.* Furnished with a scutellum; thorax downy, edged with two longitudinal wrinkles; elytra shortened. 63. Native of Europe. The larva is found in wood; the beetle on flowers. The female is armed with a stiff, short sting.

** *Feelers terminating in knobs.* Trox.

* *sabulosus.* Furnished with a scutellum; black, opaque, with wrinkled tubercles; antennæ hairy at the base. 48. Native of Europe. To be met with on sandy hills, which are exposed to the sunshine.

*morticinii.* Shield unequal and fringed; elytra striated, and marked with convex sharpish points. 404. Native of Tartary. To be found in great numbers, under dead bodies, which have been dried by the sun. It makes a noise, by rubbing its tail against its elytra. Is of an opaque black colour; and of the same size with *sc. fossor*.

*** *Feelers cylindrical: the Club of the Antennæ tunicated.*

*hemisphæricus.* Hemispherical; the fore part of the shield marked with two obtuse projections. 406. Larger than the *sc. sacer*.

432 species of this genus have been described by Gmelin, in his last edition of the System of Nature.

### 2. LUCANUS.

Antennæ clavated; the club compressed, being broadest at the sides, and divided into pectinated leaves. Jaws stretched out, and forked at the points. Two tufts under the lip, to which the feelers are attached.

*alces.* The jaws stretched out, and furnished with four teeth at the point. 8. A native of Asia.

* *cervus.* *Stag-beetle.* Furnished with a scutellum; the jaws stretched out, and forked at the points, furnished with one lateral tooth. 1. Native of Europe. It is the largest coleopterous insect to be met with in Britain. It feeds on decayed oak. The larva is white and very thick, with head and feet of a rusty colour. By some supposed to be the *crassus* of the ancients. The female smaller than the male.

*elaphus.* The jaws projecting, furnished with one tooth, and forked at the point; the lip conical and bent down. 9. Native of Virginia. In the female, which is smaller than the male, the jaws do not project.

*capreolus.* Furnished with a scutellum; the jaws projecting, and only forked at the point. 2. It is a native of the south of Europe, and North America; about half the size of the stag-beetle.

20 species of this genus have been described in the last edition of the System of Nature.

### 3. DERMESTES, *Leather-Eater*.

Antennæ clavated; club perfoliated; three articulations thicker than the rest. Thorax convex, slightly marginated. Head bent and concealed under the breast.

The *larvæ*, or grubs, of this tribe, devour dead bodies, skins, leather, and almost any animal substance; and are exceedingly destructive to books and furniture.

* *Jaw bifid.*

* *lardarius.* Black; the fore part of the elytra of an ash colour. 1. It is a native of Europe. Sometimes, though rarely, the anterior part of the elytra is of a rusty colour.

This insect is the common pest of museums, libraries, and preparations of natural history. It is also found in old bacon, whence it has received its name. When it is eating, it protrudes balls of excrement from its anus, which hang down in a string. The larva is oval and hairy.

*elongatus.* Black; the elytra livid at the base, and marked with a band of the same colour, at the posterior part; the antennæ and feet of a rusty colour. 2. Native of Europe; to be met with in old wood; almost filiform.

* *undatus.* Oblong, black; the elytra marked with a double white linear band. 3. A native of Europe. Feeds on putrid animal substances.

* *pellio.* Black; the elytra marked with two white spots. 4. It is a native of Europe. Feeds on skins, bacon, and old books. Its larva is oblong, hairy, and furnished with a bristly tail.

* *paniceus.* Oblong, of a rusty colour; with red eyes. 19. Native of Europe. In bread that has been long kept; in bookbinders glue; in books, &c. About the size of a millet seed. The larva is oblong, white and shining.

** *Jaw furnished with one tooth.* Apate.

*muricatus.* The elytra reticulated, blunted behind and notched; thorax prickly and turgid. 6. It is a native of South America; in wood, and sugar canes.

*ruficornis.* Of a dusky colour; the head drawn back; the antennæ and feet reddish. 70. It is a native of Europe, and very small.

70 species of this genus have been described in the last edition of the System of Nature.

### 4. BOSTRICHUS.

Antennæ clavated; the club solid. Thorax convex, and scarcely marginated. Head inflected and concealed under the thorax.

*capucinus.* Black; the elytra and abdomen red; the thorax flattened. 1. It is a native of Europe, and of Siberia. It is to be found in trunks of trees, particularly dead ones, and in houses.

* *typographus.* Of a brick colour; hairy; the elytra striated, blunted and notched. 4. It is a native of Europe and America; to be met with under the bark of trees. It is particularly hurtful to the pine tree; very prolific, and very voracious; scooping out furrows under the bark, from which other smaller ones proceed, in a parallel direction. They are very tenacious of life; and according to age and size, vary in colour, from a yellow to a brown, and from that to black.

*chalcographus.* Black; the elytra red, and notched. 5. It is a native

tive of Europe; to be found under the bark of trees. It sometimes varies in colour.

*polygraphus.* Blackish; the elytra are sometimes blunted, and of an azure colour. 6. It is a native of Europe. It forms winding canals under the bark of trees, and is one of the most destructive of this genus.

* *micrographus.* Of a rusty colour; the elytra entire, and of a brick colour. 7. It is a native of Europe; in wood, also within the bark of trees: small, black; the elytra, antennæ, and legs, of a brick colour.

* *piniperda.* Black, and somewhat hairy: the elytra entire and black; the feet reddish. 13. It is a native of Europe; on the under branches of pine-trees, which it perforates, dries up, and destroys. It sometimes varies in the colour of the elytra.

22 species of this genus have been described in the last edition of the System of Nature.

### 5. MELYRIS.

Lip clavated, and emarginated. Antennæ perfoliated throughout their whole length. Jaw with one tooth, and pointed.

*viridis.* Green; the elytra marked with three elevated lines. 1. Native of the Cape of Good Hope.

*igra.* Black; the elytra marked with three elevated lines. 2. About the third part of the size of the preceding species.

### 6. PTINUS.

Antennæ filiform; the articulations towards the points larger than the rest. Thorax roundish, not marginated, receiving the head.

* *Feelers clavated.* Anobia.

*ugosus.* Brown; thorax unequal; elytra striated. 1. It is a native of Europe; without spots, and double the size of the subsequent species.

* *pertinax.* All over brown. 2. It is a native of Europe; is very destructive to wooden furniture, particularly to articles made of oak; likewise to books, &c. When catched, it contracts itself and counterfeits death. It can be put in motion again, neither by pricking, nor any other means, except by the application of a strong heat. It is destroyed by the *attelabus formicarius*.

* *mollis.* Of a brick colour, with dark-coloured eyes. 3. It is a native of Europe, among rubbish; an unwelcome visitor in collections of plants, and to be got rid of effectually, in no other way but by the heat of an oven. The larva is white, and is capable of enduring a great degree of cold.

*pulsator.* *Death-watch.* Cylindrical, opaque, and much wrinkled, sprinkled with gray spots. 13. It is a native of Europe. It is common in trunks of old trees, particularly of the willow, and in houses. It beats, especially in the night-time, making a noise, resembling that produced by one's nail struck against a table. This is done by seven, nine, or eleven distinct strokes, and has been considered by the vulgar, as foreboding some fatal occurrence to the family occupying the house in which the noise is heard. But it is nothing more than the call of one sex to the other.

** *Feelers filiform, bifid.* Ptini.

* *fur.* Light brown, and almost without wings; the thorax marked with four projections like teeth; the elytra marked with two white bands. 5. It is a native of Europe, and is exceedingly destructive to seeds, museums, books, furniture, preserved subjects of natural history, and even to the leaves of tobacco. It delights in cold and moisture; and is best kept off by heat and dryness, by arsenic or alum. It is most effectually destroyed by corrosive sublimate. The female is without wings. The larva has six feet, and is soft, thick, and hairy. The pupa is enclosed in a glutinous spherical covering.

* *imperialis.* Brown; the thorax somewhat crenated; the elytra marked with a white blotch, divided into lobes. 4. It is a native of the north of Europe; to be found in trees. It is about the size of a grain of wheat: the antennæ are of the same length with the body; the legs are of a rusty colour; the scutellum white; the elytra marked with a white spot, resembling the eagle worn on the imperial standard; from whence it has received its name.

* *scotius.* The thorax black, and smooth; the elytra connected, shining, brown. 22. It is a native of Europe; on the birch.

32 species of this genus have been described in the last edition of the System of Nature.

### 7. HISTER.

Antennæ clavated. Club solid, the lower joint compressed, and bent down. Head capable of being drawn back into the body. Mouth furnished with pincers. Elytra shorter than the body. Shanks of the fore-legs notched.

*maximus.* Very large. 1. It is a native of India, similar to the *unicolor*, but ten times larger. The corners of the thorax rounded; point of the breast extended, not quite up to the mouth.

* *unicolor.* Black; the elytra obliquely striated. 3. It is a native of Europe and America; in sand, and in dung.

* *bimaculatus.* Black; the posterior part of the elytra red. 5. Native of Europe; in cow dung.

17 species of this genus have been described in the last edition of the System of Nature.

### 8. GYRINUS, *Whirler*, or *Water-flea*.

Antennæ cylindrical. Jaw very sharp, and horny. Eyes four; two above, and two below.

These little animals are found on the surface of water, on which they run very nimbly, and describe circles. When attempted to be taken, they dive down, drawing after them a bubble, resembling a globe of quicksilver.

* *natator.* Black; faintly striated. 1. Native of Europe; in lakes and ponds.

*bicolor.* Black above; below, of a rusty colour; hind-legs compressed. 3. Native of Europe; frequents waters; is larger than the *natator*.

Nine species of this genus have been described in the last edition of the System of Nature.

### 9. BYRRHUS.

Antennæ clavated, and perfoliated. Feelers equal, and somewhat clavated. Jaw bifid. Lip bifid.

*gigas.* Black; the elytra of a rusty colour, and marked with points. 1. Native of Europe. The anus of the female furnished with a sting.

* *pilula.* Brown; the elytra marked with black grooves. 4. Native of Europe; in sandy places. It is sometimes, though rarely, black.

* *varius.* Black; thorax of a bright yellow; elytra brown, and marked with three short green grooves, spotted with black. 5. Native of Britain.

Nine species of this genus have been described in the last edition of the System of Nature.

### 10. ANTHRENUS.

Antennæ clavated. Club solid. Feelers unequal, filiform. Jaws membranaceous, linear, bifid. Lip entire.

*pimpinellæ.* Black; elytra marked with a white band, and of a rusty colour towards their points, with a white stain. 4. Native of Europe; feeds on the flowers of the *pimpinella.*

* *scrophulariæ.* Black; elytra spotted with white; suture of a blood-red colour. 1. Native of Europe; on the *scrophularia.*

* *museorum.* Clouded; elytra slightly clouded. 2. Found in museums, destroying animals preserved in them, and books.

* *verbasci.* Black; elytra marked with three waved bands. 3. Native of Europe; on the *verbascum.*

Seven species of this genus have been described in the last edition of the System of Nature.

### 11. SYLPHA, *Carrion-Beetle.*

Antennæ clavated. Club perfoliated. Elytra marginated. Head prominent. Thorax flattish, marginated.

These are chiefly found under the loose bark of trees, or on the half-decayed carcases of animals, upon which both the grub and the insect feed.

* *germanica.* Oblong, black; shield roundish, unequal, and marginated; elytra very obtuse, with a rusty-coloured lateral margin. 1. Native of Germany. There are many varieties of this species. They deposit their eggs in the carcases of other insects, which they bury under ground.

* *vespillo.* Oblong, black; shield almost spherical and unequal; elytra marked with a double rusty-coloured band. 2. Native both of Europe and America.—There are many varieties of this species. In America, some of them are ten times larger than those in Europe. They frequently have the smell of musk, and fly very quickly, with their elytra erect, and applied close together. They are much infested by the *acarus,* and deposit their eggs in the carcases of other insects, which they bury.

* *quadripustulata.* Black, oblong; elytra marked with two rusty spots. 5. Native of Europe and America, in decayed wood; very smooth; the larva oblong, gray and hairy.

* *quadrimaculata.* Red; thorax and elytra black; the latter marked with two red spots. 27. Native of Europe.

* *rufifrons.* Oblong, smooth, black; the front, the legs, and two spots on the elytra, of a rusty colour. 41. Native of England. Antennæ black; club reddish; thorax smooth, without spots; elytra smooth.

* *rugosa.* Blackish; elytra wrinkled, and marked with three elevated lines; thorax wrinkled and scolloped behind. 16. Native of Europe and Asia. It consumes dead bodies, either flesh or fish. When catched, it vomits a very fœtid fluid.

94 species of this genus are described by Gmelin, in the last edition of the System of Nature.

### 12. NITIDULA.

Antennæ clavated. Club solid. Elytra marginated. Head prominent. Thorax a little flattened, and marginated.

* *Lip square.* Elophori.

* *aquatica.* Brown; thorax wrinkled, which, together with the elytra, are of a brownish yellow. 1. A native of Europe, in stagnant waters; very small, and frequently to be found among the *conferva.*

* *minuta.* Brown; thorax wrinkled, and of the colour of brass; elytra pale. 4. To be found in England, in stagnant waters; very similar to the *aquatica,* but only the third part of its size.

* * *Lip cylindrical.*

* *bipustulata.* Oval, black; elytra marked with a red dot. 5. It is a native of Europe; and feeds on animal substances.

* *discoidea* Black; elytra of a dusky colour at the point. 16. Native of England.

30 species of this genus have been described in the last edition of the System of Nature.

### 13. OPATRUM.

Antennæ moniliform, thicker towards the outside. Elytra marginated. Head prominent. Thorax somewhat flat, and marginated.

*griseum.* Of an ash-colour; thorax flat, and marginated; elytra marked with three elevated lines, and dentated behind. 1. Native of Italy, larger than the *sabulosum.*

* *sabulosum.* Brown; thorax emarginated; elytra marked with three elevated lines, and dentated. 2. Native of Europe and North America, in sandy plains.

*monilicorne.* Brown; thorax and elytra hairy. 16. Native of Europe; not quite half an inch in length.

*testaceum.* Of a light brown colour; eyes, thorax, elytra, and antennæ dark brown. The base and tips of the latter are reddish; the elytra marked at the base with a large brick-coloured spot, resembling a crescent; the thorax impressed with two dots.

22 species of this genus have been described in the last edition of the System of Nature.

### 14. TRITOMA.

Antennæ clavated. Club perfoliated. Feelers, anterior pair hatchet-shaped.

* *bipustulatum.* Black; the elytra marked with a lateral scarlet line. 1. Native of England; to be met with in those species of *boletus* which grow on trees.

Smooth,

*glabrum.* Smooth, black; the antennæ and legs of a dark colour. 2. Native of the north of Europe, to be met with under the bark of trees. It somewhat resembles the *bipustulatum.*

Seven species of this genus are described by Gmelin in the last edition of the System of Nature.

### 15. CASSIDA.

Antennæ moniliform. Elytra marginated. Head concealed under the shield of the thorax.

* *viridis.* Green. 1. Native of Europe; frequently met with on thistles, and on a variety of plants. The larva is depressed, and furnished with six feet; it is armed with acute lateral prickles, and has a tail formed of two bristles. It walks about covered with its own excrement.

*murraca.* Black, with a red shield; the elytra of a blood-colour, sprinkled with black dots. 2. Native of Europe; to be met with on different kinds of plants.

* *nobilis.* Gray; the elytra marked with a very bright blue line. 4. Native of Europe; to be met with on thistles and various plants. The bright blue line on its elytra disappears when it dies, but reappears on its immersion into warm water.

*fastuosa.* Black; elytra reddish yellow, spotted with black. 52. Native of Europe, but rare. It is to be met with on the white poplar, is about the same size with the *nobilis*, and, like it, loses its bright colour along with its life.

*jamaicensis.* Of a bright glossy yellow colour; the elytra, without spots, are marked with small concave dots. 21. Native of America. At the anterior part of the suture, there is a prominence forming a bunch on its back. It loses its colour in spirits of wine, and recovers it again on being immersed into warm water.

*superba.* Black; elytra and shield dotted, and of a golden green colour; antennæ, abdomen, and legs green. 39. Native of Europe. It loses its golden colour at the same time with its life.

This genus contains 77 species.

### 16. COCCINELLA, *Lady-bird.*

Antennæ clavated. Club solid. Feelers, the anterior pair hatchet-shaped; the posterior filiform. Body hemispherical. Thorax and elytra marginated. Abdomen flat.

* *The Elytra red or yellow; marked with black dots.*

*marginata.* The elytra yellow, without spots, with a black margin; the margin of the thorax marked with two white dots. Sometimes the elytra are red, with a black edge; the margin of the thorax marked with a white dot on each side. 1. Native of America, of a middling size.

*immaculata.* Elytra yellow, without spots; thorax marked with a black spot, and two white dots. 155. Native of Europe.

* *bipunctata.* Elytra red, marked with two black dots. 7. Native of Europe; frequent in gardens and woods; feeding on *aphides*.

* *quadripunctata.* Elytra yellow, marked with four black dots. 9. Native of Europe. Of a middle size; black below; thorax yellow, with four black dots; feet yellow.

* *quinquepunctata.* Elytra of a blood colour, marked with five black dots. 11. Native of Europe; to be met with on trees.

* *septempunctata.* Elytra red, marked with seven black dots. 15. Native of Europe. The dots on the elytra are placed in the form of a triangle. This insect, as well as some others of the coleopteræ, is said to possess the property of giving immediate and effectual relief in the most violent paroxysms of the toothache, by rubbing them between the finger and thumb, and applying the finger to the affected tooth.

* *sexmaculata.* *Lady-cow.* Elytra red, marked with six black spots; the four anterior ones transverse and arched. 68. It is a native of India. Head whitish; thorax white before with a black spot, black behind; suture red; body pale yellowish.

*variegata.* The elytra yellow; with 12 black dots and a black band in the middle. 86. It is a native of the Cape of Good Hope; of a middle size.

*centumpunctata.* The elytra tawney, with a great number of black dots, many of them running together. 118. It is a native of India, about three quarters of an inch long.

** *The elytra red or yellow, marked with white.*

*punctatoguttata.* The elytra red; marked with 14 white, and three black dots. 32. A native of Europe; differing perhaps, only in sex, from the *decempustulata*.

*quindecemguttata.* Elytra yellow, marked with 15 white spots; the middle one, common to both elytra, almost effaced. 127. A native of Europe.

*sedecemguttata.* Elytra yellow; marked with 16 white spots. 35. Native of Europe.

*** *Elytra black, marked with red.*

*analis.* Elytra black, without dots, but marked with red at the points. 129. It is a native of Europe, very like the *hæmorrhoidalis*, but only half its size.

*hæmorrhoidalis.* Elytra black, their points red, marked with a black band. 130. It is a native of Germany. It is frequently marked on the back with a red dot common to both elytra.

*cacti.* Elytra black, marked with two red spots. 41. It is a native of America, on the *cactus*; and is frequently gathered along with the cochineal insect. It is very similar to the *bipustulata*, which is common in Europe.

* *bipustulata.* Elytra black, marked with two red spots; abdomen of a blood-red colour. 42. It is a native of Europe, common in gardens. Each of the spots on the elytra is composed of three spots uniting into one.

**** *Elytra black, spotted with white or yellow.*

*pantherina.* Elytra black, marked with eight yellow dots. 48. Native of the north of Europe.

*humeralis.* Elytra black, marked with eight yellow dots, the two anterior ones hooked. 146. A native of Europe.

163 species of this genus have been described by Gmelin.

### 17. ALURNUS, *Rove-beetle.*

Antennæ filiform. Feelers six; short. Jaw horny; arched.

*grossus.* Black; thorax scarlet; elytra yellow. 1. It is a native of America and India. Antennæ black, half as long as the body; thorax a little rough, pointed on each side at the base; the hind margin black; scutellum rounded, black; elytra larger and longer than the body.

*femoratus.* Yellowish green, with a metallic lustre; the thighs and shanks of the hind-legs dentated. 2. It is a native of India. It is large, smooth, and shining; the antennæ are half as long as the body; the extreme articulations are black.

*dentipes.* Black; the thighs and shanks of the hind-legs dentated. 3. Native of the Cape of Good Hope. It is smooth, without spots, and very similar to the *al. femoratus.*

There have been only three species of this genus described.

## 18. Chrysomela.

Antennæ moniliform. Feelers six, growing thicker towards their exterior sides. Thorax marginated; elytra not marginated. Body (in most of the species) oval.

This numerous and beautiful tribe is found everywhere, in woods and gardens. Their motion is slow, and some of them when caught, emit an oily fluid of a disagreeable smell. The larvæ of this and the next family feed on the leaves of trees and plants, the fibres and cuticle of which they leave, contenting themselves with the pulp.

### * *Thighs of the Hind-legs equal.*

* *tenebrioides.* Without wings, black; antennæ and legs of a violet colour. 1. It is a native of the south of Europe. The larva has a bunch on its back, of a violet colour, with a red anus; it feeds on a variety of vegetables.

* *gottingensis.* Black; the legs of a violet colour. 4. It is a native of Europe; very rare in England.

*vittata.* The elytra blue, with a yellow edge, and marked with a yellow stripe in the middle. 3. It is a native of America; very large.

*lusitanica.* Thorax of a copper colour; elytra resembling brass; impressed with bluish dots, of a violet colour underneath. 74. Native of Portugal.

* *banksii.* Of a brass colour above, and of a brick colour below. 76. Native of Italy and Portugal, smaller than the preceding species. Very rare in England.

*hæmorrhoidalis.* Black, shining; antennæ yellow at the base; anus red above. 6. Native of Europe, on the birch and alder. The elytra are marked with regular lines of dots.

* *graminis.* Greenish-blue, very shining; the antennæ and legs of the same colour. 7. Native of Europe, on different plants, especially on grass.

* *ænea.* Green, shining; the extremity of the abdomen reddish. 8. Native of Europe; on the alder.

* *hæmoptera.* Of a violet-colour; feet and wings red. 11. Native of Europe.

*centaurei.* Of a bright copper-colour; beneath green and gold; the legs of a bright copper-colour. 102. Native of Europe, on the *centaureus.* It exhibits some variety, especially in size.

*melanostoma.* Oblong, black; head red, the mouth and a spot on the back part of the head black; the thorax red, with a black spot on each side; the elytra red, with a black suture. 254. Native of Europe.

*polita.* Thorax gilt; elytra reddish. 27. Native of Europe; to be met with on the poplar and willow.

*cruentata.* Black; the elytra smooth; marked with red waved cross bands, and with spots of the same colour. 182. Native of South America.

* *anglica.* Blackish-blue; the elytra blackish-yellow, marked with dots arranged in straight lines; wings red. 187. Native of England.

### * * *The thighs of the Hind-legs thickened, and formed for leaping.* Alticæ.

* *oleracea.* Of a greenish blue. 51. Native of Europe. It feeds on different kinds of plants, particularly on those of the class *tetradynamia.* This is the little insect which is so troublesome in fields and gardens, commonly called *turnip-fly.* It attacks turnips, radishes, and cabbages, when newly sprung above ground, and consumes their seminal leaves. It frequently destroys whole fields of turnips, so completely, as to render a second sowing necessary, which goes like the first. The attempts may be repeated with similar success, till the season for sowing be lost.

*chrysocephala.* Blackish blue, the head and four fore-legs yellow; 53. Native of Europe.

*hyoscyami.* Greenish blue; the legs testaceous; the thighs of the hind-legs of a violet-colour. 54. Native of Europe; on the henbane, turnip, and cabbage.

* *quadripustulata.* Black; the elytra marked with four reddish spots. 217. Native of England and France, in gardens.

* *anglicana.* Black; the elytra and lower part of the legs pale. 218. Native of England, on various sorts of vegetables.

* *nigripes.* Greenish yellow, with a metallic lustre; legs black. 220. Native of England.

* *fuscipes.* Of a violet-colour; head and thorax reddish; legs black. 224. Native of Britain, on plants of various sorts.

* *testacea.* Testaceous, hunch-backed; elytra very smooth. 225. Native of England, on different kinds of vegetables.

*cruciferarum.* Blackish, yellow; oblong, with black legs. 246. Native of Europe, on *tetradynamious* plants.

270 species of this genus have been described by Gmelin in the last edition of the System of Nature.

## 19. Cryptocephalus.

Antennæ filiform. Feelers four. Thorax marginated. Elytra not marginated. Body nearly cylindrical.

### * *Feelers equal, filiform.*

### † *Jaw furnished with one tooth.*

### a. *Lip entire; Body cylindrical.*

*longipes.* Dusky black; the elytra pale, marked with three black blotches; fore-legs very long. 1. Native of Europe, on the hazel and willow.

* *quadripunctatus.* Black; the elytra red, marked with two black dots; the antennæ short and serrated. 3. Native of Europe, very common on the hazel. The larva is contained in a rough-bag; which, on the fore-part, is terminated obliquely and abruptly.

*longimanus.* Of an obscure brass colour; the elytra of a brick colour, with a black spot at the base. 19. Native of Europe; feeds on the *trifolium montanum*, and the *euphorbia cyparissa;* the fore-legs are very long; the larva is enclosed in a bag.

*cordiger.* Thorax variegated; elytra reddish, marked with two black dots. 25. Native of Europe, on the hazel and willow.

willow. The spot on the middle of the thorax is sometimes of the shape of a heart.

* *vitis.* Black; smooth; elytra reddish. 27. Native of the south of Europe; on the vine, committing sometimes great havock.

*coryli.* Black; thorax and elytra reddish brown, without spots. 28. Native of Europe; on the hazel.

b. *Lip bifid; Body oblong.* Cistelæ.

*gigas.* Hairy, brown; elytra, abdomen, and thighs, of a brick colour. 91. Native of the south of France; very large.

* *cervinus* Livid; with brown legs. 92. Native of the north of Europe.

*rufitarsis.* Black; thorax square; elytra striated and of a brick colour. 96. Native of the south of Europe; on the ears of rye.

* *sulphu- eus.* Yellow; the elytra of a sulphur colour. 98. Native of Europe. Feeds on *umbelliferous* plants.

* *murinus* Black; the elytra and legs reddish brown. 103. Native of the north of Europe.

* *angusta- us.* Thorax and elytra of a dark reddish colour, black in the middle. 106. Native of Britain; somewhat resembling the *murinus*, but narrower.

* *pallidus.* Pale; the head, and tips of the elytra, brown. 107. Native of Britain.

† † *Jaw bifid; Body oblong.* Criocerides.

*incola,* Gray; the thorax marked with a line behind; the elytra with a black dot at their base. 124. Native of Italy.

*ymphææ.* Brown; the margin of the elytra a little prominent and yellow. 125. Native of Europe, on the water-lily.

*nellus.* Of a rusty colour, the edge of the thorax and elytra yellow. 133. Native of Europe, on the willow.

*cantha- oides.* Of a violet colour; head, thorax, and legs reddish. 139. Native of Britain.

*cyanella.* Blue; thorax cylindrical; prominent on the sides. 161. Native of Britain.

*elanopus* Blue; thorax and legs reddish. 162. Native of Europe. Feeds on the oak.

*subspi- osus.* Black; head and thorax somewhat prickly; feet reddish. 164. Native of Britain.

*asparagi* Thorax red, marked with two black dots; elytra yellow, marked with a black cross, and four black dots. 167. Native of Europe, feeding on asparagus. There are two or three varieties of this species. β. With two spots on the elytra connected at the base, is to be met with in Italy. γ. With two narrow red bands on the elytra, is to be met with in France.

*hellan- ii.* Black; the edge of the thorax and two lines on the elytra yellow. 168. Native of Europe; to be found at the roots of the *phellandrium aquaticum*.

* * *Feelers unequal, the anterior ones hatchet-shaped.*

† *The Lip of a substance like horn.* Erotyli.

*anteus.* Oval, black; the elytra marked with a great many tawney dots. 191. Native of India.

*ereus.* Black; the thorax and elytra of a bright copper colour. 205. Native of New Holland.

† † *The Lip membranaceous.* Lagriæ.

Black; the thorax red and hairy. 221. Native of Europe, particularly of England. * *elongatus.*

Smooth; thorax reddish; elytra yellow. 230. Native of England. * *glabratus.*

268 species of this genus have been described in the last edition of the System of Nature.

### 20. HISPA, *Blossom-eater.*

Antennæ cylindrical; approaching one another at the base, and placed between the eyes. Feelers spindle-shaped. Thorax and elytra frequently prickly.

Body entirely black; antennæ spindle-shaped; thorax and elytra prickly. 1. Native of the south of Europe and north of Africa. To be found at the roots of grass. * *atra.*

Without prickles; the antennæ hairy. 4. Native of Europe; in rubbish and in museums. * *mutica.*

Antennæ serrated; thorax red; elytra blue; head furnished with two horns. 15. Native of Britain. * *cornigera.*

Black; the antennæ pectinated; the elytra stripped. 19. Native of England. * *flabellicornis.*

20 species of this genus have been described in the last edition of the System of Nature.

### 21. BRUCHUS, *Glutton.*

Antennæ filiform. Feelers equal and filiform. Lip pointed.

The elytra black, spotted with white; the anus white, with two black spots. 1. Native of North America. It has been lately introduced into Europe, where it commits great havock in the fields of pease. It is also very destructive to orchards when in bloom. * *pisi.*

Gray, somewhat shining; the elytra very little shorter than the abdomen. 9. Large; and has been introduced into Europe, along with the seeds of the *robinia pseudacacia* from America. *robiniæ.*

Black; the elytra red, marked with raised stripes. 11. Native of Europe, chiefly on the horse-chesnut. * *scabrosus.*

Body brown, spotted with gray. 13. It feeds on the seeds of the *theobroma*. *cacao.*

The elytra gray; spotted with black; legs red; scutellum white. 2. Feeds on the seeds of the *theobroma*. *theobromatis.*

Ash coloured; elytra brown; with a black dot at the base; surrounded by a yellow circle. 17. Native of Switzerland, on different plants. *bipunctatus.*

Elytra black; speckled with white; the thighs of the hind-legs are marked with a single projection resembling a little tooth. 5. Native of Europe. Feeds on the seeds of various plants. * *granarius.*

Black; the base of the antennæ and fore feet reddish brown; thighs smooth. 6. Native of Europe, on flowers; very small. * *seminarius.*

25 species of this genus have been described in the last edition of the System of Nature.

### 22. PAUSUS.

Antennæ consisting of two articulations, clavated. Club solid and hooked.

*microcephalus.* 1. It is a native of North America; entirely black, the head very small, the thorax narrow, with an elevated transverse margin on the fore-part; the elytra terminated abruptly by a transverse line, and a little longer than the abdomen; which is likewise terminated abruptly. It is about the size of the *dermestes lardarius.*

### 23. Zygia.

Antennæ moniliform. Feelers unequal, filiform. Lip elongated, membranaceous. Jaw furnished with one tooth.

*oblonga.* Oblong, reddish; head and elytra of an obscure blue. 1. Native of the east.

### 24. Zonitis.

Antennæ setaceous. Feelers four, filiform; shorter than the jaw, which is entire. Lip emarginated.

*chrysomelina.* Yellow; the elytra marked with a black dot in the middle and at the base. 1. Native of Egypt. Black below; the extremity of the abdomen reddish.

*flava.* Reddish; the elytra yellow and black at the tip. 2. Native of the east.

### 25. Apalus.

Antennæ filiform. Feelers equal; filiform. Jaw horny; furnished with one tooth. Lip membranaceous; terminating abruptly, and entire.

*bimaculatus.* Furnished with wings; black, the elytra yellow, marked with a black dot behind; formerly *meloë bimaculatus.* Native of the north of Europe; to be seen early in the spring, in sandy places.

### 26. Brentus.

Antennæ moniliform, advancing beyond the middle of the snout. Mouth furnished with a straight, cylindrical snout, which projects considerably.

* *Thighs simple.*

*barbicornis.* Cylindrical; snout very long, bearded beneath; the elytra lengthened out and elevated. 1. Native of New Zealand. Snout longer than the body; antennæ shorter than the snout, placed near the tip; eyes globular, black; thorax cylindrical, black, with gray hairs; elytra streaked and dotted, with furrowed spots; legs black, with gray hairs.

** *Thighs dentated.*

*anchorago.* Linear; the elytra striped with yellow; thorax lengthened. Native of South America and India.

This genus includes 11 species.

### 27. Curculio, *Diamond-beetle.*

Antennæ clavated, placed upon the snout, which is formed of a horny substance, and prominent. Feelers four, filiform.

This beautiful and numerous genus is divided into five subdivisions; their larvæ have a scaly head, and six scaly legs. Those of the long-snouted ones are most destructive in granaries, and to seeds of almost every description. They insinuate themselves into the grain, and consume it gradually, leaving nothing but the skin, in which they lie concealed, and undergo their metamorphosis. Those with the short snout infest artichokes, and the stalks and leaves of plants. The leaves of many trees, particularly the elm, may be seen marked with yellow spots, occasioned by the larvæ of this tribe insinuating themselves within the cuticle of the leaf, and forming a bag, in which they lurk, till they come forth a perfect insect.

* *Long-snouted.*

† *Thighs simple.*

The thorax and elytra rough. Antennæ white at the tips. Native of Japan. Snout cylindrical, long, arched, brown on the fore-part, of an ash-colour behind; thorax round, brown, rough, with raised sharp points; elytra rough, gray, with scattered brown and white dots. *gigas.*

Black; thorax flat and dotted, with a line slightly elevated; elytra shortened and somewhat striped: the intervals dotted. 555. Native of Europe. *brachypterus.*

Black; the elytra marked with white dots set in regular rows, and with white interrupted waved bands. 556. Native of Europe. *sulcatus.*

Scarlet; the elytra marked with ten rows of dots. 558. Native of Europe. *coccineus.*

Black; the elytra of a violet colour; the scutellum white. 5. Native of Europe, particularly on the willow. *cyaneus.*

Black above; ash-coloured below, and hunch-backed. 6. Native of Europe; feeds on the seeds of the vetch; it is very small. *craccæ.*

Gray; the elytra and legs reddish brown. 101. Native of England, on the mallow. The snout and abdomen black. * *malvæ.*

The snout and thorax red; the elytra of a violet colour. 103. Native of Europe, on the oak. *roboris.*

Black; with the abdomen oval. 13. Native of the north of Europe; frequently to be met with on plants of the class *tetradynamia.* *acridulus.*

Of a blood-colour. 15. Native of Europe, and very destructive to corn which has been long kept. *frumentarius.*

Black; the thorax dotted, and of the same length with the elytra; the elytra marked with two red spots. This species is very destructive to rice kept in granaries. *oryzæ.*

*Weevil* or *Bond.* Black; the thorax dotted, and of the same length with the elytra. 16. This destructive little animal does much mischief in granaries, and in biscuit kept in ware-houses, or on ship-board. Woad, henbane, and elder, are said to drive them away from grain which has been infested by them, and, on that account, is sometimes mixed with the grain. * *granarius.*

The elytra of a brick colour, with cloudy bands. 19. Native of Europe; in the bark of the *pinus sylvestris.* * *pini.*

Black, sprinkled with green; snout black and bent, somewhat resembling a keel. 121. Native of Africa, and the south of Europe: on the flowers of the artichoke. *cynaræ.*

Cylindrical and ash-coloured; the elytra set with sharp * *paraplecticus.*

sharp points. 34. Native of Europe; on umbelliferous plants, particularly on the *phellandrum aquaticum;* in the stalks of which the larva is frequently lodged, and is supposed to be the cause of the staggers in horses.

*bardanæ.* Cylindrical; covered with a gray down; the fore-legs long. 152. Native of Europe, on the *burdock.* When old, it loses the gray down, and becomes smooth and black.

*bacchus.* Of a bright copper colour; snout and feet black. 38. Native of the south of Europe, on the vine and hazel. Somewhat hairy above.

*frugilegus* Oblong; of a chesnut colour; the elytra equalling the thorax, marked with four red spots. Native of South America and India. It is small, and very destructive to grain.

† † *Hind thighs thickened.* Saltatorii.

*quercus.* Pale yellow; eyes black. 25. Native of Europe; on the willow, elm, and oak, the leaves of which it frequently covers with blotches, by insinuating itself within the cuticle. It is about the size of the *pediculus humanus.*

*egetis.* Body black; elytra oblong. 45. Native of Europe; on the ears of corn.

† † † *Thighs dentated.*

*terrimus.* Black; the elytra shining. 10. Native of Europe; very frequent on plants of different kinds.

*cerasi.* Black; the elytra opaque and oblong. 11. Native of Europe; on the leaves of the cherry and pear-tree, the cuticle of which it eats.

*pomo-um.* The thighs of the fore-legs dentated; body gray, clouded. 46. Native of Europe, on the flowers of fruit-trees.

*caligino-ts.* The streaks of the elytra approaching one another, and dotted. 243. Native of Britain, but rare. Body oblong, entirely black, opaque; thorax round and punctured; elyra with deep approximate striæ in pairs; thighs sharply dentated.

*germa-s.* Black; the thorax marked with two reddish dots on each side. 58. Native of Europe; very common in Germany. It is amongst the largest of this genus that is to be met with in Europe.

*nucum.* Body gray, of the same length with the snout. 59. Native of Europe; frequently to be found in hazel-nuts.

*scrophu-riæ.* The elytra marked with two black spots situated near the suture. 61. Native of Europe; on the figwort, the capsules of which the larvæ consume, and substitute in their place brown follicles.

* * *Brevirostres.*

† *Thighs dentated.*

*ctabilis* The body variegated with green and black. 298. Native of New Holland.

*co-ma-latus.* Black; the thighs faintly dentated; the thorax and elytra smooth, spotted with brown. 301. Native of Europe; large, smooth.

*ttus.* The abdomen oval and black; the legs and antennæ reddish. 69. Native of Europe; in orchards.

*yri.* Yellowish-brown. 72. Native of Europe. The larva feeds on the leaves of the pear tree; the perfect insect on the flowers of the pear and of the plum. The colour varies; sometimes it is bronzed, red, green, &c.; legs reddish; body covered with oblong scales of various colours; elytra striated, punctured.

* *mali.* Downy, brown; the thighs acutely dentated; antennæ and legs brownish. 308. Native of Europe; on the apple-tree.

† † *Thighs smooth.*

*polygoni.* The thorax marked with lines; the elytra of an ash-colour, marked with little brown lines; the suture brown, dotted with black. 26. Native of Europe; on the *polygonum.*

* *griseus.* Above, brownish-gray; beneath, ash-coloured; snout grooved. 335. Native of Britain.

* *trigut-tatus.* Blackish; the elytra gray, marked with two white spots, and with a larger one behind, which is common to both elytra. 336. Native of Britain.

*imperialis.* The elytra marked with black elevated stripes, and with bright green and gold dotted furrows alternately, swelling out at their base, and drawing to a point at their tips. 349. Native of South America. It is very large, and the most beautiful insect hitherto known; commonly known by the name of the diamond-beetle.

*regalis.* Body green, silky, striped with broad gold bands. 75. Native of South America. The thighs brown, marked with a golden ring.

* *incanus.* Oblong, brown; the back part of the thorax flat. 81. Native of Europe; common in fir.

616 species of this genus have been described in the last edition of the System of Nature.

### 28. Rhinomacer.

Antennæ setaceous, placed upon the snout. Feelers four, thicker towards their exterior side.

*curculioides.* Covered with gray down; antennæ and legs black. 1. Native of Italy.

*attelaboides.* Covered with black hair; antennæ and legs reddish. 2. Native of Europe; in pine-forests.

*cæruleus.* Blue, somewhat hairy; base of the antennæ and the legs yellow. 3. Native of Europe.

Only three species of this genus have been described.

### 29. Attelabus.

Head drawn to a point on the hind part, and inclined. Antennæ mouiliform, the articulations towards the point thicker than the rest.

* *Jaw bifid.*

* *coryli.* Black; the elyra red and reticulated. 1. Native of Europe; on the leaves of the hazel, which it rolls up into cylinders and shuts up at both ends.

* *betulæ.* Black; legs formed for leaping. 7. Native of Europe; on the leaves of the birch, which it renders beautifully curled by its gnawing. It leaps very nimbly.

* * *Jaw furnished with one tooth.*

† *The posterior feelers hatchet-shaped.* Cleri.

*mutillarius.* Black; the elytra marked with three white bands, and red at the base. 19. Native of Europe.

* *formicarius.* Black; thorax reddish; elytra red, white at the base,

and marked with two white bands. 8. Native of Europe: it destroys the *ptinus pertinax* and many other insects.

* *apiarius* Bluish; the elytra red, marked with three black bands. 10. Native of Europe and America. The larva is frequently to be met with in bee-hives, the perfect insect on flowers. It is double the size of the *formicarius*.

† † *Feelers four, nearly filiform.* Spondilides.

*ceramboides.* Black; the elytra full of wrinkles, and broader than the thorax. 12. Native of Europe, in the *boletus fomentarius*.

*buprestoides.* Black; the elytra very much ribbed; the thorax almost globular. 13. Native of Europe, in woods.

There are 34 species of this genus.

### 30. Notoxus.

Antennæ filiform. Feelers four, hatchet-shaped. Jaw furnished with one tooth.

* *mollis.* Downy; the elytra black, marked with three pale bands. 3. Native of Europe; on flowers.

* *monoceros.* Thorax projecting over the head like a horn; elytra pale, marked with a black band and dot. 4. Native of Europe, on umbelliferous plants.

There are four species of this genus.

### 31. Cerambyx.

Antennæ setaceous. Feelers four. Thorax prickly or turgid. Elytra linear.

This is a very beautiful and finely variegated family. The larvæ resemble soft, oblong, slender worms, with a scaly head and hard legs on the fore part. They bore through the inner part of trees, pulverising the wood, and are transformed into perfect insects in the cavities they make. Many of them diffuse a strong smell, perceivable at a great distance; and some, when taken, utter a sort of cry, produced by the friction of the thorax on the upper part of the abdomen and elytra.

* *Feelers four, equal.*

a. *Filiform.*

† *Jaw cylindrical, entire.* Prioni.

a. *The thorax furnished with moveable spines.*

*trochlearis* The elytra variegated with a dark colour and white, with raised dots. 2. Native of India.

*longimanus.* The elytra marked with a small projection at their base, and with two at the tip; the antennæ long. 1. Native of South America. The shanks of the fore-legs, in the male, are very long.

b. *Thorax marginated.*

*cervicornis.* The thorax with three little projections on each side; the jaws stretched out, and furnished with one spine on their outside; the antennæ short. 3. Native of America. The larva is found in the wood of the *bombax*. It is eatable, and reckoned a delicacy by the natives.

*armillatus* The thorax furnished with four small projections on each side; the elytra rusty-coloured, edged with black; the thighs of the hind-legs marked with a little projection. 4. Native of India; very large.

*damicornis.* Thorax furnished with very small projections; the jaws stretching out, and furnished with two teeth; the antennæ short. 86. Native of South America. The larva is eaten by the natives, and much relished.

*faber.* The thorax wrinkly; and marked on each side with a small projection; the elytra black; the antennæ of a middling length. 6. Native of Europe; in wood.

* *coriarius.* Thorax marked with three small projections; body black; the elytra furnished with sharp points; antennæ shorter than the body. 7. Native of Europe; on decayed birch-trees. It produces large, oblong, yellowish eggs.

† † *Jaw obtuse, furnished with one tooth.* Cerambyces.

*nebulosus* Thorax prickly; elytra formed like the roof of a house, marked with black bands and dots; the antennæ longer than the body. 29. Native of Europe; in the stems of fir-tree, which it kills by consuming the inner bark.

*fasciculatus.* Thorax prickly; elytra entire, marked with three prickly dots; the antennæ of the same length with the body. 106. Native of Europe.

* *hispidus* Thorax prickly; elytra whitish at their anterior part, and furnished with two small projections at their tips; the antennæ of the same length with the body, and rough. 30. Native of Europe.

* *moschatus.* Green, shining; thorax prickly; antennæ blue, and of the same length with the body. 34. Native of Europe; on the willow. The colour of the antennæ and legs varies from a blue to a brown. The living insect has a smell of musk, which is said to have a soporific effect. It produces white eggs. The green colour of this insect is sometimes tinged with blue, and at other times it is entirely blue and gold. The smell it diffuses, is imagined by some to resemble the smell of a rose, and frequently pervades a whole meadow, where the insect happens to be plentiful.

*heros.* Black; the thorax prickly and wrinkled; the elytra somewhat prickly and reddish brown; antennæ long. 128. Native of Europe; on the oak.

† † † *Jaw divided.*

* *Horny.* Lamiæ.

*sutor.* Thorax prickly; elytra black, with rusty-coloured spots; scutellum yellow; antennæ very long. 38. Native of Europe; in woods.

*sartor.* Black; thorax prickly; scutellum bright yellow; elytra without spots; antennæ very long. 159. Native of Europe; larger than the preceding species.

*textor.* Thorax prickly; elytra black and convex; antennæ of the same length with the body. 41. Native of Europe; on trunks of trees.

*fuliginator.* Black; thorax somewhat prickly; elytra ash-coloured; antennæ short. 43. Native of Europe. When old, it becomes entirely black. It is met with in wool, after it has been cut from the sheep.

*regalis.* Thorax prickly, and marked with green bands; the elytra sprinkled with green, with three tawney spots. 167. Native of Africa. Antennæ longer than the body, black; head beneath lined with green; a tawney spot under

under the eyes; thorax black, with three impressed green bands; elytra somewhat striated; black, sprinkled with green; abdomen with a white line of tawney dots on each side.

### * * *Membranaceous*, Saperdæ.

*carcharias.* Thorax smooth, cylindrical; body gray, dotted with black; antennæ of the same length with the body. 52. Native of Europe.

*cardui.* Of a dusky colour; thorax marked with lines, scutellum yellow; antennæ long. 56. Native of Europe; on thistles, injuring them much in the month of May. Body brown, speckled with yellow; thorax marked with three yellow lines.

* *populneus.* Thorax without spines, cylindrical, yellow, and marked with lines; elytra marked with four yellow dots; antennæ of the same length with the body. 57. Native of Europe; on the poplar. Body brown; antennæ variegated with black and white.

* *cylindricus.* Cylindrical, black; fore-legs yellow. 5. Native of Europe; on the pear and plum-tree.

### β. *Feelers capitated.* Rhagia.

*cursor.* Thorax prickly; elytra obtuse and reddish, marked with a black line, and black along the suture; antennæ of the same length with the body. 45. Native of Europe.

* *anglicus* Thorax prickly; elytra marked with two oblique yellow bands. 237. Native of Britain.

*inquisitor.* Black; thorax prickly; elytra clouded with brick-coloured stripes; antennæ shorter than the body. 49. Native of Europe, on the trunks of trees. The larva has six feet, and is naked; white, head and collar horny, brown; back grooved.

*elegans.* Black; thorax with a spine on each side; elytra chesnut-coloured; their base suture, and a spot on each, are black; they are likewise marked with two yellow bands. 242. Native of Europe.

### γ. *Feelers clavated.* Callidia.

* *rusticus.* Thorax naked; body pale; the antennæ tapering, and shorter than the body. 69. Native of Europe; in woods.

*luridus.* Thorax naked and furnished with knobs, black; the elytra of a brick-colour. 68. Native of Europe; in fir-woods.

* *violaceus* The thorax somewhat downy; body of a violet colour; antennæ shorter than the body. 70. Native of Europe; chiefly in fir-timber which has been cut down some time, and which has not been stripped of its bark. It bores serpentine cavities between the bark and the wood, which are larger in diameter as the insect increases in size, filling the space it leaves behind with its excrement, which resembles saw-dust. Body dark violet, a little hairy; antennæ hardly as long as the body, hairy; sternum with a small projecting point; elytra linear, round at the tip, turgid at the base. It varies in having the head and thorax, and even the body greenish.

* *bajulus.* Thorax hairy, marked with two protuberances; body brown. 76. Native of Europe, on the trunks of trees, in timber, in houses, perforating the joists, particularly those that have been formed of fir-timber.

### * * *Feelers unequal; the anterior pair filiform, the posterior clavated.* Stenocori Fabricii.

Thorax slightly prickly; elytra formed like the roof of a house; the anterior part of them reddish brown; the breast shining. 47. Native of Europe. Male of a brick colour, female blackish; larva lies under ground, and has very long legs. * *meridianus.*

379 species of this genus have been described in the last edition of the System of Nature.

### 32. Calopus.

Antennæ filiform. Feelers four; the anterior ones clavated; the posterior filiform. Thorax turgid. Elytra narrow, and of an equal breadth throughout their whole length.

Brown; the antennæ compressed, 1. A native of Europe; it is long, and cylindrical. * *serraticornis.*

Very small, brown; the antennæ serrated and hairy. 3. A native of Europe; about the size of a flea. *pygmæus.*

There are three species described in the last edition of the System of Nature.

### 33. Leptura.

Antennæ setaceous. Feelers four, filiform. Elytra growing small towards the tip. Thorax somewhat tapering.

### * *Lip entire.* Donacia of Fabricius.

Of a golden colour; the thighs of the hind legs clavated and notched. 1. A native of Europe; on aquatic plants, on the water-lily, *phellandrum aquaticum*, at the roots of which the pupa may be found enclosed in brown globes. The thighs of the hind legs are sometimes without notches. Antennæ blackish, the joints pale, reddish at the tip; head with a little down on the middle; thorax grooved; elytra streaked, dotted, and terminating abruptly, with short appendages at each margin; body beneath downy; legs dull, brownish red. * *aquatica.*

Of a golden colour; the thighs simple. 17. A native of Britain; on aquatic plants. * *simplex.*

Shining green golden colour; the elytra marked with dotted streaks and with crenated wrinkles, likewise with a bright purple and green fillet; the abdomen, antennæ, and legs of a golden colour; the thighs of the hind-legs notched. 88. A native of Europe. *nitida.*

Silvery green; the elytra marked with dotted streaks, crenated wrinkles, with a broad green and purple fillet common to both elytra; the head, bottom, and legs, of a golden colour; the thighs of the hind-legs without notches. 89. A native of Europe. *vulgaris.*

### * * *Lip bifid.* Lepturæ.

#### A. *The Thorax on the fore part somewhat oblong and narrow.*

Black; the elytra reddish, with a black dot in the middle. 82. A native of Europe. *unipunctata.*

Black; elytra red, black at the tips and at the suture. 23. A native of Europe. The abdomen is reddish in the male, which is smaller than the female. *hastata.*

*melanura.* Black; the elytra reddish or livid, black at the tips and at the suture. 2. A native of Europe; the elytra are black at the tips in the male, in the female they are all of one colour.

* *rubra.* Black; the thorax, the elytra, and shank of the legs, purple. 3. A native of Europe; on flowers.

* *villica.* Of a rusty colour; the antennæ, elytra, and breast, dark brown. 28. A native of Britain.

*splendida.* Black; covered with yellow hairs; the elytra smooth at the tips; the legs tawney; antennæ brown, and of a rusty colour at the base. 49. A native of Europe.

*rufipes.* Black; the legs reddish; the thighs red at the base. 52. A native of Europe; frequently to be met with in the month of May, on the buckthorn, the dog-wood, and hawthorn.

B. *The Thorax nearly globular, and not attenuated on its anterior part; the Elytra blunt at the tips, but not truncated.*

* *virginia* The thorax globular and black; the elytra of a reddish colour; the abdomen reddish. 15. A native of Europe.

* *collaris.* The thorax globular and red; the abdomen red; and the elytra black. 16. A native of Europe.

*bipartita.* Black; the thorax of a rusty colour, marked with a longitudinal black line; the elytra marked with a rusty-coloured spot, common to both of them. 71. A native of Europe.

*nitens.* The thorax globular, which, as well as the abdomen, is of a shining black, covered with a yellow down; the elytra black; marked with four broad transverse yellow bands; the legs of a rusty colour. 67. A native of America.

100 species of this genus have been described by Gmelin, in the last edition of the System of Nature.

### 34. NECYDALIS, *Carrion-Eater.*

Antennæ either setaceous or filiform. Feelers four, filiform. Elytra smaller, shorter, or narrower, than the wings. Tail simple.

* *Antennæ setaceous; Elytra shorter than the wings or abdomen.*

* *major.* The elytra of a rusty colour, without spots; the antennæ shorter than the body. 1. A native of Europe.

* *minor.* The elytra reddish brown, with a small line at the top; the antennæ larger than the body. 2. A native of Europe.

* *umbellatarum.* The elytra of a brick colour, without spots; the antennæ long. 3. A native of Europe; on umbelliferous plants.

* * *Antennæ filiform; the Elytra growing narrower towards the tips, and of the same length with the abdomen.*

* *viridissimus.* The thorax somewhat tapering; body green. 13. A native of Europe; very frequent in gardens.

* *humiralis.* The elytra black, yellow at the base. 18. A native of Britain.

*melanura.* Black; the thorax and elytra reddish brown; the latter are black at the tips. 20. A native of Europe; on plants of different kinds.

26 species of this genus have been described in the last edition of the System of Nature.

### 35. LAMPYRIS, *Fire-Fly.*

Antennæ filiform. Feelers four. Elytra flexible. Thorax flat, hemispherical, surrounding and concealing the head under it. The sides of the abdomen furnished with folded papillæ. The female in most of the species without wings.

* *Feelers nearly clavated.*

* *noctiluca.* *Glow worm.* Oblong, brown; shield ash-coloured. 1. A native of Europe; in woods and meadows. The female is larger than the male, and emits a beautiful phosphoric light, for the purpose of attracting the male. It is apparent that their shining light depends on a fluid placed near the extremity of the abdomen; the light becomes brighter, and of a finer green colour, when the insect is in motion. The little animal can withdraw the light at pleasure by contracting itself. Though the insect be bruised, the light continues for a considerable time.

*corusca.* Dusky black; the shield marked, on both sides, with a circular rose-coloured spot. 2. A native of North America.

*splendidula.* Oblong, brown; the shield resembling glass at the tip. 3. A native of Europe; in woods. This has been thought only a variety of the *noctiluca;* it is peculiarly resplendent in showery weather. The female emits the brighter light, particularly when pregnant.

*pyralis.* The shield reddish, and black in the middle; the elytra black, with a white edge; the abdomen white. 4. A native of the south of America.

*japonica.* Yellow; the third segment of the abdomen from the anus is black. 22. A native of Japan; very plentiful in the months of May and June; diffusing a very strong light from two small bags at its tail, filled with air; eyes, antennæ, and wings black.

*italica.* The elytra brown; the thorax transverse, red. 11. A native of Italy and Switzerland; on trees; less than the rest of the genus; brown; the last two segments of the abdomen yellow; the breast and legs pale yellow; the female black.

* * *Feelers nearly filiform.*

*sanguinea* Black; the sides of the thorax and elytra of a blood colour. 17. A native of Europe, in stony ground.

*pectinicornis.* Black; the thorax and elytra of a brick colour; antennæ pectinated. 34. A native of Europe.

* *coccinea.* Black; the thorax and elytra of a blood colour, and without spots. 18. A native of Europe; in hedges; head sometimes reddish, the elytra sometimes striated.

* * * *Feelers with the last joint thicker than the rest, and terminating abruptly.* Lyci.

*latissima.* Yellow; elytra with a black marginal spot, and black behind, the lateral margin very much dilated. 14. A native of Sierra Leona. Mouth cylindrical, prominent; body narrower before, and very wide behind; antennæ serrated.

*atra.* Black; thorax orbicular, and with the elytra red, marked with an impressed black spot on the back. 44. A native of Europe.

Forty-four species.

### 36. HORIA.

Antennæ moniliform. Feelers four, thicker towards their outer side. Lip linear, round at the tip.

*estacea.* Reddish; antennæ and legs black. 1. A native of Tranquebar; the hind thigh of the male thickened, and grooved beneath, and marked with a little projection.

*ermestoi- es.* Reddish brown; eyes, wings, and breast black. 2. A native of Europe.

There are only two species of this genus described.

### 37. CUCUJUS.

Antennæ filiform. Feelers four, equal; the last articulation terminating abruptly, and thicker than the rest. Lip short, bifid; the divisions linear, and distant from one another. Body depressed.

*uticus.* Thorax unarmed, black, with an impressed dot on each side; elytra striated, brown. 2. A native of Europe;. black.

*staceus.* Of a brick colour; thorax nearly square, unarmed; thighs compressed. 3. A native of Europe, under the bark of the birch tree.

*uadratus.* Black; the thorax square, notch behind marked with tubercles in the middle, and wrinkled on the external edge, clavated on the anterior part; the antennæ brown; the legs and elytra simple and reddish. A native of Europe.

Eleven species of this genus have been described in the last edition of the System of Nature.

### 38. CANTHARIS.

Antennæ filiform. Thorax (for the most part) marginated, and shorter than the head. Elytra flexible. Sides of the abdomen edged with folded papillæ.

* *Feelers four, hatchet-shaped.*

This is an extremely rapacious genus, preying on other insects, and even on its own tribe; those of the division *lymexylon* only, both in the grub and perfect state, feed on green wood.

*fusca.* Thorax red, with a black spot; elytra brown. 2. A native of Europe; in hedges; most rapacious, and devouring its own species.

*arginella* Reddish; the abdomen black and marginated; the back part of the head, eyes, and breast yellow. 73. A native of Europe.

*edia.* Brown; the thorax, head, base of the antennæ, the sides and tip of the abdomen, and the legs reddish. 14. A native of Europe.

*emato- oma.* Black; mouth and abdomen red. 75. A native of Europe.

*guttata.* The middle of the thorax black; the elytra shortened, black and yellow at the tip. 11. A native of Europe; in groves and gardens.

*rdiacæ.* The thorax somewhat marginated; body black; antennæ pectinated; the elytra marked with a blood-coloured dot at the tip. 13. A native of Europe; on the *leonurus cardiaca.*

*strio.* Black; the thorax, the base of the antennæ, posterior base of the segments of the abdomen, and legs yellow, with a brown spot on the thorax. 82. A native of Europe.

* * *Feelers filiform, the last articulation setaceous.* Malachii.

* *ærea.* Bright greenish yellow; the upper surface of the elytra red. 7. A native of Europe; on plants. It is furnished with two tentacula at the base of the abdomen, of a blood colour, blunt, and connected at the base; likewise two on the thorax which can be stretched out. There is a smaller variety, with the elytra wholly of a blood colour.

* *bipustulata.* Bright yellowish green; the elytra red at the tips. 8. A native of Europe.

*hæmeroidales.* Black; the thorax and tips of the elytra red. 86. A native of Europe.

*crysomiloides.* Thorax red, emarginated; elytra blue and smooth; antennæ and legs black. 63. A native of France; when touched under the breast, it contracts its head and body; when set at liberty it runs off very quickly.

* * * *The anterior feelers stretched out; the last articulation but one, is enlarged with a large oval split appendix; the last articulation arched and acute.* Lymexylon.

*proboscidea.* Black; the elytra light brown, and black at the tip; the feelers hooked, and irregular. 69. A native of Europe; in timber.

*barbata.* Brown: the antennæ and shanks of the legs black. 70. A native of Europe; in timber; covered with glossy down of a changeable hue; antennæ and legs paler.

* *navalis.* The thorax somewhat tapering; body yellow; the margin and tips of the elytra black. 26. A native of Europe; in the timber of the oak, to which it is very destructive.

Eighty-six species of this genus have been described in the last edition of the System of Nature.

### 39. SERROPALPUS.

Antennæ setaceous. Feelers four, unequal; the anterior one longer than the rest, and deeply serrated; four articulations, the last one very large, terminating abruptly, compressed, and like a plate; the posterior one nearly clavated. Thorax marginated, the anterior one receiving the head, with a prominent angle on each side. Head bent down. Legs formed for digging.

*striatus.* Body brown; the elytra striated. A native of the island of Runsala; found on old wooden buildings in autumn.

*lævigatus.* Body black; the elytra smooth. 2. A native of Europe.

### 40. ELATER, *Skipper.*

Antennæ filiform. Feelers four, hatchet-shaped. Under side of the thorax terminating in an elastic spine, coming out from a cavity of the abdomen; by which means the body, when placed on the back, springs up and recovers its natural posture.

*flabellicornis.* Brown; antennæ with a fan-shaped tuft of eight large black leaves. 1. A native of India. This is one of the largest of the genus; the antennæ short.

*noctilucus.* Sides of the thorax marked with a smooth yellow spot. 4. A native of America. This insect, like the *lampyris* and *fulgora*, affords a strong phosphoric light in the night time, the streams of which are so strong, that a person may see to read the smallest print. When placed on its back, it will spring four or five inches from the level on which it is put, to recover its natural position; the abdomen when removed from the body is luminous internally.

*phosphoreus.* Brown; the thorax marked on its posterior part with two smooth yellow spots. 5. A native of South America, resembling the *noctiluca* very much, but only half the size, although considerably larger than the species to be found in Europe; the spots of the thorax shine in the night like the preceding species.

*bipustulata.* Black, shining; the elytra marked with a black dot at the base. 9. A native of Europe, on pasture grounds.

**brunnius* The thorax reddish, and black in the middle; the elytra and body of a rusty colour. 10. A native of Europe; in gardens.

**cruciatus* The thorax black, rusty-coloured on the sides; the elytra yellow, marked with a black cross, and black on the edges. 12. A native of Europe; on pasture grounds.

**ruficollis.* Black; the hind part of the thorax red, and shining. 14. A native of Europe; on grass land.

*mesomelas.* The thorax and edge of the elytra of a rusty colour; body and elytra black. 16. A native of Europe; larva six-footed, filiform, and hardish, furnished with a horny shield at the tail, notched at the sides, and furnished beneath with a conical hollow tubercle in form of a leg on the under side. It is common in decayed wood.

* *aterrimus.* Thorax black and shining; the elytra striated and black. 17. A native of Europe.

* *castaneus.* The thorax reddish and downy; the elytra yellow, and black at the tip. 13. A native of Europe; in low grounds.

* *sanguineus.* Black; elytra of a blood colour. 21. A native of Europe; in grass lands. The tip of the elytra black.—A larger variety is found with the thorax downy and tawney; the elytra of a deep colour, and marked with a faint black blotch at the base.

*segetis.* Black; the antennæ and feet brown; the elytra marked with longitudinal black and brown lines. 114. A native of Europe; at the roots of corn. The larva destroys the fields, especially in dry seasons; it is a long time before it undergoes its metamorphosis.

*funereus.* Reddish; the elytra striated; head brown. 144. A native of Europe.

**obscurus.* Of a rusty colour; head and thorax brown, the latter, together with the elytra and legs, are of a brick colour. 136. A native of Europe.

149 species of this genus have been described in the last edition of the System of Nature.

## 41. CICINDELA, the *Sparkler*.

Antennæ setaceous. Feelers six, filiform; the posterior ones hairy. The jaws prominent and many-toothed. Eyes prominent. Thorax rounded and marginated.

* *Lip divided into three little projections.*

This is, in general, a very beautiful genus of insects; they are found in dry sandy places, and prey with the most ravenous ferocity upon all other insects which come in their way, and which they can overcome. The larva is soft, white, long, and has six feet, with a brown scaly head; and lurks in a round perpendicular hole in the ground, with its head at the entrance, to draw in, and devour whatever insects may come near, or fall into it.

* *campestris.* Green; the elytra marked with five white dots. 1. A native of Europe; in sandy plains. The upper part of the antennæ brown, the under part red; thorax a little angular, rough; elytra irregularly dotted; upper lip white; jaws projecting, sharp; legs red, with a coppery tinge.

* *hybrida.* Purple; the elytra marked with a white band, and two white circular dots. 2. A native of Europe; in sandy places.

*germanica* Of a copper colour; the elytra green, marked with a white spot, like a crescent, at the tip. 4. A native of Europe. It varies in colour, being sometimes blue, green, or black.

*danica.* Black, above bright brown; the elytra with lateral striæ at a good distance from one another. 40. A native of Europe.

*punctata.* Black, on the upper part nearly of the colour of brass; the elytra striated, marked with four impressed dots; legs a yellowish brown. 41. A native of Europe.

*ferruginea* Of a rusty colour; legs, elytra, head, and thorax reddish; the latter green behind; the elytra are marked with a waved green band, and have a green suture. 49. A native of Europe; in water. Head two-lobed behind; lip white; thorax jagged on the fore part; it has no scutellum; elytra with each 15 punctured striæ, and three spots at the base near the anterior margin.

* * *Lip rounded, pointed, entire.* Elaphrus.

* *riparia.* Of a bright greenish yellow; the elytra marked with broad concave points. 10. A native of Europe; in moist places.

* *flavipes.* Of an obscure brass colour; the elytra somewhat cloudy, legs yellow. 11. A native of Europe; on banks. The elytra are sometimes dotted; antennæ black, the first joint yellow; thorax rounded, and grooved on the back.

*quadrimaculata.* Black; the elytra brown, marked with two pale spots, the shanks of the legs reddish. 13. A native of Europe.

**aquatica.* Of a bright brass colour, polished; head striated. 14. A native of Europe; common in water.

48 species of this genus have been described in the last edition of the System of Nature.

## 42. BUPRESTIS, the *Cow-burner*.

Antennæ filiform, serrated, and of the same length with the thorax. Feelers four, filiform; the last articulation obtuse and terminating abruptly. Head half drawn back within the thorax.

This is a genus remarkable for its rich metallic colours,

lours, having frequently the appearance of the most highly polished gold or copper; the larvæ are usually found among timber, and in decayed trees.

*vittata.* The elytra dotted, and furnished with two little projections; they are likewise marked with four elevated lines, and with a broad fillet of green and gold. 33. A native of India.

*fastuosa.* The elytra terminating abruptly, furnished with two small projections, green, and marked with dotted striæ; the back is of a bright golden colour. 34. A native of America.

*berolinensis.* The elytra variegated with green and black, and furnished with two small projections; the anus is furnished with three small projections. 36. A native of Europe.

*ectoguttata.* The elytra formed like the roof of a house, and destitute of projections, marked with four white spots; body blue. 2. A native of Europe; in groves.

*maculosa.* The elytra black, striated, furnished with projections, and terminating abruptly, marked with four yellow spots. 50. A native of Europe; of a middle size. Head and abdomen green and gold; the legs and thorax black; the edge of the latter yellow.

*mariana.* The elytra are serrated, and marked with longitudinal wrinkles, likewise with two impressed spots; the thorax furrowed. 6. A native of Europe.

* *chrysostigma.* The elytra are serrated, marked with two golden impressed spots, and longitudinal furrows; the thorax dotted. 7. A native of Europe.

* *rustica.* The elytra formed like the roof of a house, and striated; the thorax dotted. 8. A native of Europe; in groves.

* *salicis.* Shining green; the elytra entire, of a golden colour, and green at the base. 85. A native of Europe; on the willow.

120 species of this genus have been described in the last edition of the System of Nature.

### 43. Hydrophilus.

Antennæ clavated; the club perforated. Feelers four, filiform. The hind-legs hairy, formed for swimming, and almost destitute of nails or claws.

The insects of this and the next genus, *dytiscus*, are inhabitants of ponds and stagnant waters, where they swim with much dexterity, turning round with great velocity. They fly abroad by night in search of other waters. The males are distinguished from the females, by having a horny concave flap or shield on the fore-legs, near the setting-on of the feet; the hind legs are peculiarly fitted for their aquatic situation, being furnished on the inner side with a series of long and close-set filaments, resembling a fin, by which they are enabled to swim with great ease and celerity. The larvæ remain about two years and a half before they change into pupæ, forming a convenient cell, and secreting themselves in some bank; are extremely voracious and destructive to the more tender aquatic insects, worms, and young fish, which they ravenously seize with their forked jaws, and destroy by sucking out their juice.

* *piceus.* *Water-clock.* Black; breast grooved, with a long spine pointing backwards. 1. A native of Europe. The larva appears to have its legs seated on the upper part of the body near the back; but this is occasioned by the peculiar shape and position of the legs; the female spins a flattish circular web, terminated by a long tapering horn, from which the young escape, as soon as they are hatched.

* *caraboides.* Black, shining; the elytra somewhat striated. 2. A native of Europe.

* *scarabæoides.* Black, shining; the edges of the thorax and elytra yellow. 3. A native of Europe. Feelers filiform.

* *minutus.* Oval, black; the elytra and legs gray. 11. A native of Europe. It makes a buzzing noise in the evening. Thorax is sometimes gray.

*pilula.* Black, shining above, and thickly dotted. 13. A native of Europe.

Twenty species of this genus have been described in the last edition of the System of Nature.

### 44. Dytiscus.

Antennæ setaceous. Feelers six, filiform. The hind-legs hairy, almost entirely destitute of claws or nails, and formed for swimming.

* *latissimus.* Black; the edges of the elytra dilated, marked with a yellow line. 6. A native of Europe. It is so voracious as even to destroy its own species. The male is smooth, the female grooved.

* *marginalis.* Black; the whole of the edge of the thorax, and the outer edge of the elytra, yellow. 7. A native of Europe. The fore-feet of the male have a hemispherical appendage, with two circular cavities in the middle. The female is semistriated.

* *semistriata.* Brown; the elytra hairy, marked with ten furrows, reaching half their length. 8. A native of Europe. It is furnished with a sharp crooked concealed sword. Its legs are oblong, large, and white.

* *sulcatus.* The elytra marked with ten longitudinal furrows, and are hairy. 3. A native of Europe and America. The elytra of the male are smooth.

*notatus.* Brown; thorax yellow, marked with four black dots. 31. A native of Europe. The thorax is sometimes reddish, sometimes variegated with black dots, or with a short black band.

*depressus.* The thorax of a rusty colour, marked with two black dots at the base; the elytra brown, spotted with red. 32. A native of Europe.

* *glabe.* Brown; the elytra smooth; the legs and belly of a rusty colour. 86. A native of Britain; in stagnant waters.

* *nebulosus.* Bluish, clouded with black; the antennæ and legs of a rusty colour; the belly black, the margin of a light-brown colour. 87. A native of Britain; in stagnant waters.

133 species of this genus have been described in the last edition of the System of Nature.

### 45. Carabus, *Bull-head.*

Antennæ filiform. Feelers six; the last articulation obtuse, and terminating abruptly. Thorax heart-shaped; smaller end which terminates abruptly being next the body. Both thorax and elytra are marginated.

These insects are exceedingly active and quick in running: they devour the larvæ of other insects, and all the weaker animals they can overcome; the legs are long,

long, thighs compressed, shanks rounded and ciliated within; the fore ones prickly before; the larvæ are found under ground or in decayed wood.

* *Majores.*

*coriaceus.* Black, opaque; without wings; the elytra connected and marked with dots which run into one another, and somewhat wrinkled. 1. A native of Europe; in woods. One of the largest species in Europe; head and thorax irregularly dotted; body beneath shining.

* *granulatus.* Without wings, and blackish; the elytra of the colour of brass, striated, and marked with elevated dots, placed between the striæ. 2. A native of Europe; in fields.

* *hortensis.* Without wings; black, the elytra smooth, marked with a triple row of bright yellow depressed dots, and with a blue edge. 3. A native of Europe; in gardens and woods. The dots on the elytra are sometimes of the same colour with the elytra.

*arvensis.* Without wings, and of a blackish copper colour; the elytra striated, and marked with a triple row of concave dots. 42. A native of Europe.

* *nitens.* Without wings; the elytra rough, green, with longitudinal raised lines, the edge golden; legs black. 6. A native of Europe; in woods.

* *auratus.* Without wings; the elytra gilt, and marked with elevated ridges and smooth furrows. 7. A native of Europe; in close confined places in woods.

*violaceus.* Winged; the elytra somewhat smooth, black, with a gilt edge; the thorax of a violet colour. 8. A native of Europe; very common in woods.

* *sycophanta.* Shining golden colour; the thorax blue; the elytra marked with strips of green and gold. 12. A native of Europe. This is the largest of this genus that is to be met with in Europe; the larva is black; it attacks caterpillars by night, and devours them.

*adspersus.* Without wings; above of an obscure greenish yellow; beneath black; the elytra marked with four rows of concave spots, and with furrows. 82. A native of Europe; in woods, under ground. The elytra are sometimes black.

* * *Minores.*

*sabulosus.* Pale; the head black, and a black spot on the elytra. 96. A native of Europe; in sandy grounds.

* *ruficornis.* Black; the elytra smooth, and furrowed, the antennæ and legs reddish. 97. A native of Europe; in woods frequently.

* *pilicornis.* The thorax roundish; the elytra striated, and marked with impressed dots; the antennæ hairy. 104. A native of Britain. It is sometimes black, sometimes of a bright yellow.

* *spinibarbis.* Blue; the thorax spherical; mouth, antennæ, and shanks of the legs reddish. 105. A native of England.

*crepitans.* The thorax, head, and legs, of a rusty colour; the elytra black. 13. A native of Europe; in groves. It pursues the larger beetles, driving them away by the noise made by its belly.

280 species of this genus have been described in the last edition of the System of Nature.

### 46. TENEBRIO.

Antennæ moniliform; the last articulation roundish. Thorax flat on one side, and convex on the other, and margined. Head projecting. Elytra somewhat rigid.

* *Feelers six, filiform; the Fore-legs formed for digging, furnished with projections at the extremity like a hand.*

The larvæ of some of the species of this genus live in damp places under ground among rubbish; of others, in flour and different kinds of food, where they perform their metamorphosis. The perfect insects are very troublesome in houses, eating bread, meal, &c.; they precipitately avoid the light; resort to damp cellars, and dark places, where putrefaction allures and nourishes them. They are all of a very dark gloomy appearance, from which circumstance they have received their name.

*complanatus.* Black; thorax nearly square; the elytra very smooth. 13. A native of Cayenne; large.

* *fossor.* Black. 7. A native of Europe; on sand hills, in which it digs holes.

* *cursor.* Brown; thorax oblong, marked with five projecting angles. 8. A native of Europe; in sand hills.

* * *Feelers unequal; filiform.*

*atratus.* Wholly black, and smooth. 21. A native of Egypt; the elytra joined together, the fore legs furnished with two projections.

* * * *Feelers four; the anterior ones faintly clavated, the posterior ones filiform.*

*laminatus.* Black; the thorax nearly square and smooth; the elytra furrowed; the shanks of the fore legs crooked and sharp, terminating in a rusty-coloured plate. 22. A native of India; the largest of the genus.

*gigas.* Black; the elytra striated; thorax smooth. 1. A native of Surinam, about the size of the stag-beetle; the antennæ are somewhat clavated.

* *molitor.* Wholly black; the thighs of the fore legs thicker than those of the rest. 2. A native of Europe; among flour, in bake-houses, mills, dry bread, &c. The larva is white, soft, and smooth, composed of thirteen segments; it is eagerly sought after by the nightingales.

*culinaris.* Of a rusty colour; the elytra striated, the shield emarginated. A native of Europe; in loose sand, in rubbish, and in granaries.

*pomona.* Black above; beneath of a deeper and brighter black; the elytra marked with five elevated striæ on each side. 45. A native of Europe, in orchards; the larva, covered with a loose net, by twos or threes lurk in the folded leaves.

*lignarius.* The thorax marked with two cavities; the elytra of a violet colour or reddish; the antennæ and legs of a rusty colour. 57. A native of Europe. The larva is to be met with in the trunks of pine trees that have been cut down, the inner bark of which they consume; the insect is, when full grown, about half an inch long.

64 species of this genus have been described in the last edition of the System of Nature.

### 47. PIMELIA.

Antennæ filiform. Feelers four. Thorax flat on one side, and convex on the other and marginated. Head projecting,

jecting. Elytra slightly ridged. Wings are wanting in many of the species.

#### * *Antennæ moniliform towards their extremity.*

#### A. *Feelers clavated.*

*gages.* Black; thorax roundish; the elytra sharp pointed and very smooth. 1. A native of Europe.

*sulcata.* The elytra furnished with sharp points, and furrowed. 2. A native of Egypt; common in gardens. They are recommended as remedies in the ear-ache, and against the bite of scorpions; the Turkish women dress and eat them, and think them very fattening.

* *mortisaga.* Black; the elytra are furnished with sharp points, and smooth. 3. A native of Europe; in shady close situations. This insect is regarded as a presage of the death of one of the family, by the common people in Sweden, when it is seen crawling about the house.

#### B. *Feelers filiform.*

*muricata.* Black; the elytra obtuse, striated, and furnished with sharp points. 20. A native of Europe, and the northern parts of Africa and Asia; it makes a noise by rubbing its hind legs against its elytra; it resembles the *mortisaga*, but larger.

*striatula.* Black; the elytra oblong, oval, and striated. 54. A native of Europe.

#### * * *The Antennæ filiform through their whole length.*

#### A. *Feelers four, filiform.*

*tricuspidata.* The thorax furnished with three sharp points; body gray. 56. A native of Egypt.

#### B. *The anterior feelers hatchet-shaped, the posterior ones clavated.*

*cærulea.* Bluish; the thorax nearly round, the elytra striated. 61. A native of Europe.

* *anglica.* Black; the thorax roundish before; the elytra dotted and striated; the antennæ reddish at the tips. 76. A native of England.

*buparia.* Black; smooth and furnished with wings; the thorax circular; the jaws strong, furnished with teeth, and longer than the head. 84. A native of Europe.

84 species of this genus have been described in the last edition of the System of Nature.

### 48. MANTICORA.

Antennæ filiform. The articulations cylindrical. Feelers four, filiform. Thorax roundish before, and emarginated at the tip behind. Head projecting. Jaws projecting. Elytra united. No wings.

*maxillosa.* 1. Native of the Cape of Good Hope; body large, black; head nearly globular, and impressed on each side; jaws furnished with teeth at the base; thorax impressed in the middle, and elevated behind, the margin rounded and notched at the tip; elytra above, flat and rough, deflected at the edge, with a very sharp lateral serrated line; legs simple, black.

Only one species of this genus has been described.

### 49. ERODIUS.

Antennæ moniliform. Feelers four, filiform. Jaw horny, bifid, and ending abruptly. Lip horny, emarginated.

*cstudiarius.* Hunch-backed, black; the elytra united and rough; the sides dusty white. 1. A native of the Cape of Good Hope; large, flat beneath.

*gibbus.* Hunch-backed, black; the elytra marked with three dotted lines. 2. A native of Africa; in loose sand, and very common in Egypt.

*planus.* Black; the elytra marked with one clavated line. 3. A native of Egypt.

*minutus.* Black; the elytra very smooth. 4. A native of Asia.

Only four species of this genus have been described.

### 50. LYTTA.

Antennæ filiform. Feelers four, unequal; the posterior pair clavated. Thorax roundish. Head inflected, and turgid on the upper side. Elytra soft, and flexible.

*vesicatoria.* Green; the antennæ black. 1. A native of Europe; on the privet, the ash, the elder, the lilach both common and Persian, the poplar, and on the Tartarian woodbine.

This insect is used in pharmacy, chiefly for the purpose of raising blisters. It multiplies greatly, and has a nauseous smell, not much unlike that of mice; which helps to conduct those who go in quest of them. The odorous particles exhaled from them are extremely corrosive. They were formerly ranked among the *cantharides*; more recently in the genus *meloë*. More accurate observation has placed them in the genus *lytta*.

* *nitidula.* Green and gold; the elytra reddish brown. 2. A native of England.

*quadrimaculata.* Black, smooth; breast downy; the elytra grayish yellow, marked with two black and almost square spots. 14. A native of the north of Asia. A pleasant smelling oil exudes from its legs.

*fenestrata.* Smooth, pale reddish brown; thorax depressed; the elytra gray, and black at the tips, and marked with two square glazed spots. 15. A native of the north of Asia, among flowers; of a middle size. A pleasant smelling oil is likewise exuded from its legs.

*formicaria.* Brown; the fore part of the elytra, and the thorax, which are elongated, are red. 29. A native of Europe.

29 species of this genus have been described in the last edition of the System of Nature.

### 51. MELOE, *the Blossom-eater.*

Antennæ moniliform. Thorax roundish. Elytra soft, and flexible. Head inflated, and turgid on the upper side.

The larva as well as the perfect insect, both of this and the preceding genus, feed on leaves.

#### * *No Wings; Elytra shortened.*

* *proscarabæus.* Body of a violet colour. 1. A native of Europe. It is to be met with, particularly in the spring, in sandy plains. They feed on the ranunculus and veratrum; its eggs have a pleasant smell; when touched, a very thin yellowish oil exsudes from the joints of its legs. It is recommended as a remedy in the hydrophobia. The female is thrice as large as the male.

*majalis.* The segments of the abdomen red. 2. A native of the south of Europe.

#### * *Furnished with Wings; the Elytra covering the Wings.*

#### A. *Jaw bifid.*

*cichorei.* Black; the elytra yellow, marked with three black bands.

bands. 5. A native of Asia, and the east of Europe. It is used in medicine among the Chinese. The antennæ are sometimes yellow at the tips.

*decempunctatus.* Black; the elytra reddish, marked with five black dots. 6. A native of Italy. The last articulation of the antennæ clavated.

B. *Jaw entire.*

*schæfferi.* Green; the antennæ and legs yellow. 12. A native of Europe.

*schreberi.* Green; the antennæ, legs, and three segments of the abdomen, yellow.

32 species of this genus have been described in the last edition of the System of Nature.

### 52. MORDELLA, *the Nibbler.*

Antennæ moniliform or pectinated. Feelers four; the anterior pair clavated, the posterior filiform. Head bent down under the neck. Elytra bent downwards towards the lip. Before the thighs, and at the base of the abdomen, there is a broad plate.

* *Antennæ pectinated.*

*paradoxa.* The sides of the thorax, and the elytra, a brick colour. 1. A native of Europe; on umbelliferous plants.

*flabellata.* Reddish brown; mouth, breast, and upper part of the abdomen, black. 10. A native of Europe.

** *Antennæ moniliform.*

*bimaculata.* Of a rusty colour; breast black; elytra reddish, marked with a black spot. 13. A native of Europe. Large.

* *aculeata.* Black; the anus terminating in a spine. 2. A native of Europe; on umbelliferous, and a variety of other plants.

* *abdominalis.* Black; thorax and abdomen tawney; the anus terminating in a spine. 19. A native of Europe.

* *humeralis.* Black; the mouth, sides of the thorax, and legs yellow. 3. A native of Europe; on flowers.

* *bicolor.* Black; the elytra reddish, black at the tip, and marked with a black band in the middle. 25. A native of Britain; very common on the flowers of the hawthorn, of the dock, and of some kinds of umbelliferous plants. Very small.

*** *Antennæ clavated.*

* *clavicornis.* Wholly black. 23. A native of Europe; on the rhubarb.

28 species of this genus have been described in the last edition of the System of Nature.

### 53. STAPHYLINUS, *Rove-beetle.*

Antennæ moniliform. Feelers four. Elytra half the length of the body. Wings covered. Tail simple, furnished with two vesicles, which can be thrust out at pleasure.

This is an extremely rapacious tribe, devouring whatever insects they can catch, and frequently each other; many of them, when laid hold of, turn up the tail; the jaws are strong and projecting, with which they bite and pinch very hard. Most of them are found in damp places, among putrid substances, and a few upon flowers. The larvæ live under ground.

* *All the Feelers filiform.*

Hairy, black; the thorax and posterior part of the abdomen black. 1. A native of Europe; in sandy places. * *hirtu.*

Downy, and ash-coloured, clouded with black. 2. A native of Europe; in dead bodies, and in dung. The elytra blue underneath; larva six-footed, naked, pale; the head and three first segments of the abdomen chesnut brown; tail with two jointed bristles, and a cylindrical tubercle beneath. * *murin*

Downy, black; marked with ash-coloured bands; the jaws of the same length with the head. 3. A native of Europe; in woods, living on plunder. * *maxil- sus.*

Black; the thorax and elytra shining. 5. A native of Europe; on dead bodies; when recently caught, it diffuses a very fragrant smell. * *polit*

Black; the edges of the thorax yellowish; the elytra of a rusty colour, with a black edge. 4. A native of Britain. * *

** *The posterior Feelers hatchet-shaped.*

Reddish; the head, posterior part of the elytra and abdomen, as well as the base of the thighs, black. 6. A native of Europe; on the *boletus.* * *rufu.*

Black; the elytra, antennæ, and legs of a rusty colour. 22. A native of Europe; on the *boletus.* *flavipe.*

*** *The anterior Feelers clavated.*

Reddish; the elytra blue; the head and tip of the abdomen black. 9. A native of Europe. *ripar*

Black; thorax reddish; the elytra pale blue. 96. A native of Europe; under stones. *rufipe*

Black; the posterior part of the elytra, the legs and antennæ, of a rusty colour. 14. A native of Europe. *elonga*

### 54. FORFICULA, *the Earwig.*

Antennæ setaceous. Feelers unequal and filiform. Elytra half the length of the body. Wings covered. Tail furnished with pincers.

The larvæ of the forficula run very quickly. This insect is very common, and very well known; the pincers at its tail, from whence it has received its Latin name *forficula*, afford a very good distinguishing mark.

The elytra white at the tip; the antennæ have fourteen articulations. 1. A native of Europe; common in fruit. It is accused of creeping into the ears of people while sleeping, whence it has received its name, *earwig.* * *auri- laria.*

Pale above, variegated with black; the anus furnished with two projections; the pincers projecting considerably, and each furnished with one projection. 3. A native of Europe. Very large. *gigan*

The elytra reddish, without spots; the antennæ have ten joints. 2. A native of Europe. The tips of the antennæ are whitish. It is rare. * *min*

Black; the hind part of the head and legs reddish; back of the elytra marked with a white spot. 4. A native of Europe. The antennæ have eleven joints. *bipunc*

11 species of this genus have been described in the last edition of the System of Nature.

II. HEMIPTERA.

## II. HEMIPTERA.

The mouth and snout bent inwards, towards the breast. Wings covered with hemelytræ. The upper wings, composed of a semicrustaceous substance, do not form a straight suture when shut, but the inferior edge of the one passes over the superior edge of the other.

### 55. Blatta, *Cock-roach.*

Head bent inwards. Antennæ setaceous. Feelers unequal, filiform. Elytra and wings smooth, and somewhat resembling leather. Thorax flattish, circular, and marginated. Feet formed for running. Two small horns are situated at the tail in most of the species.

These insects, with their larvæ, wander about by night, and secrete themselves by day. They are fond of warmth, and haunt about houses, devouring meal, and whatever provisions they can get at. They run with great celerity; and are destroyed by the fumes of charcoal or sulphur, also by the root of the *nymphea alba* boiled in milk.

*gigantea.* Livid; the shield of the thorax marked with a square chesnut-coloured spot. 1. A native of Asia and America. It is the largest of this genus, being nearly the size of a hen's egg.

*maderæ.* Brown; the thorax and elytra livid, and variegated with brown. 11. A native of the island of Madeira; a little smaller than the last species.

*americana.* Of a rusty colour; the shield of the thorax whitish behind. 4. A native of America; it has been introduced into Europe along with sugar.

*ustralasiæ.* Of a rusty colour; the thorax black, marked with a white ring; the elytra marked at the base with a small white line. 13. Found in ships returning from the South seas.

*orientalis.* Of a rusty brown colour, without spots; the elytra short, marked with an oblong furrow. 7. A native of America, and has been introduced into Europe for almost two hundred years. Frequent in many countries of Europe, in meal and bread, and other provisions; likewise in shoes, which it destroys. It shuns the light, and runs very quickly. It is much harassed by the large *tenthredo cærulea.* The female is without wings; she produces a cylindrical egg, half the size of the abdomen.

*pponica.* Yellowish; the elytra spotted with black. 3. A native of Europe; consuming provisions. In the moist woods however of the east of Europe it is less noxious.

*ermanica* Livid; body yellowish; the thorax marked with two black parallel lines. 9. A native of Europe.

*maculata.* Thorax black, with a whitish edge; the elytra pale, marked with a large black spot near the tip. 25. A native of Europe; in pine forests and heaths.

43 species of this genus have been described in the last edition of the System of Nature.

### 56. Pneumora.

Body oval, inflated, and transparent. Head bent inwards, and furnished with jaws. Thorax convex, beneath formed like a keel of a ship. Elytra deflected and membranaceous. Legs formed for running.

The whole of this genus seem to consist of a mere hollow inflated membrane; by rubbing their legs against their bodies, they make a shrill noise in the twilight; and during the night, they are attracted by a bright light.

*immaculata.* Elytra without spots. 1. A native of the Cape of Good Hope. Head green; eyes white; between the eyes are three red stigmata, and above these two short projections; antennæ short, green; thorax rough, with a short tooth before and an impressed wrinkle in the middle; the elytra ash-coloured, reticulated with green, sometimes marked with very small black dots; they are very rarely yellowish or reddish; the insect is about twice the size of the house-cricket.

Three species of this genus have been described in the last edition of the System of Nature.

### 57. Mantis, *Soothsayer.*

Head nodding; furnished with jaws. Feelers filiform. Antennæ setaceous. Wings four, membranaceous, rolled up. Fore-legs compressed, notched underneath, furnished with one hook, and with a lateral setaceous jointed finger; the four hind-legs smooth, and formed for walking. Thorax linear, long, and narrow.

*gigas.* The thorax somewhat tapering and rough; the elytra very short; the legs prickly. 1. A native of Asia; wings very large.

*mendica.* Thorax marginated, and marked with small projections; the elytra variegated with green and white; dotted with white along the edge. 17. A native of Alexandria.

*oratoria.* The thorax smooth; the elytra green; the wings reddish at the anterior part, marked with a black spot. 6. A native of Europe. This insect rests sometimes on its four hind-legs, stretches the fore-legs out to the right or left, and for this reason has been supposed to point out the way to strangers, when asked.

*precaria.* The thorax somewhat fringed; the elytra greenish, marked with a rusty-coloured ocellus. 8. A native of America and Africa; the half of the ocellus on the elytra is white, sometimes entirely white. This is supposed to be the idol of the Hottentots.

*fausta.* Linear, ash-coloured, spotted with black. 30. A native of the Cape of Good Hope. This is the tutelary deity of the Hottentots.

52 species of this genus have been described in the last edition of the System of Nature.

### 58. Gryllus, *Cricket.*

Head bent inwards; furnished with jaws. Feelers filiform. Antennæ either setaceous or filiform. Wings four, either deflected or twisted; the under wings folded. Hind-legs formed for leaping.

The whole of this genus feed on vegetables, except those contained in the first division, *acrida*, which devour other insects; the *achetæ* destroy the roots of plants; the *tettigoniæ* and *locustæ*, the leaves or tender shoots, in some countries laying waste whole districts; the larvæ and pupæ resemble the perfect insects, reside chiefly under ground, and are six-footed, voracious and active: some of this tribe are used as an article of food by the natives of Africa and India; many of them produce sound by the friction of some parts of their body.

### * *Antennæ the shape of a sword; Head conic, and longer than the thorax.* Acridæ.

*nasutus.* Body green. 1.

*turritus.* Head conic; antennæ sword-shaped; the wing transparent. A native of Africa and the southern parts of Europe; the mouth placed at the under part of the head; antennæ on the top of the head, and not longer than the thorax.

*giganteus.* Green; marked with two reddish fillets; the antennæ of a rusty colour; thorax marked with three raised lines. 64. A native of America; larger than the *gr. nasutus.*

*foliaceus.* Wings yellowish; the antennæ resembling a leaf. 67. A native of Asia.

### ** *Thorax formed like a keel; Antennæ filiform, shorter than the thorax.* Bullæ.

* *bipunctatus.* Brownish; the scutellum of the thorax of the same length with the abdomen. 7. A native of Europe; on sand hills exposed to the sunshine.

* *subulatus.* The scutellum longer than the abdomen. 3. A native of Europe; in ditches. It is sometimes gray, sometimes brown.

### *** *Antennæ setaceous; Feelers unequal; Thorax rounded; the Tail furnished with two bristles.*

* *gryllotalpa.* *Mole-cricket.* The wings furnished with a projection like a tail, and longer than the elytra; the fore-feet formed like hands, and downy. 10. A native of Europe. This troublesome little animal frequents gardens and cultivated grounds, both of Europe and America, where it burrows below the ground, and is very destructive; eating and destroying the roots of plants. Body dark brown, hairy; antennæ shorter than the body.

*monstrosus.* The elytra and wings furnished with projections like tails, and rolled up. 73. A native of India.

* *domesticus.* *House-cricket.* The wings furnished with a tail and longer than the elytra: legs simple; body yellowish brown. 12. A native of Europe; in many houses, about ovens, and kitchen chimneys: wanders about during the whole night, keeping a continual chirping, especially before rain; is said to forsake houses infested by the cockroach. There is a variety of this species six times the size of the European. Arsenic or the root of the wild carrot, mixed up into a paste with flour, is sometimes made use of to poison them; but an opinion prevails among the vulgar that their presence in any house is the cause of good fortune; and, therefore, though they be troublesome, they are unwilling to driva them away.

* *campestris.* *Field-cricket.*—Wings shorter than the elytra; body black, and furnished with a long spine. 13. A native of Europe; chirps from the beginning of May till the end of September, and is said to drive away the house-cricket when domesticated.

*pellucens.* Whitish; thorax of the form of a trapezium. 85. A native of Carniola and Europe; in vineyards and gardens; about half an inch in length; it makes a noise during the whole summer in the night time; it resembles the house-cricket, but larger; the head is shining; the thorax is marked with three brown spots, the elytra with yellowish ones.

### **** *Antennæ setaceous. Feelers unequal. Tail of the female armed with a projection like a sword.* Tetigoniæ.

*aquilinus.* The thorax round, and somewhat warty; wings very broad; with 15 nerves. 27. A native of South America and India; large; the elytra of the shape of a lance; the shanks of the legs set with four rows of prickles.

*griseus.* Brown; the thorax roundish and keel-shaped behind, furnished with a black crooked spine resembling a sword, the base of which is pale on each side. 108. A native of Europe; the antennæ yellow, and of the same length with the body; legs greenish; the elytra variegated with brown and ash colour.

*viridissimus.* The thorax round; the wings green and without spots; the antennæ very long. 31. A native of Europe; on trees, in pasture grounds, in barley fields. It makes a noise in the night time in warm weather about the time of the dog days.

* *verrucivorus.* Thorax nearly square and smooth; the wings green, spotted with brown; the antennæ setaceous, about the same length as the body. 34. A native of Europe, and is collected by the common people of Sweden for the purpose of destroying warts in the hand; which it said to perform by biting off the excrescences, and discharging on the wound a fluid which causes them to decay.

### ***** *Antennæ filiform; Feelers simple; Tail unarmed.* Locustæ.

*elephas.* The thorax entirely keel-shaped; body without wings. 35. A native of Africa; this is the largest and heaviest of the *Locustæ;* green, the thighs smooth, the rudiments of two wings.

*migratorius.* The thorax faintly carinated, composed of one segment; head obtuse; jaws black. 41. A native of Tartary, and migrates in incredible swarms into various parts of Europe. The mischief these voracious creatures do, when they appear in vast swarms, far exceeds that done by any other tribe of animals. By suddenly destroying all vegetation, they change the most fertile countries into barren deserts, leaving behind them desolation and famine. They have occasionally appeared in small flights in England, but have perished in a short time. This was probably the species that constituted one of the plagues of Egypt. They are eaten by the inhabitants of different countries, particularly by the Egyptians, who roast them alive and eat their bodies, after having removed their wings and legs.

* *stridulus.* The thorax marked with an elevated ridge like a keel, the wings red and black at the tips. 47. A native of Europe; in dry sandy situations, chirping all day long, till late at night. Either black or variegated with black and yellow.

240 species of this genus have been described.

### 59. FULGORA, *Lanthorn-fly.*

The head inflated; forehead prominent. The antennæ short, placed under the eyes, composed of two articulations, the upper one being the largest and globular.

globular. The snout, long and bent inwards, is a sheath consisting of five articulations. Legs formed for walking.

*nterna- a.* The forehead extended, forming a straight beak; wings bluish, the under wings marked with ocelli. 1. A native of South America. It emits a very bright light from the prominent part on its forehead. Travellers are said to avail themselves of the light they emit; two or three of them, fixed on the end of a stick, affording light sufficient to let them see in the dark.

*'adema.* The forehead set with tapering points, and extended into a beak, divided at the tip into three; wings black, spotted with red. 2. A native of India.

*ndelaria* The forehead extended into a clavated beak; the elytra green, spotted with yellow; the wings yellow with black tips. 3. A native of China.

*hospho- a.* The forehead raised into a tapering beak; body grayish yellow. 4. A native of South America.

*yalina.* The forehead conic and unequal; wings transparent, marked with a black streak. 17. A native of Bengal.

20 species of this genus have been described in the last edition of the System of Nature.

### 60. Cicada, *Frog-hopper.*

Snout bent inwards. Antennæ setaceous. Wings four; membranaceous and deflected. Legs (in the most of the species) are formed for leaping.

The insects of this genus feed on the juice of plants; the larva is without wings; the pupa has only the rudiments of wings, but they have both six legs; they very much resemble the perfect insect, and are very active; the perfect insect chirps as well as those of the preceding genus.

* *Antennæ tapering at the point, and placed on the forehead.* Membracides.

A. *Thorax compressed, membranaceous, and larger than the body.* Foliaceæ.

*flata.* The thorax inflated, light brown and reticulated. 52. A native of Cayenne.

*genistæ.* The thorax brown; lengthened out behind, the abdomen being half the length of the thorax. 56. A native of England; on the *genista tinctoria.*

*ermis.* The thorax greenish, tapering to a point, and of the same length with the abdomen. 57. A native of America, on plants.

B. *The thorax furnished with a horn on each side.* Cruciatæ.

*ornuta.* The thorax furnished with two horns; black, tapering to a point behind, and of the same length with the abdomen; wings brown. 6. A native of Europe; on thistles and willows.

* * *Legs not formed for leaping.* Maniferæ.

*beia.* The tip of the scutellum marked with two small projections; the elytra marked with four anastomoses, and six lines of a rusty colour. 15. A native of Europe and Africa, very large. Of this insect Virgil says, *et cantu querulæ rumpent arbusta cicadæ,* and *sole sub ardente resonant arbusta cicadis.*

*i.* Black, spotted with yellow; the elytra are surrounded with a thin edge, with six brown connected dots; the wings are white, marked with two black spots, and yellow at the base. 16. A native of Europe; the larva is eatable.

* * * *Antennæ filiform, situated under the eyes.*

A. *The sheath of the snout stretched out, obtuse, and grooved above.* Cercopides.

*bifasciata.* Yellowish; the elytra brown, marked with two white bands. 11. A native of Europe; on plants of different kinds.

* *spumaria.* Brown; the elytra are marked on the sides with two white spots, and with a double interrupted whitish band. 24. A native of Europe; on various plants, frequently on the rose, on grass and osier; the larvæ and pupæ of this, and some others of the genus, discharge a frothy matter from numerous pores about the tail, within which they are completely enclosed; this is frequently found in summer on various plants, very much resembling a quantity of saliva, and is commonly known by the name of *cuckow spit;* the perfect insect will frequently leap two or three yards to escape from any one who attempts to catch it.

*punctulata* Brown; the fore part of the thorax marked with impressed dots, the elytra marked on the sides with two white spots. 212. A native of Europe.

† † *The sheath of the snout very short, membranaceous, cylindrical, obtuse.*

*Legs formed for leaping.* Ranatræ.

*nervosa.* Brown; wings transparent, spotted with brown, and marked with dotted ribs. 25. A native of Europe; on plants.

* *fulgida.* Yellow; the elytra gilt and brown. 123. A native of Britain; on plants.

§ § *The wings deflected, covering the sides.* Deflexæ.

*aurata.* Yellow; the elytra marked with brown, with four black spots, and gilt behind. 48. A native of Europe.

*quercus.* Yellowish; the elytra marked with blood-coloured spots, and brown at the tips. 173. A native of Europe; on the oak.

240 species of this genus have been described in the last edition of the System of Nature.

### 61. Notonecta, *Boat-fly.*

Snout bent inwards. Antennæ shorter than the thorax. Wings four, folded cross-wise, the upper ones coriaceous. Hind legs hairy, formed for swimming.

The insects of this and the next genus, *Nepa*, live in stagnant waters, and prey on aquatic animals; the larvæ and pupæ are six-footed, active, and swim readily, and very much resemble the perfect insect; the larva is destitute of wings, the pupæ have only the rudiments of wings.

* *Lip long.*

* *glauca.* The elytra gray, dotted with brown along the edge, and divided at the tip. 1. A native of Europe; in waters, very troublesome to fish. It swims on its back, for which reason it has been called by the Greek name of *notonecta.* The hind legs, which are longer than the rest, serve it as oars. When caught, it must be cautiously handled, as the point of its snout is very sharp, and its puncture very painful.

* * No.

* * *No Lip.* Sigaræ.

* *striata.* The elytra brown; marked with a great number of cross waved lines of a darker colour. 2. A native of Europe.

14 species of this genus have been described in the last edition of the System of Nature.

### 62. Nepa, *Water Scorpion.*

Snout bent inwards. Antennæ short. Wings four, folded cross-wise, the upper ones coriaceous. The fore-legs formed like claws; the other four are formed for walking.

The insects of this genus are very voracious, and feed on other aquatic animals, which they pierce and tear with their sharp snout, while they hold them with the claws of their fore-legs. They fly well, especially in the evening and night, and convey themselves from one pool to another, particularly when water begins to fail in the pool they have been in.

* *Antennæ divided into several divisions resembling a hand; Lip wanting.*

* *cinerea.* Ash-coloured; thorax unequal; body long and oval. 5. A native of Europe; in stagnant waters; the upper part of the abdomen red.

* *linearis.* Linear; the claws furnished with a lateral spine. 7. A native of Europe and India, in fresh water. The eggs of this insect are furnished at one end with two hairs; they deposit them in holes made in stalks of rushes, leaving the hairs standing out.

* * *Lip stretched out and roundish,* Naucorides.

* *cimicoides.* The edge of the abdomen slightly notched. 6. A native of Europe.

Twelve species of this genus have been described in the last edition of the System of Nature.

### 63. Cimex, *Bug.*

Snout bent inwards. Antennæ longer than the thorax. Wings four, folded cross-wise; the upper wings coriaceous in the fore part. Back flat. Thorax marginated. Legs formed for running.

Most bugs have a bad smell; all of them except the *reduvii,* feed on the juice of plants, and all of them, without exception, on the juices of animals, particularly of the softer insects, which they suck by means of their snout. The larvæ and pupæ have six feet, run quickly, and very much resemble the perfect insect; the larvæ have no wings, only stumps of wings.

* *Antennæ placed before the Eyes.*

A. *Lip wanting.* Acanthiæ.

† *Without Wings.*

* *lectularius.* *House-bug.* Without wings. 1. A native of Europe, though originally a foreigner; it was introduced into Europe before the Christian era, but not into Britain until the seventeenth century, being little known before the year 1670. It is a troublesome and nauseous inhabitant of most houses in large towns; crawling about in the night time to suck the blood of such as are asleep, and hiding itself by day in the most retired holes and crevices.

† † *The Elytra almost totally coriaceous.* Coleoptrati.

* *grylloides.* Black; without wings; the elytra oval, with yellow edges, and shorter than the abdomen. 13. A native of Europe. The thorax resembling the *gryllus.*

† † † *Membranaceous and very flat.*

* *pyri.* The thorax divided into three wings; the scutellum resembling a leaf; the elytra reticulated and swelling out at the base. 137. A native of Europe; on the under surface of the leaves of the pear tree, which become spotted with its punctures.

B. *Lip long, tapering to a point at the extremity.*

† *The Scutellum of the same length with the Abdomen.* Scutellati.

* *lineatus.* Black; the thorax marked with five, and the scutellum with three orange-coloured lines; the abdomen yellow, dotted with black. 6. There is a variety of this species,

*nigrolineatus.* (β) Red; the thorax marked with five, and the scutellum with three black lines; the abdomen yellow, dotted with black. A native of Europe; on the flowers of the apple and elder.

† † *The Thorax armed with a spine on each side.* Spinosi.

* *luridus.* The thorax armed with blunt prickles; the elytra gray, marked with a brown spot, the shield emarginated. 190. A native of England; in thickets.

† † † *Thorax without spines.*

A. *Rotundati, such as are round or oval.*

* *baccharum.* Somewhat tawney, the edge of the abdomen spotted with brown. 45. A native of Europe; on berries.

* *oleraceus.* Blue, with a metallic lustre; the thorax marked with a small line; the tip of the scutellum, and dots on the elytra, all of a red or white colour. 53. A native of Europe; on tetradynamious plants. It is very destructive to cabbages and to turnip fields.

B. *Such as have the Thorax oblong.*

† *Antennæ terminating in small hairs.*

* *flavicollis.* Black; head, thorax, and legs reddish. 364. A native of England.

* * *Antennæ clavated.*

*ictericus.* Brown; head and thorax reddish. 679. A native of Europe.

C. *Antennæ filiform.*

‡ *Legs smooth.*

* *pratensis.* Yellowish; elytra green. 36. A native of Europe; in meadows.

‡ ‡ Legs

‡ ‡ *Legs notched or prickly.*

*alcaratus.* Brown; the upper part of the abdomen of a blood colour; the thighs of the hind legs furnished with six sharp projections. 114. A native of Europe.

D. *Antennæ setaceous.*

‡ *Legs notched.*

*abietis.* Spotted, with tawney coloured spots; legs reddish; thighs thick. 115. A native of Europe; on the fir tree.

‡ ‡ *Legs without prickles.*

*patulinus.* Green, without spots; wings transparent. 83. A native of Europe; in meadows.

§ § § *Linear; Body oblong and narrow.*

‖ *Antennæ setaceous.*

*edes.* Variegated, with brown and yellow; the thighs of the hind-legs long and notched. 524. A native of India.

‖ ‖ *Antennæ filiform.*

*stagnorum.* Black and tapering; the thorax marked in the centre with two globular dots. 113. A native of England; very common in lakes.

‖ ‖ ‖ *Antennæ clavated.*

*ispinosus* Greenish brown; the antennæ long, with three erect prickles on the back. 542. A native of Surinam.

‖ ‖ ‖ ‖ *Antennæ double clavated.*

*uecicus.* Ash-coloured; the thighs clavated. 543. A native of Europe.

‖ ‖ ‖ ‖ ‖ *Antennæ with two terminations.*

*pularius.* Whitish; all the legs very long; the thighs clavated. 120. A native of Europe; on mosses.

* * *The Antennæ placed above the Eyes; the Snout arched.* Reduvii.

*ersonatus* The antennæ resembling hairs at the tips; body somewhat hairy and brown. 67. A native of Europe; in rubbish. The larva is rough, and destroys the house-bug.

*ridulus.* Smooth, black; the elytra brown, spotted with black, and with a red edge. 557. A native of Europe. It is small, and moves about with great agility early in the spring; it keeps its antennæ in constant motion, and makes a shrill noise by rubbing them against the thorax.

693 species of this genus have been described in the last edition of the System of Nature.

### 64. MACROCEPHALUS.

Snout bent inwards. Sheath of one valve, and consisting of three articulations, and furnished with three bristles, destitute of jaws, feelers, and lip. Antennæ stretched forwards, very short, clavated, and nearly moniliform. Head oblong, cylindrical above. Scutellum of the length of the abdomen, flat and membraneous.

*cimicoides.* A grayish-reddish colour; the scutellum of an ash-colour; a yellow spot on the elytra; the wings of a purplish violet colour; the thighs of the fore-legs thickened. 1. A native of America.

Only one species of this genus has been described in the last edition of the System of Nature.

### 65. APHIS, *Plant-louse or Vine-fretter.*

Snout bent inwards; a sheath of five joints, furnished with one bristle. Antennæ setaceous, and longer than the thorax. Wings four, erect in none. Legs formed for walking. Abdomen frequently terminating in two horns.

The minute animals which compose this singular genus, infest various plants, generally in large societies, hindering their growth, and consuming their juices. A peculiarity in the mode of their propagation attracted the attention of naturalists a good deal towards the beginning and about the middle of last century. Reaumur, from some observations of his own, and from the opinions of some preceding observers, was led to believe, that they propagated without sexual connection. Bonnet adopted the same opinion, and thought he had established it beyond controversy by some very accurate experiments and observations of his own, which he communicated to the Royal Academy of Sciences. He shut up a young aphis, at the instant of its birth, in the most perfect solitude, which nevertheless brought forth 95 young ones in his sight. The same experiment being repeated on one of this family, it multiplied like its parent; and one of this third generation, brought up in solitude, proved no less fruitful than the others. Repeated experiments, in this respect, as far as the fifth or sixth generation, all uniformly afforded the same result. A suspicion entertained by Mr Trembley induced Mr Bonnet to repeat his experiments with still more accuracy, and to continue them longer. He reared to the amount of the tenth generation of solitary aphides, and had the patience to keep an account of the days and hours of the births of each generation: he discovered, that they are really distinguished by sexes; that the males are produced only in the tenth generation, and are but few in number; that these soon arrive at their full growth, and copulate with the females; that the virtue of this copulation serves for ten generations: he likewise found that they were viviparous during spring and summer; and that they were oviparous only in the tenth generation; that from these eggs the aphides of the following year were hatched early in the spring. His observations have been repeated by other naturalists, particularly by Dr Richardson of Rippon, who has given a very minute account of his observations, in a paper published in the Philosophical Transactions, vol. xi. art. 22. These little animals discharge from their anus a sweet fluid, commonly called *honey-dew*, which attracts the bees and ants. The species are very difficultly distinguished; it is still more difficult to describe them; different species are sometimes found on the same plant.

* *longirostris.* Of an ash-colour; the snout three times the length of the body. 34. A native of Europe; under the barks of trees; feeds on the larvæ of the ants.

* *vitis.* 56. A native of Europe; on the vine. This destructive little insect cuts through the peduncles, or stems which support the clusters of grapes, in their very early stage, causing them to wither and drop off soon after the fruit is formed.

* *pistaciæ.* Black; wings whitish; shanks of the legs very long; the thorax warty. 33. A native of Europe and Asia; on the pistachia: the antennæ moniliform; eyes blackish; the abdomen without bristles, covered with white down, mixed with small balls; the wings sometimes erect. It is lodged in a follicle arising from the base of the leaf, swelling out in the middle, and tapering toward each end, of more than an inch in thickness, at first green, after the insects have left it becoming flesh-coloured.

77 species of this genus have been described in the last edition of the System of Nature.

### 66. CHERMES.

The snout is a sheath placed in the breast, furnished with three bristles, bent inwards. Antennæ cylindrical, longer than the thorax. Wings four, deflected. Thorax turgid on the upper side. Legs formed for leaping.

These insects inhabit various trees and plants, and produce by their punctures, protuberances and excrescences of various shapes and sizes, in which are frequently enclosed the eggs, and insects in their several states; the larva is six-footed and apterous; the pupa is distinguished by two protuberances on the thorax, which are the rudiments of future wings.

* *graminis.* 1. A native of Europe; on grasses, particularly the *aira flexuosa.*

* *castanea.* Brown; the antennæ setaceous and smooth; the wings very much ribbed. 21. A native of Europe; on different plants.

Twenty-six species of this genus have been described in the last edition of the System of Nature.

### 67. COCCUS, *Cochineal.*

The snout furnished with bristles, situated in the breast. Antennæ filiform. The anus furnished with bristles. Male with two erect wings; female without wings.

These are extremely fertile; and very troublesome in hothouses and greenhouses; the male is very active, with an oblong body, and ovate abdomen; the tail is furnished with a style and two long bristles; the female has a body nearly globular, and is inactive and fixed to different parts of plants.

*hesperidum.* Oval, oblong. 1. A native of Europe: on evergreen plants, in greenhouses, *e.g.* the orange, the laurel, &c.

*adonidum.* Reddish, dusted over with powder, and hairy. 4. A native of America and Africa, lately in the warmer parts of Europe; on trees. Body oval and whitish; antennæ and legs brown, marked on the back with an elevated line, and with a raised dot on each of its segments, with the edges of the side acute, furnished with fourteen prominent segments and raised dots; its surface sprinkled with as many dots set longitudinally between the clavated line on the back and the edge; the tail divided; the perfect insect constructs a follicle in which it conceals itself and its yellow eggs.

*polonicus.* Body oblong, ovate; purple or chesnut. 17. On the roots of the *scleranthus perennis.*—This insect without impropriety may be called the cochineal of the northern part of the world. It prefers cold climates, and is commonly called *coccus tinctorius polonicus*, or the *scarlet grain* of Poland. Ray calls the plant on which it feeds the *polygonum cocciferum;* but it is not confined to one kind of vegetable, for it is found on the mouse-ear, pimpernel, and pellitory, as well as on the *scleranthus perennis.* It is a native of some other northern countries as well as Poland; though formerly the greatest quantity of it used to be collected there. Towards the end of June the *coccus* is in a fit state for gathering. Every one of these creatures is then nearly of a spherical form, and of a fine violet colour. Some of them, however, are not larger than poppy seeds, and others of the size of a pepper corn. The males are produced from the small grains, the females from the larger ones; each of them is lodged in a sort of cup like that of an acorn. These cups cover more than one half of the body of the animal. They are rough and of a blackish brown on the outside, and smooth and shining on the inside. At the roots of some of the plants only one or two grains are to be found, at the root of others more than forty are to be met with.

Those who collect the grains have a short spade, with which they raise the plants from the ground; after the insects have been collected they replace the plants; the grains are then separated from the earth, which may have adhered to them, by means of a sieve, and sprinkled with very cold water or vinegar to prevent them from hatching.

After this they are dried in the sun, or by gentle artificial warmth; but this must be managed with caution, as too hasty drying might injure their colour. Sometimes the grains are separated from their covers, and made up into balls.

According to Bernard de Bemith, the Turks and Armenians make use of these grains not only for dyeing silk and wool, but likewise the manes and tails of their horses. The Turkish women use it for tinging the tips of their fingers. The Dutch formerly mixed it with the true cochineal. The colouring matter extracted from this insect, by means of a solution of alum with the addition of a little chalk, is said to form a lake equal in beauty to that of Florence. The great superiority of the Mexican cochineal, has caused the scarlet grains of Poland to be neglected in all the countries of Europe where dyeing is best understood, as they contain not a fifth part of the colouring matter which may be extracted from the real cochineal.

*cacti.* Body depressed, downy, and transversely wrinkled; abdomen purplish; legs short and black; antennæ subulated, the third part of the length of the body. 22. A native of South America, on the *cactus coccinellifera.* The male is very small; its body is long, of a deep red colour; two long diverging threads proceed from the extremity of the abdomen; its wings are large, white, and incumbent; its legs are pretty long; the antennæ are nearly the length of the body.

The female is more than double the size of the male, when

when at its full growth, it is almost as large as a pea, of a dark brown colour, and covered with a white powder; the antennæ are short; the body flat beneath, and convex above, and edged with annular segments distinctly marked; the legs are short.

The female of this insect is the real cochineal, so highly valued in every part of the world, for the incomparable beauty of the red colour which it affords, which forms so considerable a branch of commerce between the new and old continents. In the year 1736, there was imported into Europe 700,000 pounds weight, worth upwards of 700,000l. sterling. It was a long while made use of before its nature was ascertained: for a considerable time it was thought to be the fruit of some vegetable. The same opinion prevailed with respect to another species of *coccus*, which was much used as a dye before the introduction of the Mexican cochineal, and which, under the name of *kermes*, is collected in Spain, Sardinia, Africa, and Asia Minor. America is still the only quarter from which the true cochineal is to be obtained. The principal countries, where the cochineal insects are bred, are Oaxaca, Tlascala, Chulula, Nueva Gallicia, and Chiapa, in the kingdom of New Spain; and Hambalo, Loja, and Tucuman in Peru; but it is only in Oaxaca that they are gathered in great quantities, and form a branch of commerce; the cultivation of these little creatures being there the chief employment of the Indians. It is imported into Europe, in the form of small irregular grains, flat on the one side, and convex on the other: the best is of a slate gray colour, mixed with red, and covered with a white powder. There are two kinds of cochineal: First the fine, called by different names, according to the places from whence it comes, viz. *Mastique*, *Campescane*, and *Tetrascale*; of these the mastique is reckoned the best. The second is called *sylvester*, from its being commonly collected from a species of *cactus*, which grows without culture; this is much inferior to the other, both in price and in the quantity of the colouring matter which it affords; it is likewise smaller, and generally believed to be a different species of *coccus*. The plant on which they rear the best cochineal is called *nopal* by the Indians, (*cactus coccinellifera* of Linnæus). The colour of the cochineal is by some supposed to be derived from the juice of this plant. Its flowers and the juice of its fruit are of a beautiful red colour. The natives of those countries where the cochineal is reared, form plantations of the nopal in small gardens near their houses; the plant is propagated by cuttings, which grow freely. In about eighteen months after the plantations have been formed they are fit for the reception of the insects. These plantations must be renewed every six years, as the insects succeed best on young vigorous plants.

The nopal will grow on almost any soil, and needs no other culture but to be kept clear of weeds, and protected from the north-wind. The insects are placed upon the nopal about the middle of October, the period at which good weather commonly commences in Mexico after the rains. Those who rear the insects, take care to preserve a sufficient number of females for this purpose, either by protecting them during the rainy season with a covering of matts, or by removing some branches of the nopal loaded with them into their own houses. Eight or ten of these females are put into a small nest formed of a tuft of threads collected from a species of palm, or of any other cottony matter, which is attached to the spines of the nopal, on that side of the plant exposed to the rising sun, the rays of which promote the hatching of the young insects, which soon proceed in great numbers from the nest, as each female produces upwards of a thousand. The larvæ spread over the plant, and soon fix themselves by means of their trunk; after this, should they by any accident be displaced, they inevitably perish, as their trunks are broken. In some districts the females are preserved during the rainy season in boxes carefully shut up. The males live for little more than one month; the females about double that time. Both of them remain in the state of larvæ for about ten days; they remain fifteen days longer in the state of pupæ. The males when they pass from the state of pupæ get wings; but till that time they are not distinguishable from the females, except that they are only about half the size. After they acquire wings, they impregnate the female, and die. The female, in going through her different changes, does not change her form, but only casts her skin. After she has been impregnated she lives for about a month, and increases considerably in bulk; then lays her eggs, and dies. According to M. Thierry, there are six generations of these little animals in the year. They might be collected during the whole year, did not the rainy season check their progress, and almost entirely destroy them. According to all the writers on the subject, there are three collections made of them yearly. The first takes place about the middle of December, and the last in the month of May. When they make the first collection, they take away the nests, and pick out the dead females, which had been placed on the nopal the preceding October. The second collection is made when the insects again begin to produce young. The insects are detached from the plant with a knife, the edge and point of which have been blunted, to prevent the nopal from being injured. The insects are received into a vessel as they are separated from the plant, put to death, and dried. The Indians have several ways of killing these insects; which they are anxious to accomplish as soon as possible, because the females may live for some time after they are detached, and produce their young, which might escape and diminish the quantity of cochineal collected. Some natives put the cochineal in a basket, and dip them in boiling water; afterwards they expose them to the sun to dry.

Others put them in a hot oven, or on heated plates of iron. But it appears that the best cochineal is obtained by following the first mode. The different colours imported into Europe depend entirely on the mode of killing the insects. That which has been killed by dipping in boiling water, loses part of the white powder, with which they were covered, and acquires a brownish red colour: this kind is called *renagrida*. That which is killed in an oven retains the white powder, and remains of a gray colour: this is called *jarpeada*. That which is killed by plates of heated iron becomes blackish, and is called *negra*.

The dead females which are taken from the nests which had been put on the nopal, lose more of their weight in drying than the insects which are taken off alive and full of young; the first losing three-fourths, and the last two-thirds in drying. After it has been dried it may be kept for any length of time without losing either weight or colour.

It requires much care and attention to preserve these insects from their numerous enemies. The principal enemies which infest the cochineal are, the larvæ of a species of coccinella, which suck them, and leave nothing but the skin. A caterpillar of about an inch long, and of the thickness of a crow quill, is their most destructive enemy, which would soon destroy the whole race, were they allowed to carry on their depredations without molestation. The larvæ of a species of *ptinus* feeds on them likewise. There is a species of insect which lives on the nopal in great numbers, and does as much injury to the plant as the cochineal insects themselves do; which pinches their body, prevents them from taking nourishment, and causes them to drop from the plant. A small mouse which always prefers the fine cochineal to the sylvester, because the cottony matter with which the sylvester is more abundantly covered entangles its teeth, also preys on them. Many birds, too, are fond of them, and would destroy great numbers of them, were they not driven away by the owners of the plantations.

The sylvester is smaller than the true cochineal; their bodies are covered with a white cottony matter, and edged all round with hairs. About eight days after they are fixed, the cottony matter and the hairs increase in length, and become so closely attached to the plant, that part of them is commonly left adhering after the insect has been removed. Though these insects commonly feed on a prickly species of *cactus*, which grows wild, the Indians frequently rear them on the nopal, because they are collected from it with much more facility than from the uncultivated species: for the most dexterous workman cannot collect more of the insects in one day than will produce two ounces of cochineal when dry; whereas he can collect from the *cactus coccinellifera* as many as will yield three pounds when dry. There is also another advantage obtained from rearing the sylvester on the nopal which they cultivate in their gardens; the insects become almost as large as the true cochineal, and lose more and more of their cottony covering in proportion to the frequency of their reproduction. The sylvester has been lately introduced into the British settlements in India. The following account of its introduction and comparative value has been published by Mr Nicholas Fontana, who resided for many years in that part of the world.

"The introduction of cochineal into Bengal, which our neighbours had endeavoured to naturalize in their West India possessions, deserves particularly to be marked, as being likely, under proper management, to become not only a new æra in the progressive resources of the company, but an accession of opulence to the British empire: an æra the more remarkable, as notwithstanding the attempts of government, the design was not accomplished but through accident, the great parent of discovery, which, with never-ceasing influence, operates in many ways for the good of mankind.

"After a large plantation of the various species of *opuntia* had been reared at Madras, waiting only the arrival of the insect to make it serviceable, which a long correspondence of thirteen years could not obtain, Dr Anderson's solicitations about it had almost been forgotten; yet though his laborious industry and zeal for his country's interest, had no other reward, the introduction of the cochineal insect into India is entirely owing to his publications on the subject, which fortunately fell into the hands of Captain Nelson, who was then stationed at Madras with the 52d regiment. On the captain's return to India in 1795, the fleet in which he sailed, repaired for refreshment to the port of Rio de Janeiro. In his perambulations a little way out of this town, he was attended as usual by the centinel, when he saw a plantation of opuntia with the insect upon it. This circumstance immediately brought to his recollection the ardent wish for the importation of the insect expressed in the letters he had read at Madras; and he conceived the hope of being able to gratify Dr Anderson's desire, by carrying some to India with him.

"A day or two previous to his embarkation, he took another walk to the place where he had seen the opuntia or nopal. He made bold to ask the cultivators for some of the plant, being curious, he said, in matters of natural history. Having collected several other plants, he wished to have this also. The good people being the less suspicious as he was in his regimentals, granted his request. They gave him several plants with insects on them, which he carefully carried aboard. Many of these, during the passage to Bengal, which was remarkably long and tedious for such delicate passengers, died. A few insects only remained alive on the last plant, several of the leaves having withered.

"Captain Nelson, on his arrival in Calcutta, sent the survivors to the botanic garden, where they were distributed on the different species of the opuntia. This well nigh frustrated the whole labour. On the China and Manilla species, they were found to die fast. It fortunately occurred to make trial on the indigenous opuntia of Bengal, which is also abundant in many parts of India. On this the insects thrived amazingly; insomuch, that from these few, in the course of four or five months, a quantity had been collected sufficient for distribution among all who wished to try the rearing of them, and several plants upon which the insects were feeding were sent to Madras.

"The novelty and importance of the object promising so speedy and plentiful a harvest of fortune, engaged a multitude of individuals to undertake the business; and this, no doubt, the more readily, as the cultivation of this field of wealth required but very little capital. Many golden dreams were enjoyed by the new planters. All who had a mind were provided with insects; and undertook plantations of opuntia.

"The anxiety and impatience natural to all, who, indulging in ardent expectations, undertake new enterprises, induced some of the planters of nopal to put the insect upon it when the plant had just emerged from the ground. Others, through inattention, kept their insects in places too near to where the opuntia was growing young, which in that tender and premature state was devoured by these creatures when hard pressed by hunger. The unskilful mode of drying was likewise adopted; and some of those persons whose opinions led the multitude, declared in the most decided and positive manner, that the cochineal would never answer, as it would not be found worth the trouble and expence attending the cultivation of it. All these considerations damped in a great measure the ardour of the enterprise.

Many

Many abandoned the pursuit, and left the insects to provide for themselves, after the plants destined for their use were destroyed, wherever they could find nourishment. They were seen flying about indiscriminately on various other plants, and thus perishing; while others rooted out the plantations, and employed the ground for other purposes.

"Besides the discouraging circumstances already mentioned, it was urged that the species imported into India was the *grana sylvestris*, and that the first specimens sent home had been of no value. They had grown lumpy and musty for want of being properly dried, or thoroughly divested of the cottony matter with which the insect is covered. But supposing, it was added, that a proper mode of drying and preparing it could be found out, and the cultivation of it brought to the greatest perfection, it would soon overstock the market, as there is a certain quantity only, and that not very great, which is required for Europe. This would soon be supplied, and loss instead of gain would accrue to the planters. This excess, however, it was farther urged, was to be presumed only in the case of the country being able to supply plants sufficient for the food of the insect, which was very doubtful on account of its quick reproduction, as it sends forth a new generation every forty days. These, with other objections of less force, may easily be refuted by any impartial observer acquainted with the nature of the climate and soil of India, even without any kind of knowledge of agriculture. In such a vast extent of territory as that of the East India Company, and lying under such a variety of climates, it is not surely impossible, or very difficult to find a climate and soil fitted for the naturalization and rearing the cochineal insect, and where the plants will grow to proper size for affording it food; in the same manner as in the districts of Mexico, where the people who take most pains, have them growing to such a height as to require ladders to gather the insects. Such a state of the plant would check the too rapid reproduction of the insect, and at the same time improve its quality; for it is a fact, that the sylvester cochineal, when bred upon a full grown nopal, loses part of its tenacity, and grows to double the size of that gathered on gummy plants, and is less covered with the cottony substance.

"The cultivation of cochineal, would in all probability be greatly favoured by the vicinity of a hilly country; such as the Boglepore, Rajahmahl, and Purneah. It can be ascertained by good authority, that there are already in the Chittagong district, plantations of large opuntias, which have been growing for two years past. Whenever the insect shall be placed on these plants, we shall see cochineal of a very good quality. The nature and habits of the natives seem entirely calculated for the employment of gathering the insect; work that may be done by old men, women or boys.

"As to the drying the insects, there is no country where the sun has such influence as in Bengal. The method of drying in the sun, after scalding the insect in hot water, is that practised in Mexico and Brazil: the insects collected in wooden bowls are thereby spread from them on a hot dish of earthen ware, and placed alive on a charcoal fire, where they are slowly roasted, till the downy covering disappears, and the aqueous juices of the animal are wholly evaporated. During this operation, the insects are constantly stirred about with a tin ladle, and sometimes water is sprinkled upon them, to prevent absolute torrefaction, which would destroy the colour; but a little practice will teach them to remove them from the fire, though surely its barbarity ought to prevent its adoption.

"By an estimate, made on a large scale, of the necessary expence that would attend the cultivation of one hundred biggahs of opuntia, it appeared, that after making every possible allowance for ground rent, ryots gathering, and an European overseer, and interest on disbursement at twelve per cent. the quantity produced of *grana sylvestris*, during nine months of the year, reckoning it at four sicca rupees per seer of thirty-two ounces, would more than treble the capital employed. But if this calculation be just in the vicinity of Calcutta, and there is no reason to suppose it otherwise, where labour and ground rent is dear; how much would the whole expence of cultivation and preparation be, if transferred to a greater distance, and to the other provinces!

"When the insect has been well dried, it should be packed immediately, as it might otherwise be affected by the damp air of Bengal. In this business the method used in Mexico should be followed; which is to put it first into a linen bag, covered with a compact net; and then over the whole an ox's hide sewed so closely as to render it impervious to water.

"For some of the cochineal which I wanted for the purpose of making experiments, collected at Eutally, two miles from Calcutta, I paid in 1796 sixteen rupees per seer; for the same quantity raised by another planter the following year eight rupees; and in 1797, I might have bought a great quantity, part of which came one hundred miles from Calcutta, at five rupees per seer.

"The improveability of the *grana sylvestris*, by attention, will be ascertained more clearly by the following fact, than by a thousand arguments. Some merchants, at my recommendation, bought about two hundred pounds of cochineal made at Rassapuglah, five miles from Calcutta, at five rupees per seer. The same house paid for seven mauns, or 280 seers, to Mr Stephens at Keerpay, seven rupees per seer; and I can say, that it was the best of the sort that had yet been seen in the town, both for its size, cleaning, and drying.

"Let us now suppose for a moment, such cochineal as that made at Keerpay, to be the best that can ever be obtained at Bengal, and that the above may be within a rupee, more or less the average price. The *grana fina* that is brought to Bengal by way of Manilla, sells, when abundant, at sixteen rupees per seer, but oftener at nineteen and twenty. The Bengal *sylvestris* contains only from $\frac{4}{16}$ to $\frac{10}{16}$ parts of the colouring matter contained in the other; but say only one half, so that the manufacturer will be obliged to use two seers instead of one, the quality of the colour to be the same; even at this rate, the silk manufactories at Bengal might be supplied with it, with a yearly saving. After supplying this market, if the quantity be increased, there will be a demand for it in the China and English markets, though only of the sylvester kind. Supposing it for ever to remain such, by leaving it to the indolent natives only, even this would be a great acquisition, considering the various ways in which it can be employed by the dyers. Besides, if the prices were immediately to fall, so as not to indemnify the present freight and insurance to the private adventurers, how easy would it be to reduce the insect

sect to a much smaller bulk, by making a lake, and producing carmine no less valuable than the *grana fina*.

"The overstocking of the market, however, with a drug so important, and of such extensive use, is not a thing very likely to happen. The manufacturer, wherever he could get it at a low price, would use it generally, and substitute it in the room of other materials for reds, such as madder, red-wood, and others, used for woollens, and silks; besides the great varieties of shades from scarlet and crimson, down to all those various tints to be obtained by modifications of re-agents from cochineal, with a brilliancy, and stability, that would soon repay the small additional expence that might be incurred by the substitution.

"It is a thing greatly to be wished, by every citizen and patriot, that the Bengal cochineal may soon be brought to such a degree of perfection, and produced in such plenty, as may admit of a reduction of its price sufficient to induce the calico printers in Europe to use it more commonly than hitherto, in the dyeing of cotton; which would open a much wider field for its consumption. As to the shyness of cotton to the admission of this animal colour, it is not an obstacle that ought by any means to be considered as insurmountable in the present state of chemistry, advancing so rapidly to farther improvements, and particularly applying with vast success many of its operations to the art of dyeing. The few unsuccessful attempts made by manufacturers and chemists to fix this colour on cotton, have been defeated more by the dearness of the drug, than by any impracticability of the design. This exhausted at once the purse and patience, both of the artist and chemist; and precluded that continuation, repetition, and diversification of experiment, which is necessary to the completion of new inventions.

"It was upon cotton that the Spaniards first saw the cochineal used in Mexico; but for want of preparation it produced but a dull crimson. When some of the dried Bengal insect was shewed to the vakeel of the rajah of Napaul, residing as minister to our government at Calcutta, he soon knew it, and declared that it was always used in dyeing his country robes and turbans. The opportunity arising from the management of a chintz manufactory, induced me to make some trials of cochineal in cotton cloth and thread. By these it was ascertained, that the quantity of colouring matter contained in the Bengal cochineal of 1796, compared with the *grana fina*, was from nine or eleven to sixteen. I then repeated, as far as the chemical reagents to be obtained in India would permit, various experiments of the kind mentioned by Dr Bancroft, in his first volume of the Philosophy of Fast Colours; and nearly with the same success, in variety of shades, and degrees of permanency. From these experiments, there resulted two considerable benefits to that manufactory: the first was, that I was induced to make an addition of a certain quantity of powdered cochineal to the morinda root, for the fine cloths and muslins that were to undergo the boiling process in the vat. The second, I was led to mix with the basis for printing red (alum), a decoction of cochineal, instead of the *turmeric* or red wood, formerly used by printers in tracing their designs. This last substitute was only boiled in simple morinda, and the other with the addition of cochineal. By this process, deep and brilliant reds were obtained, such as had not hitherto been seen in Bengal."

The cultivation, therefore, of the cochineal insect, is an object worthy of all the countenance and care of government. The attempts towards its naturalization ought not by any means to be abandoned; but continued with all persevering industry, and unwearied attention to every circumstance that may promote so important a branch of commerce. For this article we send annually immense sums to the Spaniards. Not only might this expence be saved to Britain; but, in due time, the rest of the world might be supplied from the Bengal produce of this valuable commodity. It is in the recollection of most people conversant with India affairs, how the first specimens of indigo sent home from Bengal were depreciated and rejected. Hence the cultivation of it was obstructed for some years. But when it began to be attended to in 1780 and 1782, by people who were acquainted with the best modes of manufacturing it, it was improved with such rapidity that in 1790, some of the Bengal indigo was judged to be equal to the Guatimala, and bore the same price. The quantity sent home in the years 1795 and 1796, was far beyond what had ever been imported into the port of London from all the world, and more than is required for the annual consumption of Europe. The use of indigo in the dye-house is very circumscribed, and confined chiefly to the colours of blue and green. It gives also a few finer blacks, with lilac grounds; but it cannot, like cochineal, be applied to the various principal colours, as crimson, scarlet, purple, and all the intermediate shades.

Body red; antennæ branched; tail furnished with *ficus*. two bristles. 23. A native of India; on the *ficus religiosa* and *indica*. This is the insect which produces the gum lac.

In the months of November and December, they first appear, and traverse the branches of the trees on which they are produced for some time, and then fix themselves on the extremities of the young branches. By the middle of January, they are all fixed in their proper situations, when they appear as plump as before, but shew no other signs of life. The legs, antennæ, and setæ, are no longer to be seen. Around their edges they are environed with a subpellucid liquid which seems to glue them to the branch; it is the gradual accumulation of this liquid which forms a complete cell for each insect, and is what is called *gum lacca*. About the middle of March the cells are completely formed, and the insect is in appearance an oval smooth red bag without life, about the size of a small cochineal insect, emarginated at the obtuse end, full of a beautiful red liquid. In October and November, we fine about twenty or thirty oval eggs, or rather larvæ, within the red fluid of the mother. When this fluid is all expended, the young insects pierce a hole through the back of their mother, and walk off one by one, leaving their exuviæ behind, which is that white membranous substance found in the empty cells of the stick lac.

These insects feed on some other trees besides the *ficus religiosa* and *indica* of Linnæus, viz. on the *rhamnus jujuba* (Linn.) and on the *plaso*, (Hort. Malabar.). The insects generally fix themselves so close together, and in such numbers, that scarcely one in six can complete her cell; the others die, and are eaten by various insects. The

The extreme branches appear as if they were covered with a red dust, and their sap is so much exhausted that they wither and produce no fruit; the leaves drop off or turn to a dirty black colour. These insects are transported from one tree to another by birds. It is worth observing that these fig-trees exsude, when wounded, a milky juice, which instantly coagulates into a viscid ropy substance, and when dried resembles the gum lac.

A red gum is procured by incision from the *plaso*, so similar to the gum lacca, that it may readily be taken for the same substance. Hence, it is probable, these animals have but little trouble in preparing the sap of the trees for the construction of their cells.

The gum *lacca* is rarely seen on the *rhamnus jujuba*, and is inferior to what is found upon the other trees. This gum, in Bengal, is principally found on the uncultivated mountains on both sides the Ganges, where it is produced in such abundance, that the markets might be readily supplied, were the consumpt ten times greater than it is.

The only trouble in collecting it is in breaking down the branches. The best lac is of a deep red colour: if it be pale and pierced at top, the value diminishes, because, the insects having escaped, it cannot be useful as a dye, though it may answer better as a varnish.

These insects and their cells have been variously denominated: viz. *gum lacca*, *lack*, *lactra*, and in Bengal *lascha*. By the English, lac is divided into four kinds; viz. *stick lac*, *lump lac*, *seed lac*, and *shell lac*; for which, and their varieties, see the article Lac.

The following account of the lac insect by Dr William Roxburgh, is published in the Asiatic Researches, vol. ii.

Some pieces of very fresh looking lac, adhering to small branches of the *mimosa cinerea*, were brought me from the mountains on the 20th of last month. I kept them carefully; and to day, the 4th December, fourteen days from the time they came from the hills, myriads of exceedingly minute animals were observed creeping about the lac and branches it adhered to, and more still issuing from small holes over the surface of the cells: other small and perforated excrescences were observed with a glass, amongst the perforations; from which the minute insects issued, regularly two to each hole, and crowned with some very fine white hairs. When the hairs were rubbed off, two white spots appeared. The animals, when single, ran about pretty briskly; but in general they were so numerous, as to be crowded over one another. The body is oblong, tapering most towards the tail, below plain, above convex, with a double or flat margin; laterally on the back part of the thorax are two small tubercles, which may be the eyes; the body behind the thorax is crossed with 12 rings; legs six; feelers (antennæ) half the length of the body, jointed, hairy, each ending in two hairs as long as the antennæ; rump, a white point between two terminal hairs, which are as long as the body of the animal; the mouth I could not see.

"On opening the cells, the substance that they were formed of cannot be better described, with respect to appearance, than by saying it is like the transparent amber that beads are made of: the external covering of the cells may be about half a line thick, is remarkably strong, and able to resist injuries: the partitions are much thinner; the cells are in general irregular squares, pentagons, and hexagons, about an eighth of an inch in diameter, and a fourth deep; they have no communication with each other; all those I opened during the time the animals were issuing, contained in one half a small bag filled with a thick red jelly-like liquor, replete with what I take to be eggs; these bags, or utriculi, adhere to the bottom of the cells, and have each two necks, which pass through perforations in the external coat of the cells, forming the fore-mentioned excrescences, and ending in some very fine hairs. The other half of the cells have a distinct opening, and contain a white substance, like some few filaments of cotton rolled together, and numbers of the insects themselves ready to make their exit. Several of the same insects I observed to have drawn up their legs, and to lie flat; they did not move on being touched, nor did they show any signs of life, with the greatest irritation.

"December 5th. The same minute hexapedes continue issuing from their cells in numbers; they are more lively, of a deepened red colour, and fewer of the motionless sort. To day I saw the mouth; it is a flattened point, about the middle of the breast, which the little animal projects on being compressed.

"December 6th. The male insects I have found today. A few of them are constantly running amongst the females most actively; as yet they are scarce more, I imagine, than one to 5000 females, but twice their size. The head is obtuse; eyes black, very large; antennæ clavated, feathered, about two-thirds the length of the body; below the middle an articulation, such as those in the legs; colour between the eyes, a beautiful shining green; neck very short; body oval, brown; abdomen oblong, the length of the body and head; legs six; wings membranaceous, four, longer than the body, fixed to the sides of the thorax, narrow at their insertions, growing broader for two-thirds of their length, then rounded; the anterior pair is twice the size of the posterior; a strong fibre runs along their anterior margins; they lie flat, like wings of a common fly, when it walks or rests; no hairs from the rump; it springs most actively to a considerable distance on being touched; mouth in the under part of the head; maxillæ transverse.

"To-day the female insects continue issuing in great numbers, and move about as on the fourth.

"December 7th. The small red insects still more numerous, and move about as before; winged insects, still very few, continue active. There have been fresh leaves and bits of the branches of both *mimosa cinerea* and *corinda* put into the wide-mouthed bottle with them: they walk over them indifferently, without showing any preference, nor inclination to work nor copulate.

"I opened a cell whence I thought the winged flies had come, and found several, eight or ten, more in it, struggling to shake off their encumbrances; they were in one of these utriculi mentioned on the 4th, which ends in two mouths, shut up with fine white hairs, but one of them was open for the exit of the flies; the other would no doubt have opened in due time; this utriculus I found now perfectly dry, and divided into cells by exceeding thin partitions. I imagine, before any of the flies made their escape, it might have contained about twenty. In those minute cells with the living flies, or whence they had made their escape, were small, dry, dark-coloured, compressed grains, which may be the dried excrements of the flies.

*ilicis.* Shining brown, covered with white down. 6. This insect is commonly called *kermes grains*, and inhabits the *quercus coccifera* of the southern parts of Europe. Mr Hellot of the French Academy of Sciences, in his Art of Dyeing, chapter 12. says it is found in the woods of Vauvert, Vendeman, and Narbonne; but more abundantly in Spain, towards Alicant and Valencia; but also in Murcia, Jaen, Cordova, Seville, Estremadura, la Mancha, Serranias de Cuença, and other places. In Xicona, and Tierra de Relluc, there is a district called *de la Grana*, where the people of Valencia first began to gather it, whose example was followed all over Spain. It has some years produced 5000l. to the inhabitants of Xicona. Both the ancients and moderns seem to have had very confused notions concerning the origin and nature of the kermes; some considering it as a fruit: this opinion was entertained by Pliny, and by most of the ancient naturalists; others taking it for an excrescence formed by the punctures of a particular fly, like the common gall observed upon the oak. Tournefort was of this number. Count Marsigli, and Dr Nisoli a physician of Montpelier, made observations and experiments, with a view of discovering its nature, but did not perfectly succeed. Two other physicians at Aix in Provence, Dr Emeric and Dr Garidel, applied themselves about the same time with greater success; they discovered the kermes to be nothing else than the body of an insect. About the beginning of March they are perceived on the branches of the *quercus coccifera*, very small; they soon fix themselves and become immoveable, after which they increase rapidly in size. In April they arrive at their full growth, and are nearly about the size of a pea. About the end of May, sooner or later, according to the warmth of the climate, the husk appears replete with small eggs, less than poppy seed. These are properly ranged under the belly of the insect, progressively placed in the nest of down that covers their bodies. After this it soon dies, though it still adheres to its position, rendering a further service to its progeny, and shielding them from the inclemency of the weather, or the hostile attacks of an enemy. In a good season they multiply exceedingly, producing from 1800 to 2000 eggs. In Languedoc and Provence the poor are employed to gather the kermes; the women letting their nails grow for that purpose, in order to pick them off with greater facility.

The custom of lopping off the boughs is very injudicious, as by this means they destroy the next year's harvest. Some women will gather two or three pounds a-day; the great point being to know the places where they are most likely to be found in any quantity, and to gather them early with the morning dew, as the leaves are more pliable and tender at that time, than after they have been parched by the rays of the sun: strong dews will occasionally make them fall from the trees sooner than usual; when the proper season passes, they fall off themselves, and become food for birds, particularly doves. Sometimes there is a second collection; but the insects are commonly smaller, and do not afford so much colouring matter. The insects which are produced in the spring, are generally found adhering to the bark; those of the second crop are commonly attached to the leaves.

Those who buy up the kermes for exportation, spread it on linen, taking care to sprinkle it with vinegar, to kill the insects, which causes a red dust to separate from them; in Spain, this is carefully collected, and kept apart by itself. After it has been dried, they pass it through a searce and put it up into bags. In the middle of each, its proportion of red dust is put into a leather bag, which likewise belongs to the buyer. The people of Hinojos, Bonares, Villalba, and of some other parts in Spain, dry it on mats in the sun, stirring it about, and separating the red dust, which is the finest part; which they sprinkle with vinegar, and call *pastil.* The kermes is much in request on the coast of Barbary, particularly that which comes from Spain. The people of Tunis mix it with what is brought from Tetuan, for dyeing those scarlet caps so much used in the Levant.

43 species of this genus have been described in the last edition of the System of Nature.

### 68. Thrips.

Snout concealed within the mouth. Antennæ filiform, of the same length with the thorax. Body linear. Abdomen capable of being bent upwards. Wings four, straight, incumbent, narrower than the body, and nearly forming a cross.

The insects of this genus leap about very actively on flowers; their feet are vesicular; the larvæ are equally active with the perfect insect; commonly red.

The elytra yellowish; body black. 2. A native of Europe; on compound flowers. It shuts up the flowers of the *lotus corniculatus*, and causes them to swell out; it is very destructive to wheat and rye, frequently rendering the ears quite empty. **physapus*

Eleven species of this genus have been described in the last edition of the System of Nature.

## III. LEPIDOPTERA.

Wings four, covered with small scales laid over one another, like tiles on the roof of a house. The mouth furnished with a spiral tongue. Body hairy.

### 69. Papilio, *the Butterfly.*

Antennæ thicker towards the points. Most frequently they are both elevated and furnished with a knob at the extremity. Their wings, when at rest, are for the most part erect. They fly about in the day-time.

The butterfly feeds on the nectarious juice of flowers, or on the saccharine juice which exudes from the leaves of vegetables. Their larvæ are active, and run about a good deal. They are furnished with tentacula and 16 feet; some are naked, others covered with prickles, and feed on the leaves of plants. The pupa is naked, and remains torpid for a longer or shorter period; frequently adhering to different substances, by means of threads attached to its middle or head. The perfect insect is furnished with two feelers, but wants jaws, and has four or six feet. Their names are frequently taken from the plants on which they feed.

These butterflies which belong to the family of *knights* are, for the most part, furnished with filiform antennæ, and with a tail or long appendix to the wings; the larvæ are commonly variegated, and but few of them are natives of Europe.

Linnæus has arranged the genus of Butterfly into six divisions, and these again into many subdivisions.

| | |
|---|---|
| 1. Equites. Alis primoribus ab angulo posteriore ad apicem longioribus quam ad basin; his sæpe antennæ filiformes. | 1. Knights. Those which have their upper wings longer from the posterior angle to the tip, than to the base, and have their antennæ for the most part filiform. |
| A. *Troes.* Sæpius nigri, maculis ad pectus sanguineis. | A. *Trojans.* Those equites that are generally black, and marked on the breast with spots of a blood-red colour. |
| B. *Achivi.* Pectora non cruenta, ocello ad angulam ani. | B. *Greeks.* Such as are not marked on the breast with red spots; but have an ocellus at the angle of the wing near the anus. |
| *a.* Alis absque fasciis. | *a.* Wings without bands. |
| *b.* Alis fasciatis. | *b.* Wings marked with bands. |
| 2. Heliconii. Alis angustis integerrimis, sæpe denudatis; primoribus oblongis, posterioribus brevissimis. | 2. Heliconii. Those which have narrow and perfectly entire wings, frequently bare, the upper ones oblong, the under very short. |
| 3. Parnassii. Alis integerrimis rotundatis. | 3. Parnassii. Those with wings perfectly entire, the upper pair being round. |
| 4. Danaii. Alis integerrimis. | 4. Danaii. Wings perfectly entire. |
| A. *Candidi.* Alis albis. | A. *Candidi.* Wings white. |
| B. *Festivi.* Alis variegatis. | B. *Festivi.* Wings variegated. |
| 5. Nymphales. Alis denticulatis. | 5. Nymphales. Those with wings notched. |
| A. *Gemmati.* Alis ocellatis. | A. *Gemmati.* Wings adorned with several ocelli. |
| *a.* In alis omnibus. | *a.* on all the wings. |
| *b.* primoribus. | *b.* on the upper wings. |
| *c.* posterioribus. | *c.* on the under wings. |
| B. *Phalerati.* Alis absque ocellis. | B. *Phalerati.* Wings without ocelli. |
| 6. Plebeii. Parvi, larva sæpius contracta. | 6. Plebeii. Such as are small and have contracted larvæ. |
| A. *Rurales.* Alis maculis obscurioribus. | A. *Rurales.* Such as have their wings marked with obscure spots. |
| B. *Urbicolæ.* Alis maculis sæpius pellucidis. | B. *Urbicolæ.* Those with transparent spots on their wings. |

### 1. *Equites.*

### A. *Troes.*

### † *Wings furnished with a tail.*

*hector.* Wings of the same colour, both on their upper and under surfaces, black; the upper ones marked with a white band, the under with red spots. A native of India; on the *aristolochia.* The white band on the upper wings is composed of eight white half-divided spots. The scarlet spots on the under wings are round and form a double arch.

*ascanius.* Wings black, both above and below marked with a white band, common to both wings; that on the lower clouded with red. A native of the Brasils. It resembles the *tinctoria;* body black, breast marked with blood-coloured spots.

*antenor.* Wings of the same colour, both on their upper and under surfaces, black spotted with white; the under ones marked with circular red spots along their edges. A native of India. Head red; antennæ and thorax black; abdomen white, with red bands; wings marked with numerous white spots, the lower part greenish in the middle, with a red circular spot at the angle of the tail.

*glaucus.* Wings nearly of the same colour on both upper and under surfaces, clouded; the upper wings marked with a yellow spot, the under with a tawney one near the tail. A native of America. The under surface of the lower wings are marked with red and yellow spots.

*palinurus.* Wings black, sprinkled with green and gold dots, and marked with a bluish green band. A native of Tranquebar. Body covered with green and gold specks. Wings black, speckled with white on their under surface. The upper ones ash-coloured at the tip, the under marked with tawney spots along their edges.

*philenor.* Wings black, the under ones of a shining green, the under surface marked with seven red spots somewhat resembling eyes. A native of America. Body black; abdomen speckled with white; margin of the upper wings variegated with white and black; under ones with a few faint white specks; the margin variegated with white and black, marked with a white dot at the base on the under surface; the tip greenish, with seven round tawney dots surrounded with a black ring, and marked with a small white lateral dot.

*asius.* Wings black, with a white band; the under surface of the lower wings marked at the base and at the tip with red. A native of America. Thorax marked with an ash-coloured lateral line; breast with an ash-coloured dot on each side; abdomen with an ash-coloured lateral line beneath; upper wings with both surfaces alike; under ones black above, with three scarlet circular spots at the angle of the tail, and five white ones at the margin, brown beneath, marked with red spots at the base, a red line at the inner margin, and three circular spots at the angle of the tail, with four white circular spots on the outer margin.

### †† *Wings notched.*

*priamus.* Wings notched and silky, the upper ones green on their superior surface, marked with a black spot, the under with six black spots. A native of Amboyna.

This

This is the most remarkable species of this genus, both for its size and beauty. Head and legs black; abdomen bright yellow, and the sides of the thorax variegated with scarlet lines.

*anchises.* Wings of the same colour on both their upper and under surfaces, black; the under wings marked with seven oval scarlet spots. A native of America; on the orange tree. The larva is prickly, brown marked with white circular stripes, and furnished with tentacula. They are gregarious. Pupa brown, marked with four projections on its anterior part.

### B. *Achivi.*

#### † *Wings furnished with a double tail.*

*pyrrhus.* Wings brown, each of them marked with a white band, the band on the upper wings as it were halved. A native of South America and India.

*eteocles.* Wings of a dusky blue, marked on both sides with a white band, the edges of the under one green. A native of Africa.

#### †† *Wings furnished with two notched tails.*

*tiridates.* Wings black on their upper surface, spotted with blue, and marked with a dotted white edge. A native of Amboyna.

*pollux.* Wings brown; marked with a yellow band on their upper surface, and on their under surface with a white band and white spots. A native of Africa.

#### ††† *Wings furnished with two very slight tails.*

*-socles.* Wings striped with white and yellow, with a white band in the middle; the lower wings marked on their under surfaces with a strip of dots resembling little eyes. A native of Siam. Of a middle size, and very tender.

#### †††† *Wings notched and furnished with a tail.*

*polycaon.* Wings black, marked with a yellow band; the under surface of the lower wings marked with tawney blue and yellow circular spots. A native of Surinam; feeds on some species of the *althæa.*

*xiphares.* Wings black, the upper spotted with white, the under ones marked with a yellow band. A native of Africa.

#### ††††† *Wings furnished with a tail.*

*ulysses.* Wings black, with a blue radiant centre; the under surface of the lower ones adorned with seven ocelli. A native of Asia.

*agamemnon.* Wings black, spotted with green; the under surface of the lower ones adorned with an ocellus, and with red spots. A native of Asia.

* *machaon* Wings of the same colour in both surfaces, yellow with a brown edge, marked with yellow circular spots, and with a tawney one at the angle of the tail. A native of Europe; on umbelliferous plants, and on rue. The larvæ are seldom found in numbers together, are smooth and marked with annular strips of green and blacked, dotted with red; their tentacula are short and yellow. They emit a very disagreeable smell, by which they keep off the *ichneumon.* Their pupa is black and yellow. The under wings are adorned with an eye of a yellowish-red colour, encircled with blue, which is situated at the edge nearest the extremity of the abdomen. This is the largest and one of the most beautiful butterflies which Britain produces. It changes into the pupa in July, assumes the winged state in August, and frequents meadows. Sometimes it appears in May.

* *podalirius.* Wings nearly of the same colour both on their upper and under surfaces, marked with brown bands set in pairs; the under surface of the lower wings marked with a blood-coloured line. A native of Europe and the northern parts of Asia and Africa. It feeds on different species of the *brassica:* Larva solitary, yellowish dotted with brown; head pale green; pupa yellowish dotted with brown, marked with two slight projections towards the anterior extremity.

*alcibiades.* Wings white, the upper ones marked with black bands along the edges, the under ones marked on their superior surface with red near the tip. A native of Tranquebar. Head tawney, with a broad black line in the middle; thorax downy and ash-coloured, marked with two tawney spots; abdomen whitish, marked on the sides with a line of black blotches; upper wings greenish at the base; under ones marked with a black spot near the tail, and marginal circular spots; tail long, black tipped with white, streaked with black beneath.

#### †††††† *Wings terminating in a slight projection faintly resembling a tail.*

*phidippus.* Wings brown, marked on their under surfaces with white bands, adorned with two eyes, and with a double eye at the tail. A native of India. The female much larger than the male.

*aurelius.* Wings brown, black at the tip, spotted with white; the under wings on their lower surfaces adorned with two eyes. A native of India.

*jason.* Wings, upper surfaces brown; under wings with a band marked with six green blotches. A native of South America and India.

*philoctetes.* Wings brown: the under wings marked with two blue ocelli, with black pupils, and three white dots. A native of South America and India. The female has a tuft of long diverging hairs at the end of the upper wings.

*nereus.* Wings black, marked with a plain green band; the under surfaces of the wings are blackish. A native of South America and India.

#### ††††††† *Wings notched.*

*menelaus.* Upper surfaces of the wings of a bright blue, the under spotted with brown. A native of South America. The larva prickly and yellow, marked with rose-coloured strips; head brown and feet red. Pupa pale, and has a cylindrical inflected tail.

*nestor.* Upper surfaces of the wings brown, spotted with white, and blue in the centre; their under surfaces adorned with three or four eyes. A native of America.

*telemachus* Wings brown; the upper surfaces of both have a large radiated disk, the under surface of each marked with six eyes. A native of South America.

*perseus.* Wings pale blue, and black at the tips, spotted with red. A native of Surinam.

*achilles.* Upper surfaces of the wings black marked with a blue band; the under ones are brown, adorned with three or five eyes. A native of America.

Under

*argyrios.* Under surfaces of all the wings of blue and silver; the upper wings black on their superior surfaces, marked with two silver bands, and with two brown ones on the under surface; the under wings marked on their superior surface with a broad silver band, and with seven spots of blue and silver. 378. A native of Asia.

### † † † † † † † † *Wings faintly notched.*

*domeneus.* Wings nearly crenated, and of a dusky blue colour; the under surfaces clouded, and adorned with two ocelli. 45. A native of South America. The larva is reddish, with feathery protuberances set round it in a ring. The pupa is dentated, and furnished with two crooked horns at the head.

### 2. *Heliconii.*

*erpsi- hore.* Upper wings yellow; under wings of a deeper yellow than the upper, sprinkled with black spots. 55. A native of Asia.

*alliope.* Wings yellow; the upper marked with three black streaks, and the under with three black bands. 56. A native of South America and India. Tips of the upper wings speckled with white.

*lymnia.* Wings pale yellow; the upper ones marked with a bright yellow band, the under with three black bands. 58. A native of South America. Larvæ yellowish and prickly.

*olæ.* Wings tawney, dotted with black, and the under ones have a black edge dotted with white. 359. A native of India; on the violet and borrage.

*cini.* Wings brown; the upper wings marked on both sides with two white bands. 63. A native of America; on the *ricinus palma christi;* the base of the under wing in the male marked with purple, in the female with blue; the larvæ green, covered with white hairs.

### 3. *Parnassii.*

*ollo.* Wings white, spotted with black; the under wings are red at the base, and adorned with four ocelli on their upper, and six on their under surfaces. 50. A native of Europe, and feeds on the *sedum telephium*, and the *saxifraga cotyledon;* flies about slowly; the larva solitary, silky, black, and furnished with two tentacula at the back part of its head; all its segments are marked on each side with two red dots. The pupa covered with a slight follicle; oval, bluish, and marked on each side with red dots on the anterior part.

*emo- ie.* Wings white, with black veins; the upper ones marked with two black spots near their edges. 51. A native of Europe.

*atægi.* Wings white, with black veins. 72. A native of Europe; on fruit trees. It is very destructive in gardens and orchards, and emits a fluid of a reddish colour, which has frequently given rise to the reports of showers of blood which are said to have fallen in different places. Larva gregarious; hairy and yellow, green beneath; head black; body marked with three black lines; pupa greenish, with black spots and dots.

*oma-* Wings of the same colour, both on their upper and under surfaces; the upper ones dusky and naked, the under yellow. 382. A native of New Holland. Head black; feelers yellow; thorax black, with a yellow dot on each side; breast spotted with yellow; posterior margin of the lower wings black, marked with seven yellowish dots.

### 4. *Danai.*

### A. *Candidi.*

* *brassicæ* Wings black at the tips, marked with two black spots. 75. A native of Europe; on some species of *brassica.* The upper wings in the male are without black spots, and the same happens in the two following species. The larva solitary, dotted with black, and marked with three sulphur-coloured lines; the tail black; pupa pale green, marked with three yellow lines, and three of its segments globular; eggs set in clusters.

* *rapæ.* Smaller than the preceding species; wings white, upper ones tipt with brown; the female has three brown spots on the upper, and one on the lower pair. 76. A native of Europe; on the turnip and other species of *brassica;* also on the *tropæolum.* Larva green; marked with a bright yellow line on the back, and bright yellow on the sides; pupa greenish, marked with three sulphur-coloured lines.

* *napæ.* Wings marked on their under surfaces with broad greenish veins. 77. A native of Europe; on several species of *brassica.*

* *sinapis.* Wings roundish; of a dusky colour at the tips. 79. A native of Europe; on the mustard.

*discors.* Wings white above; the upper ones on their superior surface, black at the edge and tip, which is marked with four white dots; inferior surfaces black, marked at the tips with four yellow spots and a yellow base; the inferior surface of the under wings scarlet, marked with black veins. 881.

* *daplidicæ.* Wings roundish, brown at the edges; their under surfaces of a grayish yellow spotted with white. 81. A native of Europe; on different kinds of *reseda* and *brassica;* larva covered with bluish hairs, marked with black spots and yellow streaks.

* *cardamines.* Wings round; the centre of the upper ones tawney; the inferior surface of the under ones clouded with green. 85. A native of Europe; on the *cardamine*, *brassica*, and *thlaspis.* Larva solitary; greenish above and whitish beneath. Pupa green, marked with a white line on each side; thorax conical, ascending.

*palæno.* Wings yellow, with black tips, and a brown margin; the inferior surface of the under ones marked with a silver dot. 99. A native of Europe; on the *coronilla;* wings sometimes whitish. Larva somewhat hairy; green marked with yellow lines and black dots.

* *rhamni.* Wings angular and yellow; each marked with a rusty-coloured spot. 106. A native of Europe; on the buckthorn. Commonly flies about in August, though frequently it lies dormant all winter, and appears early in the spring. The male is very often of a sulphur colour; the female white. Larva smooth; and green with a dark line on the back. Pupa in the anterior part turgid, and drawn to a point.

### B. *Festivi.*

*cassiæ.* Wings almost entire, brown, with a rusty-coloured band divided at the point. The lower surface of the under wings ash-coloured, and adorned with two ocelli. The larva green, streaked with red, with two prickles on its head, and tail divided. Pupa reddish, with silvery spots. 120.

* *hyperanthus.* Wings entire, of a dusky colour; the lower surface of the upper ones adorned with three ocelli, and the inferior surface of the under wings with two or three. 127. A native of Europe; is found at the roots of the *poa annua;* the wings sometimes have ocelli on their upper surfaces. Larva solitary, hairy, and of an ash-colour, marked with a black line behind; the tail furnished with two little prominences; pupa brown, spotted with yellow; and has a bunch on its back.

*oedipus.* Wings entire; their upper surfaces black, without spots, the under brown; the upper wings adorned with three ocelli, the under with five. 495. A native of Europe.

* *pamphilus.* Wings perfectly entire and yellow; the upper adorned on their lower surface with one ocellus; the under ones ash-coloured, marked with a band and four faint ocelli. 239. A native of Europe; on the *cynosurus cristatus;* in woody meadows. Larva and pupa green; the former marked with a white line, and has two small prominences at the tail.

*ascanius.* Wings perfectly entire, of a rusty colour; the upper marked on their inferior surfaces with a single ocellus; the under wings with five, the first being separated by a band. 242. A native of Europe; in woody meadows. Larva green, marked on the back with dust-coloured lines, and on the sides with yellow lines; the tail furnished with two little prominences.

*leander.* Wings perfectly entire, brownish; (the upper wings of the female tawney), the lower surface of the under ones ash-coloured and tawney at the tips, adorned with six ocelli. 503. A native of Europe; somewhat resembling the last.

### 5. NYMPHALES.

### A. *Gemmati.*

* *jo.* Wings angularly notched, tawney, spotted with black; each adorned with one ocellus. 131. A native of Europe. Larva gregarious, prickly, black, dotted with white; their hind legs of a rusty colour. Pupa green, dotted with gold; having ten small projections on the fore part of the body; the tail divided.

* *macra.* Wings notched, brown; the upper marked on both surfaces with one ocellus and a half; the under adorned on their superior surfaces with three ocelli, and on their inferior with six. 141. A native of Europe; on pasture ground. Larva greenish, somewhat hairy, having two small prominences at the tail. Pupa greenish, slightly divided, and prickly on the sides.

* *megæra.* Wings notched, yellow, and marked with brown bands; the upper adorned with one ocellus, and the under with five ocelli on the superior, and six on the inferior surface. 142. A native of Europe; on pasture ground. Larva, hairy, green, striped with white; the tail divided.

* *ageria.* Wings notched, brown, spotted with yellow; the upper adorned on both surfaces with one ocellus; the under with four ocelli on their superior surface, and four dots on their inferior. 143.

*phædra.* Wings notched, brown on both their superior and inferior surfaces; the upper wings adorned with violet-coloured ocelli. 150. A native of Europe; feeds chiefly on the *avena elatior.* Larva gray, with two lines of black dots on its back; tail divided. It remains under ground till it has undergone its metamorphosis.

### B. *Phalerati.*

*populi.* Wings notched, of a dusky colour, marked with white dots and bands; their inferior surfaces yellow, marked with white bands and black spots. 162. A native of Europe; on the *populus tremula.* The female marked with a broader white band than the male. Larva prickly, and variegated; head and tail tawney. Pupa yellowish, dotted with black.

* *antio* Wings angular, black, with a whitish circumference. 165. A native both of Europe and America; on the birch and willow. When it appears in spring, the edges on the wings are white, and in the summer they become yellow. Larva gregarious, prickly, black, marked with square rusty-coloured spots on the back. Pupa black, marked with small projections and tawney dots.

* *polych ros.* Wings angular, tawney, spotted with black; the upper ones marked on their superior surface with four black dots. 166. A native of Europe; on fruit trees. Larva gregarious, prickly, blackish, marked with a yellow line on the sides. Pupa of a flesh colour.

* *urtic* Wings angular, tawney, spotted with black; the superior surface of the upper wings marked with three black dots. 167. A native of Europe; very common on the nettle; supposed, though often falsely, to be a forerunner of spring. Larva gregarious, prickly, brown, variegated with green; the head black. Pupa brown, marked with small projections, and golden spots on the neck, and sometimes entirely of a golden colour. This insect, and many others of the same genus, *p. atalanta, polychloros, jo,* &c. soon after their enlargement from the chrysalis state, discharge a few drops of a reddish-coloured fluid; which in places where they have appeared in great numbers, has had the appearance of a shower of blood, and been marked by writers as a prodigy foreboding some extraordinary event.

* *C alb* Wings angular, tawney, spotted with black; the under ones marked on their inferior surface with a white C. 168. A native of Europe; on the nettle, willow, and gooseberry. Larva solitary, prickly, and tawney; the back yellow on the fore part, and white behind. Pupa of a flesh colour, contracted in the middle, dotted with gold.

*hypsip* Wings notched, yellow, variegated with black, and radiated at the tips; the under ones marked with seven red dots. 607. A native of Europe; on the *aristolochia clematis.* Larva yellow, marked with black, furnished with prickles set round in a circle; red, with black tips.

* *atal* Wings black, spotted with white; the upper ones marked with a purple band on both sides, the under with a purple band along the edge. 175. A native of Europe and America; on the nettle. Larva solitary, prickly, green, marked with yellow lines on the sides. Pupa marked with small projections; blackish above, and ash-coloured below, dotted with gold.

*celtis* Wings angularly notched, brown, marked with tawney spots and a single white one; the under wings gray on their inferior surfaces. 639. A native of the south of Europe. Larva green, marked with white lines, spotted with black. Pupa green, marked with white lines.

*leva* Wings slightly notched, variegated, and reticulated, on on their inferior surface; the upper ones marked on their superior surface with some white spots. 201. A native of Europe; on the common thistle. Larva gregarious, prickly, and black; legs red; head marked with two prickles; pupa furnished with small brown projections; thorax yellowish below.

* *adippe.* Wings notched, brown, spotted with black, adorned on the inferior surface with twenty-three silvery spots. 212. A native of Europe; on the *viola odorata* and *tricolor*: the silver spots sometimes, though rarely, change into yellow; larva ash-coloured or brown, covered with many reddish prickles, and marked on the back with a black line, rising out of a white one; pupa brown, marked with silver dots.

### 6. Plebeii.

### A. *Rurales.*

*cupido.* Under wings terminating in six small projections, white on their inferior surface, marked with silver spots. 217. A native of America; on the cotton. Larva white, dotted with black.

* *betulæ.* Wings furnished with a slight tail, the under ones marked with two white streaks, 220. A native of Europe; on the birch and sloe, Wings of the male marked with tawney spots; larva thick, green marked with two obliquely transverse white lines, and two small furrows on the back; pupa smooth, of a rusty colour.

*pruni.* Wings slightly tailed, brown above, with a red spot at the tip of the lower ones; lower wings beneath with a tawney marginal band, dotted with black. 221. A native of Europe; on the plum-tree. Larva thick, green, with a pale lateral line; pupa brown, with a white head.

**quercus.* Wings slightly tailed, bluish, beneath ash-coloured, with a white streak and double tawney dot near the tail. 222. A native of Europe; on the oak. Larva thick above, of a rose colour; with three lines of green dots. Pupa smooth, of a rusty colour; with three lines of brown dots on the back.

*cerasi.* Wings tailed, brown, without spots; the inferior surfaces marked with a white streak, and tawney circular spots; the under wings marked with a black dot. 719. A native of Europe; on the cherry tree.

*sedi.* Wings furnished with a tail, blue, with a white spotted edge, white on their inferior surfaces, marked with black square spots, and a reddish band. 743. A native of Europe; on the *sedum telephium*. Larva green; marked with a red line on the back. Pupa obtuse; green on the anterior, and brown on the posterior part.

*cyllarus.* Wings entire, and blue with a black edge; beneath of a brownish colour, adorned with a streak of dots resembling ocelli; the under wings on their inferior surface blue at the base. 750. A native of Europe; on the flower of the *astragalus* and *mellilot*. Larva pale; marked with a red streak on the back, and on the sides with oblique green lines; head black. Pupa brown, spotted with black.

### B. *Urbicolæ.*

*omma.* Wings perfectly entire, spreading so as to form an obtuse angle, tawney, marked with a small white line and with white dots beneath. 256. A native of Europe; the line wanting in the female. Larva of a shining red; head black, with a white strip on the collar. Pupa long, cylindrical, and brown.

* *linea.* Wings perfectly entire, spreading so as to form an obtuse angle; tawney, with a black margin. 817. A native of Europe; upper wings in the male marked with a small black line on the middle. Larva solitary and green. Pupa green; with a very thin covering.

* *malvæ.* Wings notched and spreading so as to form an obtuse angle; brown, waved with ash colour; the upper wings marked with transparent dots; the under ones with white dots. 267. A native of Europe; on the *malva* and *althæa*. Larva gray; head black; neck marked with four sulphur-coloured dots. It draws together the leaves on which it feeds, by threads which it spins. Pupa hunch-backed and bluish.

876 species of the butterfly have been described in the last edition of the System of Nature published by Gmelin; but a great many more are to be met with in the collections of the curious, which have not yet been described by any author.

### Sphinx, *Hawk-moth.*

Antennæ nearly prismatic, thickest in the middle. Tongue (in most species) projecting. Feelers two, bent back. Wings deflected.

* Legitimæ. *Antennæ scaly, Feelers hairy, Tongue spiral.*

† *Wings angular.*

* *ocellata.* The under wings reddish, adorned with a blue eye. 1. Native of Europe and America; on the *spiræa*, willow, and fruit trees; the thorax marked with a rusty-coloured spot, the tongue very short. The larva solitary, rough, green, and furnished with a tail; marked with obtuse white streaks, and dotted with yellow ocelli. The pupa is brown, with a black back.

*quercus.* Wings angularly notched, yellowish, marked on the under surface with brown bands; the under wings with a red band. 48. Native of Europe, on the oak. The body of the male is ash-coloured; that of the female brown. The larva solitary, furnished with a tail, and green; marked on the sides with oblique white stripes, and with reddish specks. The pupa a light brown, with reddish edges.

* *populi.* Wings dentated, reversed and gray; the under wings of a rusty colour at the base; the upper ones marked with a white dot. 2. Native of Europe; on the poplar and willow. The larva solitary, rough, green, furnished with a tail; it is marked on each side with a white line, and with white oblique cross stripes. The pupa a dusky gray, and of a rusty colour behind.

* *tiliæ.* Wings marked with greenish bands, and clouded with dark green; the superior surface of the upper wings of a yellowish brick-colour. 13. Native of Europe; on the lime-tree. The larva solitary, rough, green, furnished with a tail. It grows smaller towards the head, and is marked on the sides with oblique blood-coloured and yellow stripes. The pupa of a dusky brown.

*œnothera.* Wings irregularly notched, and greenish, marked with a dark green band; the under wings tawney, and black at the tips. 54. Native of Europe: on the *œnothera*. The larva solitary, brown, and without a tail; marked with blood-coloured specks, and with a black ocellus, the pupil of which is white, on the last segment

segment but one of the abdomen. The pupa is uncovered, and light brown.

*nerii.* Wings faintly angular and green; variegated with bands of pale or dark green, and yellow. Native of Europe; on the *nerium.* The larva solitary, dotted with white, and marked on each side of the neck with a blue ocellus. The tail is bent down, and almost jointed. The pupa yellow, marked with a black line and black dots on the back.

† † *Wings entire.*

* *convolvuli.* Wings clouded; the under ones faintly marked with bands; the abdomen marked with belts of red, black, and white. 6. Native of Europe; on the *convolvulus.* It smells of ambergrise. Its eyes are very bright. The larva furnished with a tail; marked on each side with oblique white lines, and dotted with faint *ocelli.* The pupa light brown, furnished with a reflected involuted horn.

* *ligustri.* The under wings reddish, marked with three black bands; the abdomen red, surrounded with black belts. 8. Native of Europe; on the privet, lilac, ash, and elder. The larva green, and furnished with a tail; marked on the sides with oblique streaks of a carnation colour towards the anterior part of the body, and white towards the posterior. The fore part of the body is erect, and it rests with the feet elevated. The pupa brown; with a tail formed of four small projections.

* *atropos.* The under wings yellow, marked with brown bands; the abdomen yellow, marked with black belts. 9. Native of Europe; on the jessamine, potato, and hemp. It is also a native of Africa and Asia; but the variety to be met with there, is double the size of that in Europe. It makes a noise by rubbing its feelers against its tongue. The larva is solitary, and lies concealed under ground all day, coming out in the evening to feed. It is yellow dotted with black, and furnished with a tail which is bent down; it is marked on the sides with cross lines, half blue, half green. The pupa light brown, marked on both sides with black specks.

* *celerio.* Wings gray, marked with white streaks; the under ones with brown ones, and with six red spots. 12. Native of the south of Europe; on the vine. The larva is brown, marked on the sides with two white lines, and with two ocelli on each side of the neck. It is furnished with a tail. The pupa is of a dark brown before, and of a light brown behind.

* *elpenor.* The wings variegated with purple and green; the under wings red, and black at the base. 17. Native of Europe; on the French willow, the balsam, the convolvulus, and the vine. The larva is furnished with a tail, and is spotted with black; it is also adorned with two blue ocelli on each side of the neck. The pupa on the anterior part of the body is of a dusky gray, and brown on the posterior part, marked with dark-coloured specks.

* *euphorbiæ.* Wings gray; the upper ones marked with two green bands; the under with two red bands, with a black streak at the base; the antennæ a pure white. 19. Native of Europe; on the *euphorbia.* The larva is furnished with a tail, and is black, marked with white; marked with a blood-coloured line on the back, and on the sides with yellow dots. The pupa light brown, marked with black specks.

* * Sesiæ. *The wings entire; the Tail furnished with a beard; the Tongue projecting, and terminating abruptly; the Antennæ cylindrical.*

* *stellatarum.* The sides of the abdomen variegated with black and white; the under wings of a rusty colour. 27. Native of Europe; on the madder, and on the rest of these plants which form the natural order called *stellatæ.* The larva is spotted with white, and is furnished with a blue tapering tail, of a rusty colour at the tip. The pupa brown.

* *fuciformis.* The abdomen black, marked with a yellow band; the wings transparent, with a black edge. 28. Native of Europe; on the woodbine, and on the scabious. The larva is green, marked on the sides with a yellow line, and furnished with a reddish horn. The pupa black, marked on the fore part of the body with yellow streaks, and enclosed in a follicle.

* *apiformis.* The wings transparent; the abdomen yellow, with black incisures; the thorax black, marked with two yellow spots. 29. Native of Europe; on flowers. The larva on the trunk of the poplar-tree.

*sesia.* The upper wings brown, the under wings transparent; the abdomen black, marked with three yellow belts. 102. Native of Europe.

* *vespiformis.* The wings transparent, with a black edge and black band; the abdomen black; the second and last segments marked with a yellow margin. 31. Native of Europe.

* *tipuliformis.* The wings transparent, with a black edge and black band; the abdomen black; the incisures are alternately marked with a yellow margin. 32. Native of Europe. Feeds on the pith of the common red currant.

* * * Zygænæ Fabricii, s. Adscitæ. *The Tongue projecting, and setaceous; the Antennæ thicker in the middle.*

* *filipendulæ.* The upper wings blue, marked with six red dots; the under wings red with a blue edge. 34. Native of Europe; on the *spiræa filipendula.* There is a variety of this species (*β. peucedani*) distinguished by a red belt on the abdomen, which feeds on the *peucedanus.* The larva is thick, of a sulphur-colour; marked with four rows of black dots, and furnished with a tail. The pupa is brown, of a sulphur-colour in the middle, and marked with brown specks.

*pythia.* Black; the upper wings green, marked with three oblong blood-coloured spots, placed near one another; the under ones red. 106. Native of Europe. The larva hairy and white; the head marked with two lines of black dots; the fore legs are black; the hind legs yellow.

*fulvia.* Blue; the upper wings green, marked with five red spots; the under ones of a blood colour, and without spots. 107. Native of Europe; on the *lotus corniculatus.*

*phegea.* Greenish-black; the wings marked with transparent dots, six on the upper, and two on the under wings; the abdomen marked with a yellow belt. 35. Native of Europe; on the oak, &c. The larva brown, with reddish head and legs; with tufts of whitish feathers on the back.

*ephite.* Blue; the upper wings marked with six red dots; the under ones with one red dot; the abdomen girt with a red belt. 36. Native of the south of Europe; on the *medicago.*

*medicago*. Sometimes the wings are dotted with white, and the base of the upper wings and the abdomen marked with a yellow belt. The larva hairy and yellowish; the head, legs, and two lines on the body, are of a pale yellow colour.

165 species of this genus have been described in the last edition of the System of Nature.

### 77. PHALÆNA, *Moth*.

Antennæ growing gradually smaller from their base to their tip. Tongue spiral. Jaws none. Shield (in most species) short, and of a horny substance.

Moths fly about at night, have their antennæ composed of many articulations, and commonly pectinated in one or both sexes. They feed chiefly on the nectareous juice of flowers. The larva is active, commonly smooth, and more or less cylindrical, and feeds on the leaves of plants. The pupa remains torpid, is generally cylindrical, sometimes pointed before, sometimes at both ends, and in most instances covered with a follicle.

| PHALÆNÆ dividuntur in, | MOTHS are divided into, |
|---|---|
| 1. BOMBYCES. Larva 16-poda, sæpius pilosa, subcylindrica; pupa apice acuminata; antennis filiformibus, apice acutis; palpis duobus, compressis, reflexis, æqualibus, pilosis, obtusis; lingua spirali, brevi, membranacea, vix exserta, filiformi, obtusa, bifida. | 1. BOMBYCES. Those whose larvæ are generally hairy, nearly cylindrical, and furnished with 16 feet; whose pupa is drawn to a point at the head; and which have their antennæ filiform and sharp at the tip: two feelers, equal, compressed, bent back, hairy and blunt; the tongue spiral, short, membranaceous, slightly projecting, filiform, blunt, and divided at the extremity. |
| a. *Attacos*, alis patulis. | a. *Attacos*, with spreading wings. |
| b. *Bombyces*, alis non patulis. | b. *Bombyces*, with wings not spreading. |
| α. Alis reversis. | α. Wings reversed. |
| β. deflexis. | β. deflected. |
| γ. incumbentibus. | γ. incumbent. |
| δ. convolutis. | δ. convoluted. |
| 2. GEOMETRÆ. Larva octo vel decem-poda, pedibus pectoralibus 6, caudalibus 2, et interdum subcaudalibus 2; hirudinem instar incedans, dum quiescitat erecta, glabra; pupa apice acuminata; antennis filiformibus, articulis obsoletis; palpis duobus æqualibus, reflexis, membranaceis, cylindricis; lingua porrecta, membranacea, setacea, bifida; alis inquiescentibus, ut plurimum patulis, horizontalibus. | 2. GEOMETRÆ. Those whose larvæ are smooth, and have eight or ten feet, six attached to the breast, two to the tail, and sometimes two more near to the tail; moving like a leech, and resting in an erect posture; whose pupæ are pointed at the head; which have filiform antennæ, with faint articulations, two feelers equal, bent back, membranaceous, and cylindrical; the tongue membranaceous, setaceous, divided at the extremity, and projecting; the wings, when at rest, spreading horizontally. |
| *a*. Alis angulatis, antennis ut plurimum pectinatis. | *a*. Wings angular; antennæ, for the most part, pectinate. |
| *b*. integris. | *b*. entire. |
| *c*. rotundatis. | *c*. round. |
| 3. TORTRICES. Alis obtusissimis, ſere retusis, margine exteriore curvo; antennis filiformibus; palpis duobus æqualibus, nudiusculis, basi cylindricis, medio dilatato-ovatis, apice setaceis; lingua porrecta, membranacea, setacea, bifida; larva 16-poda, folia, quæ vorat, et intra quæ se recipit, filis contorquente, et connectente. | 3. TORTRICES. Those which have their wings very blunt, with a curved exterior margin; the antennæ filiform; two feelers equal, nearly smooth, cylindrical at the base, dilated in the middle into an oval form, and setaceous towards the tip; the tongue membranaceous, setaceous, divided at the extremity, and projecting; and whose larvæ are furnished with 16 feet, and twist up the leaves on which they feed, by means of threads they spin, into a retreat for themselves. |
| 4. PYRALIDES. Alis conniventibus, in figuram deltoideam forficatam; antennis filiformibus, articulis obsoletis; palpis duobus æqualibus, reflexis, membranaceis, cylindricis; lingua porrecta, membranacea, setacea, bifida; larva 14—16-poda. | 4. PYRALIDES. Those which have the wings passing over one another, forming a forked figure resembling the Greek δ; the antennæ filiform, with their articulations faintly expressed; two feelers equal, bent back, membranaceous, and cylindrical; the tongue membranaceous, setaceous, divided at the extremity, and projecting; whose larva has from 14 to 16 feet. |
| 5. NOCTUÆ. Larva 16-poda, sæpius glabra, pupa apice acuminata, antennis setaceis, palpis duobus compressis, pilosis, apice cylindricis, nudis; lingua porrecta, cornea, setacea, bifida. | 5. NOCTUÆ. Those whose larvæ are for the most part smooth, and furnished with 16 feet; whose pupæ are pointed at the head, and have their antennæ setaceous; two feelers compressed, hairy, with naked cylindrical tips; the tongue formed of a horny substance, setaceous, divided at the point, and projecting. |

*a*. Alis

| | |
|---|---|
| *a.* Alis patulis. | *a.* Wings spreading. |
| *b.* incumbentibus. | *b.* incumbent. |
| α. Thorace lævi. | α. Thorax smooth. |
| β. cristato. | β. crested, |
| *c.* Alis deflexis. | *c.* Wings deflected. |
| α. Thorace lævi. | α. Thorax smooth. |
| β. cristato. | β. crested. |
| 6. TINEÆ. Larva 16-poda, sæpius intra cucullum latente; pupa anterius acuminata; antennis setaceis; lingua membranacea, setacea, bifida. | 6. TINEÆ. Those whose larvæ have 16 feet, and most commonly lie concealed under a covering; whose pupa is pointed at the head; and have the antennæ setaceous, the tongue membranaceous, setaceous, and divided at the extremity. |
| a. *Tineæ*, palpis quatuor, inæqualibus; larva sæpius rebus culinariis, vestimentis, pellibus, &c. victitante. | a. *Tineæ*, with four unequal feelers; whose larva feed on clothes, hides, furniture, &c. |
| b. *Tineæ*, palpis duobus ad medium bifidis, lacinia interiori acutissima. | b. *Tineæ*, two feelers divided to the middle, the interior division very sharp. |
| 7. PTEROPHORI sive ALUCITÆ. Alis digitatis ad basin usque fissis; antennis setaceis; palpis duobus tenuissimis, cylindricis, filiformibus, reflexis, nudis, apice subulatis; lingua porrecta, membranacea, elongata, setacea, bifida; larva 16-poda, ovata, pilosa; pupa nuda apice, subulata. | 7. PTEROPHORI or ALUCITÆ. Those which have their wings divided to the base into several portions; the antennæ setaceous; two feelers, very slender, cylindrical, filiform, bent back, smooth, and tapering at the tip; the tongue membranaceous, setaceous, divided at the extremity, projecting, and very long; whose larvæ are oval, hairy, and furnished with 16 feet. |
| 8. HAPIALI. Larva 16-poda, subcylindrica, sæpius glabra, radicibus plantarum victitante; pupa folliculata, cylindrica, apice acuminata; antennis brevibus, moniliformibus; palpis duobus æqualibus, obtusis, compressis, membranaceis, reflexis; linguæque bifidæ inter hos rudimento. | 8. HAPIALI. Those whose larvæ are cylindrical, commonly smooth, furnished with 16 feet, and feed on the roots of plants; whose pupa is cylindrical, pointed at the head, and enclosed in a follicle; and have short, moniliform antennæ; two feelers, equal, obtuse, compressed, membranaceous, bent back, and the rudiment of a divided tongue placed between them. |

### * *Antennæ filiform.*

### a. *Feelers compressed.*

### † *Wings spreading.* Attaci.

*atlas.* Wings curved, of the same colour, both on their upper and under surfaces, variegated with yellow, marked with a transparent spot; the upper wings have a small transparent spot joined to the other. 1. Native of Asia and America; on the orange tree. Each articulation of the antennæ has two projections proceeding from them in opposite directions. The larva has hairy tubercles set round it in circles. It spins a large ball of silk, which is unravelled with very great difficulty.

*nictitans.* Wings of a dark carnation colour; the under ones marked with a rusty-coloured eye, the pupil of which is transparent. 469. Native of Africa. Female larger than the male.

* *pavonia.* Wings round, clouded with gray, and faintly marked with bands, adorned with a long semitransparent ocellus. 7. Native of Europe; on heath, bramble, the rose, the elm, the willow, and fruit trees. There are three varieties of this species, *minor*, *media*, and *major*. The antennæ in the male are more distinctly pectinated than in the female. The larva is gregarious, and green, having red and yellow hairy tubercles set round it in circles. The pupa is blackish, with a hole at the top of the follicle, which is elastic, and acting like a valve.

*tau.* Wings of a brick colour, adorned with an eye of a violet colour; with a white spear-shaped pupil. 8. Native of Europe; on the birch. The larva green, marked on the sides with oblique white streaks, the back covered with knots. The pupa light-brown and hairy.

### † † Bombyces. *Wings not spreading.*

### α. *Wings reversed.*

*populifolia.* Wings of a brick colour, notched, and marked with a great many brown spots like crescents. 485. Native of Europe; on the white poplar.

* *quercifolia.* Wings notched, and of a rusty colour; the mouth and shanks of the legs black. 18. Native of Europe; on grass, the sloe, pear tree, apple, and willow. The larva is hairy, of a rusty colour, with a blue neck, and furnished with a slight tail. The pupa brown, marked with red bands.

* *rubi.* Wings fawn-coloured, marked with two whitish streaks on their upper surface. 21. Native of Europe; on the bramble and willow. The larva is hairy, black on the under side, and of a rusty colour, marked with black rings on the upper side. When young it is covered with a veil of black silk. The pupa blackish, marked with three yellow rings, and enclosed in a covering of silk.

*pruni.* Wings notched, yellow, and marked with two brown streaks and a white dot. 22. Native of Europe; on the plum. The larva is smooth, of an ash colour, marked with blue lines, and furnished with tufts of hair on the neck and along the sides; the hind-legs are stretched out, and at a distance from one another. The pupa black on the fore part of the body, and of a light brown behind.

* *potatoria.* Wings faintly notched, and yellow, marked with a broad tawney stripe, and with two white dots. 23. Native of Europe; on grass. It produces oblong eggs of a leaden colour, marked at each end with a green ring, and with a green dot in the middle. The larva has a tail

tail and a crest, is hairy, and spotted on the sides with white. The pupa of a light brown.

* *quercus.* Wings of a rusty colour, marked with a yellow streak; the upper wings with a white dot. 25. Native of Europe; on heath, the sloe, the birch, the willow and oak. The colour of the female is paler than that of the male. The larva is hairy, gray, marked with black rings, and spotted with white. The pupa is enclosed in a thick covering of silk, is green, and brown on the fore part.

* *lanestris.* Wings of a rusty colour, marked with a white streak; the upper wings are white at the base, and marked with a white dot. 28. Native of Europe; on the lime tree, the sloe, and the willow. It produces eggs covered with ash-coloured wool. The larva is hairy and black; each of its segments is marked with three white dots between two red tufted spots. It is gregarious, and lives in habitations which it forms for itself composed of many cells; going out in quest of food, it returns through parallel holes. The pupa is of a sulphur colour.

* *vinula.* Wings nearly reversed, waved and streaked with brown; body white, dotted with black. 29. A native of Europe; on the willow and poplar. Larva solitary, green, and brown on the back, on which there is situated a turgid prominence; the tail is furnished with two bristles; it discharges an acrid fluid from a chink under its head. Pupa brown.

*mori.* *Silk-worm.* Wings pale, marked with three faint brown streaks, and a brown circular spot. 33. Native of China and Persia; on the mulberry. It was introduced into Europe by Justinian. It varies a little in size and colour; the wings being sometimes yellowish, sometimes whitish. The larva is furnished with a tail, is naked, and whitish. The pupa light brown, enclosed in a thick silky covering, from which silk is manufactured. The first person who unravelled the cocoons of the silk-worm, and manufactured them into silk, was Pamphilia, a woman of Coos, the daughter of Latous, (*Vide* Plin. xi. 22.); *seu potius Platis filia*, (Aristot. Anim. v. 19.).

* *populi.* Brown and whitish on the fore-part; the wings brownish, marked with a whitish spreading stripe, with a small one placed close by it. 34. Native of Europe; on the poplar, and on fruit trees. The larva hairy, and of an ash-colour, darker on the back; each segment is marked with two pairs of red dots. The pupa is brown on the fore part, and reddish behind.

*everia.* Wings yellow (in the female brown), marked with a white dot, and becoming paler towards the tip. 499. Native of Europe; on the sloe, &c. It deposits rough eggs in clusters. The larva gregarious, hairy, and light-brown. The divisions between the segments black, and marked on the sides with blue spots and sulphur-coloured dots. The pupa yellowish.

* *castrensis.* Wings dark-coloured, marked with two pale bands, 36. Native of Europe; feeds on the *pilosella*, *jacea*, *millefolium*, *alchemilla*, and *euphorbia*. It deposits its eggs in circles round branches. The larva is gregarious, consuming a great variety of vegetables; it feeds under a web, and frequently shifts its quarters: it is hairy, blue, and marked with red lines dotted with black. The pupa is dark-coloured.

* *processionea.* Wings of a brownish ash-colour: the female marked with one dark stripe; the male with three. 37. Native of Europe; on the oak. Of a middle size. The larvæ gregarious, hairy, of a brownish ash-colour, black on the back, and marked with yellow warts: they move in sets, differing in number. The skin which they cast excites inflammation when touched.

### β. *Wings deflected.*

### † *Tongue short.*

### ‖ *Back smooth.*

*rufa.* Wings whitish, marked on the back with a brown spot, and with six brown spots like crescents on the lower wings. 508. Native of Europe. The under wings white, with a brown edge; the antennæ pectinated and brown; the legs brown.

* *plantaginis.* Wings black, with white veins; the under wings yellow, with a black edge, and dotted with black. 42. Native of Europe; on the plantane, elm, and hyacinth. The under wings in the female are scarlet; but in the north of Europe, frequently white, with a black edge and black spots: when caught it emits a yellow drop from its collar. Larva hairy, black, with the back brown.

* *monacha.* Wings white, waved with black, marked with blood-coloured rings between the segments of the abdomen. 43. Native of Europe; on the bramble, the willow, the apple, the oak, the larix, and other species of pine. To these last it is particularly destructive. Larva brownish ash-coloured, with red tufts on the back; the second segment of its body is marked with a black spot of a heart-shape. Pupa black.

* *dispar.* Wings marked with spots clouded with gray and brown: the wings of the female whitish, with black stains. 44. Native of Europe; on the oak, the lime, and fruit trees; the pest of orchards. The female twice the size of the male, covers her eggs with balls of dust. The larvæ feed on a variety of vegetables, are hairy, marked with white lines, dotted with blue on the fore part of the body, and with red behind. When touched they excite an itching in the hands. The pupa is marked on the fore part of the body with four black dots; when touched, it rolls itself up in a circle.

* *chrysorrhœa.* Wings of a snow-white, a beard of a rusty colour at the anus. 45. Native of Europe; on the oak and fruit-trees. There is a smaller variety of this species with brownish wings in India. The female produces yellow eggs, and covers them with a large quantity of tawney-coloured wool. The larva is blackish, hairy, gregarious; not confined to one kind of food; marked with two red lines on the back, tufted with white on the sides. The pupa blackish.

### ‖ ‖ *Back furnished with a Crest.*

* *pudibunda.* Wings of an ash-colour, marked with three brown weaved streaks. 54. There is a variety of this species, *scopularis β*. Antennæ pectinated, wings whitish, marked with three dark-coloured bands; the under wings white. It is a native of Europe; on the oak, beech, and fruit-trees. The larva is yellow, hairy; the tuft on the tail longer than the rest, and red; four tufts on the back, white; the head is pale yellow. The pupa is black in the lower part of the body, and a light brown behind, spotted with yellow.

* *cossus.* Wings clouded; the posterior part of the thorax marked with a black band; antennæ lamellated. 63.

A native of Europe; in decayed wood. The larva somewhat hairy, of a carnation colour; the head black, and back of a blood-colour. It was reckoned a delicacy by the Romans, who fattened it with flour. (Plin. xviii. 24.). The pupa of a light brown on the fore part of the body, and yellow behind.

*cerari*a. Wings yellowish, marked with black bands. 1306. A native of Chili; on a kind of *conyza*. The larva is naked, and red; while it undergoes its metamorphosis, it rolls itself up in a kind of wax, at first white and sweet, and afterwards yellow and bitter, which the natives gather in the autumn and put into cakes.

### † † *Tongue long.*

### a. *Back smooth.*

* *aulica.* The upper wings gray, and dotted with yellow; the under ones tawney spotted with black. 68. A native of Europe; on the *angelica*, nettle, and grass. The larva solitary, black, marked with white warts; on the upper part of the body it is covered with whitish hairs, and underneath with hairs of a rusty colour.

*matronula.* Wings brown; the upper wings gray, spotted with yellow on their superior surface; the under ones yellow marked with black bands. 92. A native of Europe; on the *artemisia vulgaris*.

### b. *Back furnished with a Crest.*

*oo.* Wings of an ash-colour, streaked with a light brown, and marked with *oo*. 81. A native of Europe; on the oak. Larva naked, of a violet-colour, marked with white lines, and dots.

*æsculi.* Of a snow-white colour; wings marked with a great number of bluish-black dots; the thorax with six. 33. A native of Europe; in the wood of the pear and horse-chesnut. Larva yellow, dotted with black; head and tail black.

### γ. *Wings incumbent.*

**graminis* Wings gray; marked with a white line dividing into three branches, and a white dot. 73. A native of Europe; on grass. It varies in size, and is very destructive to pasture grounds. The larva consumes all kinds of grass except the *alopecurus*. It is smooth, dusky, with a lateral and dorsal yellow stripe. It is destroyed by rooks and hogs. The pupa remains torpid for fourteen days only.

* *fuliginosa.* Wings dark-coloured, tinged with red, marked with a double black dot; abdomen red; and black on the back. 95. A native of Europe; on the turnip, mustard, grass, and birch-tree. The larva is hairy, of a rusty colour, with black head and fore-legs; wanders over the snow in winter in Norway; and is said to forbode a cold summer and scarcity where it appears in considerable numbers. Pupa black, marked with yellow bands behind.

*varella.* Wings transparent and gray; antennæ brown. 591. A native of Europe; on the *vicia sylvatica*. The female deposits her eggs while in the pupa state, and never becomes a perfect insect.

### δ. *Wings convoluted.*

*histrio.* Wings tawney, marked with numerous white spots, surrounded with blue. 593. A native of the island of Tobago. Feelers white at the base, and tipt with black; thorax bluish black with white dots, and two tawney spots; abdomen beneath white, with black rings; anus tawney; upper wings blue at the tip, with white dots; lower wings, and all beneath, black; the hind margin a little whitish.

### § § *Feelers cylindrical.* Geometræ.

### a. *Wings angular.*

Wings green and faintly notched, marked with a faint waved whitish streak; a smaller line of the same description being placed contiguous to it. 199. A native of Europe; on thyme. Larva dark-coloured, marked with carnation-coloured spots on the back; the head and collar furnished with two little projections. Pupa light brown, marked with a black line, sharp-pointed before, and divided behind, and covered with a very thin follicle. *thymiaria.*

Wings ash-coloured, and marked with a rusty-coloured streak, and transverse row of black dots. 200. A native of Europe; on the oak. Larva ash-coloured, marked with yellow spots on the sides. Pupa of a pale carnation colour above, beneath yellow; and is attached to a leaf. *punctoria.*

### b. *Wings entire.*

Wings green, somewhat waved, marked with a waved streak, and smaller streak of the same description contiguous to it. 225. A native of Europe; on birch-trees. Larva green, with ten crooked reddish prickles on the back. Pupa green, varied with yellow; remains torpid for 14 days. *papilionaria.*

Wing pale, marked with a pale fillet. 654. A native of Europe. *vittata.*

### c. *Wings round.*

All the wings yellowish, marked with brown streaks, and very small dots. 214. A native of Europe; on the *centaurea*. Larva gray, and smooth, marked with a number of interrupted lines of rusty colour, having two tubercles on the posterior part of the body. * *atomaria*

Wings white, marked with a striated yellow band; the abdomen yellow dotted with black. 213. A native of Europe; on the elm and plane-tree. Larva green, marked with black lines; head and tail black. Pupa bluish. * *pantaria*

Wings variegated with green and ash-colour, marked with two black streaks; the anterior one curved, the posterior one waved. 633. A native of Europe; on lichens. Small. Larva rough, varying in colour according to the colour of the lichen on which it feeds, green, ash-coloured, or yellow, spotted with black on the sides; the fore-legs marked with a black spot, and a green dot. *lichenaria.*

### § § § *Feelers almost naked, and cylindrical at the base; dentated in the middle, and oval; tapering at the tips.* Tortrices.

The upper wings green, marked with two oblique yellow streaks; the under wings white. 235. A native of Europe; on the alder and oak. Larva and pupa green: the former is marked along the side with a yellow line, and has the second segment of the back marked with tubercles; the latter marked on the back with a black line. *prasinaria*

Wings

***pomona.*** Wings clouded, the under ones marked with a reddish golden spot. 401. A native of Europe; on the apple. Larva naked, and red; with a black head. Pupa light brown.

***resinaria.*** Wings brown, marked with a brown spot at the base, common to both wings, and with a triangular rusty spot at the tips. 406. A native of Europe. It takes up its habitation in a ball of rosin, which exudes from a wound made in the branches of the pine. Larva naked, and yellowish; head light brown. Pupa brown.

§ § § *Wings shutting closely, with the under edge of one over the upper edge of the other.* Pyralides.

***farinalis.*** Feelers bent backwards; wings yellowish and polished, marked with white waved streaks, yellowish at the base and tips. 327. A native of Europe; in flour and meal. It walks with its tail erect.

**** pinguinalis.*** Feelers bent backwards; wings ash-coloured, thicker at the edges, faintly marked with black bands. 336. A native of Europe; on butter, bacon, &c. Very common in houses and kitchens, sometimes in the human stomach; the most pernicious of all the animals that live within the bodies of others. The larva smooth, brown, shining. Pupa naked, of a light brown.

***secalis.*** Wings gray, streaked with brown, and marked with a kidney-shaped spot, on which there is inscribed a Roman A. 338. A native of Europe; within the stalks of rye, which it consumes within the sheath, going from one to another: this is the cause of the ears becoming white and empty. Larva green, marked with three longitudinal green lines; head light brown.

* * *The Antennæ setaceous.*

§ *Tongue projecting and horny.* Noctuæ.

a. *Wings spreading.*

***odora.*** Wings notched, brown, and waved with black; the upper wings are adorned with a black eye, and marked with a blue spot like a crescent, and with a white spotted streak. 11. A native of Surinam.

***strix.*** Wings of the same colour, both on the upper and under surface, reticulated and clouded with black and white. 82. A native of South America. Larva naked, black, and marked on the sides with a greenish line, and with green rings.

***macrops.*** Wings indented; brown, waved with black; upper pair adorned with a large light brown eye. 968. A native of China. In some specimens, probably the females, the outer margin of the lower wings is reflected, forming a pouch which contains a great quantity of fine silk.

b. *Wings incumbent.*

α. *Thorax smooth.*

***livida.*** Wings shining black; under wings of a rusty colour, edged with dark brown. 999. A native of Europe. Larva growing smaller towards each end, naked, greenish, variegated with yellow and shining red, marked with a dark-coloured line on the back, and with a very slender pale one on the sides; the head of a pale colour.

β. *The Thorax furnished with a Crest.*

***typhæ.*** Wings white, streaked with dark brown, dotted with black on their posterior margin. 1005. A native of Europe; on the stalks of the *typha angustifolia.* It comes forth in August, about the size of *pinguinalis*, smooth and whitish. Larva is gray and naked. It undergoes its metamorphosis within the stalks, in the month of July.

**** solani.*** Wings variegated with green and gray; the under ones reddish, marked with a band near the edge. 1009. A native of Europe; on the potato and bean, devouring the larvæ of other insects. Larva thick, wrinkled, and of an ash-colour. Pupa naked, and of a light brown.

***C. nigrum.*** Wings brownish gray, marked with a black spot; white on the outer edge, and with a black line at the tip. 162. A native of Europe; on the common spinach. Larva variegated with gray and dark brown, marked on the sides with black cross lines, and with a single pale one.

c. *Wings deflected.*

α. *Thorax smooth.*

***trapezina.*** Wings whitish, marked with a very broad band of a darker colour, dotted with black along the edge. 99. A native of Europe; on the hazel. Larva greenish, marked with ash-coloured, whitish, and sulphur-coloured lines: it devours the larvæ of other insects, and even of its own species. Pupa of a light brown; it lies dormant for four weeks.

***lucernea.*** Wings ash-coloured, without spots, marked with three whitish waved streaks; the collar divided. 102. A native of Europe; frequently flying into candles, whence it has received its name; though many moths are attracted by the light as well as this.

β. *Thorax furnished with a Crest.*

**** psi.*** Wings ash-coloured; the upper wings marked at the base with a black line, and black characters; legs without spots. 135. A native of Europe; on the alder, oak, and fruit-trees; varying in the number and figure of the characters. Larva hairy; back yellow; the sides spotted with black and red; a black erect horn on the thorax.

***turca.*** Wings yellowish, marked with two dark brown streaks, and adorned with a yellowish eye. 140. A native of Europe; on the *juncus pilosus*, and in corn fields under stones. Larva reddish yellow, black at each end, underneath of a whitish yellow, marked on the back with a whitish line, and on the sides with a dark coloured one; the divisions between the segments are marked with small black lines, and the head is dark brown. It gnaws over the stalks of the corn close by the ground, in the months of May and June.

**** oleracea.*** The upper wings of a rusty colour, marked with a yellowish spot like a crescent, and with a white line divided behind. 171. A native of Europe; at the roots of cabbage, greens, &c. likewise on the leaves of pease and beans. Larva feeds on a variety of vegetables; naked, of a livid colour, dotted with black, and marked on the back with a dark brown line, and on the sides with a whitish one. Pupa naked and blackish.

**** pisi.*** Wings of a rusty colour marked with two spots, and with

with a pale waved streak on their posterior part. 172. A native of Europe; on the pea and broom, consuming their pods. Larva naked, and of a rusty colour, marked with four yellow lines; head of a carnation colour. Pupa dark brown; the divisions between the segments of a blood colour.

*tritici.* Of an ash-colour; the wings marked with two pale-coloured spots, and with a single blackish one. 179. A native of Europe; on the ears of wheat and oats. Larva naked and yellow; marked with three white lines.

*flavicornis* Upper wings of an ash-colour, marked with three black streaks; antennæ yellow. 182. A native of Europe; on fruit trees. Larva naked, greenish, marked on the sides with white dots; head of a carnation colour.

§ § *Tongue prominent and membranaceous.* Tineæ.

a. *Wings four, unequal.*

*cerella.* Wings gray, emarginated behind; back of a dark brown, and furrowed. 282. A native of Europe; in bee hives, feeding on the wax.

*padilla.* The upper wings of a livid colour, and marked with 20 black dots; the under ones brown. 351. A native of Europe; on apple trees. The larva gregarious; living in swarms, under a common covering: it is naked, and gray, marked with a black dot on each side of its segments. Pupa yellowish.

* *pellionella.* Wings gray, marked in the middle with a black dot. 372. It is to be met with everywhere in woollen stuffs, which it destroys, lying concealed within a covering. Larva whitish, marked with a red line on the back. Pupa yellowish.

* *tapezella* Wings black, under ones whitish; head pure white. 371. A native of Europe; on tapestry, furs, and skins, into which it gnaws holes.

* *fascitella* Wings of an ash-colour; thorax marked on each side with a white dot. 373. A native of Europe; in cloths and furs, which it destroys. It lies concealed under a covering.

* *mellonella.* Wings whitish, growing purple towards their exterior part, marked with a white streak; the scutellum black, and white at the tip. 375. A native of Europe; in bee-hives, where it penetrates the honey-combs. Larva is naked, and gray, with a light brown head. Pupa light brown.

* *proletella.* Wings whitish, marked with two dark brown dots; tongue bent inwards. 379. A native of Europe; on different species of cabbage; on the horned poppy; and on the oak. An individual, in the space of a year, may produce many millions, as they propagate every month, each depositing a great number of eggs.

b. *Feelers divided the length of the middle, two in number.*

* *granella* Wings variegated with black and white; head very white. 377. A native of Europe; in granaries, where it destroys the grain and collects it into knots; it climbs up the walls of houses in winter.

§ § § *Wings divided into many divisions.* Alucitæ.

* *didactyla* Wings spreading and brown, marked with white streaks; the superior wings bifid; the posterior ones divided into three divisions. 454. A native of Europe; on the *geum rivale*, and on the *convolvulus*. Larva green, covered with tufts of hair. Pupa long; with two lines of tubercles on the back, each furnished with four prickles.

* * * *Antennæ moniliform and short.* Hepiali.

* *humuli.* Wings yellow, with tawney streaks; the wings of the male of a snow-white colour. 84. A native of Europe; at the roots of the hop: the hop-planters manure with hogs dung, as a remedy against this troublesome insect; it deposits a very great number of eggs.

1529 species of this genus have been described in the last edition of the System of Nature.

## IV. NEUROPTERA.

Wings four; naked; their veins forming a net-work. Tail unarmed.

### 72. Libellula, *Dragon-fly*.

Mouth furnished with jaws. Jaws numerous. Lip divided into three. Antennæ shorter than the thorax; very slender and filiform. Wings extended. Tail of the *male* furnished with a hooked forceps.

* *Wings spreading when the insect is at rest.*

A. *The central division of the Lip very minute.*

* *quadrimaculata.* The under wings marked at the base with a blackish spot; and all the wings marked on the middle of their upper surface with a blackish spot; the abdomen flattish and downy. 1. A native of Europe; in waters.

* *rubicunda.* The under wings becoming black at the base; the body quadrangular. 4. A native of Europe; in fresh waters. The one sex is waved on the back with red, and the other with yellow.

* *depressa.* All the wings black at the base; the abdomen depressed; the sides yellowish. 5. A native of Europe; in fresh water. The abdomen of the male bluish, marked on the sides, near the base, with yellow spots; the abdomen of the female brown, and yellow on the sides.

B. *The divisions of the Lip equal.* Æshnæ.

*minuta.* Abdomen yellow, marked with two black lines; the under wings yellow, marked with two black spots. 42. A native of China. Small: head yellow; eyes brown; thorax with yellow lines beneath; abdomen with two black lines above, and one beneath; upper ones black at the base, with a yellow spot.

* *forcipata* Thorax black; marked with various yellow characters; tail furnished with crooked hooks. 11. A native of Europe.

* * *Wings erect when the insect is at rest; the Eyes distant from one another; the exterior division of the Lip slightly divided.* Agriæ.

* *virgo.* Wings coloured.

*a.* Body shining, greenish blue; wings bluish in the middle, the base and tip whitish, the margin without spots.

*b.* Body silky; wings bluish green, the tip brown, the margin without spots.

*c.* Silky, green; wings brownish, with a white marginal dot.

*d.* Body silky; wings brown, gilt with a black spot. 20. A native of Europe; about fresh waters.

* *puella.* Wings transparent.

*a.* Body red, with yellow and black lines at each segment; wings with marginal spots.

*b.* Body carnation colour; wings with a brown marginal dot.

*c.* Body alternately blue and ash-colour; wings with a black dot.

*d.* Body beneath bluish green, above brown; thorax with alternate brown and bluish bands; wings with a black marginal dot.

*e.* Body green, and pale carnation colour; thorax with three black lines; wings with a brown marginal dot. 21. A native of Europe; in almost endless variety.

This is an extremely ravenous tribe, and are generally seen hovering over stagnant waters. They copulate in the air, and fly about joined together. They fly very rapidly, and at a greater height than most other insects. The larvæ are six-footed; active; inhabitants of the water; furnished with articulated pincers, with which they seize and prey with the most rapacious ferocity on aquatic animals. The pupa resembles the larva, but has the rudiments of wings.

48 species of this genus have been described in the last edition of the System of Nature.

### 73. Ephemera, *Day-fly.*

Mouth without jaws. Feelers four, very short, and filiform. The resemblance of a jaw, membranaceous, cylindrical, and connected with the lip. Antennæ short, and tapering towards the tip. Two large stemmata above the eyes. Wings erect, under ones very small. Tail bristly.

These short-lived animals are found everywhere about waters in the summer, and in their perfect state seldom live above a day, during which time they perform all the functions of life. They remain in the state of larvæ and pupæ for one, two, or three years. The larva lives under water, and is eagerly sought after by fish, particularly by trout, for which it forms an excellent bait. They are furnished with six feet, a tail, and six fins which serve them as oars. The pupa resembles the larva, except in having the rudiments of future wings. They scoop out holes for themselves in the banks of rivers, formed like siphons; the one leg serving as an entrance, the other as an outlet. The banks of some rivers are often perforated with them. When the waters decrease, they form fresh holes lower down. The ephemeræ on the Rhine appear two hours before sunset; they come forth almost all at the same time, and in immense numbers. Those on the Marne and Seine, in France, do not begin to fly till two hours after sunset. The females, by the help of the threads of the tail, and the flapping of their wings, support themselves on the surface of the water, and, in almost an upright position, drop their eggs in clusters. A female will drop seven or eight hundred eggs, which sink to the bottom.

* *Tail furnished with three bristles.*

* *vulgata.* Wings reticulated and spotted with brown; body brown. 1. A native of Europe; in fresh waters. In the month of June, they are to be seen in the evenings fluttering about under trees in innumerable swarms. In the neighbourhood of Laz in Carniola, they abound so much, that the country people collect them for manure; the peasant who has not collected to the amount of twenty cart loads, thinks himself unfortunate.

* *marginata.* Wings white, the outer margin brown; body black. 3. A native of Europe.

* *vespertina.* Wings black, the under ones whitish. 4. A native of Europe; in fresh waters.

* * *Tail composed of the two bristles.*

* *bioculata.* Wings white, and reticulated; the head marked with two yellow tubercles. 5. A native of Europe; in fresh waters. The bristles of the tail white dotted with brown, and longer than the body.

* *horaria.* Wings white, the edges blackish and thicker than the rest of the wing. 9. A native of Europe; in fresh waters.

18 species of this genus have been described in the last edition of the System of Nature.

### 74. Phryganea.

Mouth furnished with a horny mandible, short, arched and sharp, without teeth. Jaw membranaceous. Feelers four. Stemmata three. Antennæ setaceous, and longer than the thorax. Wings incumbent, the under ones folded.

These insects are seen in a summer evening floating in the air in great numbers, and are eagerly devoured by swallows; they are easily distinguished from the smaller moths, by their wanting the spiral tongue. The larva is six-footed, found at the bottom of shallow waters enclosed in a tube, constructed of sand, straws, or small chips of wood, and is known to fishers by the name of *caddy*, or *caddo*, who use it as a bait for trout, after they have taken off the tube with which it is covered. When about to become a pupa, it shuts up the mouth of its tube with a few loose threads of silk, of the same nature with that by which it connects the straws and chips that compose its tube. The larvæ of the species which compose the first division have one or three tails, which serve them for fins; the pupæ have six feet, and prominent horny jaws. The larvæ of the other species are somewhat hairy, furnished with two hooks at the tail, and with three tentacula on the fourth segment. The pupa very much resembles the perfect insect.

* *Jaw divided. Tail formed of two bristles, and terminating abruptly.* Semblis.

* *bicaudata.* Wings marked with many veins, forming a net-work. 1. A native of Europe; in fresh waters; carrying about its eggs in a mass under its belly; body greenish.

*phalænoides.* Body black; wings white, spotted with black. 3. A native of Europe.

* * *Tail without bristles; the Jaw joined to the lip.*

*reticulata.* Body black; the wings of a rusty colour, reticulated with black. 4. A native of Europe.

* *grisea.* Body gray; the upper wings clouded, and marked with a black spot on the edge. 6. A native of Europe; in fresh waters. The larva is covered with a tube composed of grass and rushes.

* *grandis.* Wings of a brownish brick-colour, marked with ash-coloured spots. 7. A native of Europe; in fresh waters. The larva is concealed in a cylindrical tube formed of chips of wood.

* *rhombica.* Wings gray, marked with a white rhomboidal spot. 8. A native of Europe; in fresh waters. The larva is lodged within a cylindrical tube, formed of bits of grass, connected together transversely.

50 species of this genus have been described in the last edition of the System of Nature.

### 75. Hemerobius.

Mouth furnished with a short horny mandible. Jaw cylindrical, straight, and cleft. Lip prominent and entire. Feelers four; projecting, unequal, and filiform. No stemmata. Wings deflected, but not folded. Antennæ setaceous, projecting, and longer than the thorax, which is convex.

Like the *ephemera*, these insects are very short-lived; and in every state of their existence, they prey with unceasing avidity upon *aphides*. The larva is six-footed, generally oval and hairy. The pupa commonly folliculated. The eggs are deposited in clusters on the leaves of plants; each placed on a small stalk made of gum. Many of them, when touched, have an excrementitious smell. The follicle in which the pupa is enclosed, is of a dense texture, formed of whitish silk. In summer, at the end of three weeks, the *hemerobius* comes forth a perfect insect. When the follicle has not been formed till the end of autumn, the pupa remains in it the whole winter; and does not undergo its final metamorphosis till the ensuing spring.

A. *Lip cylindrical, membranaceous, and marked with rings.* Semblides.

* *lutarius.* Black; wings whitish, streaked and spotted with white. 14. A native of Europe; in fresh waters; very common in the spring. It deposits a great number of light brown eggs, which it attaches in clusters to the leaves of aquatic plants by means of a glutinous matter.

B. *Lip horny, round at the tip and arched.*

*perla.* Yellowish green; wings transparent, and marked with green veins. 2. A native of Europe; on vegetables. Its eggs are set on capillary stalks.

*mellanotictos.* Yellowish; wings transparent, variegated with blue and gold, marked with whitish veins, dotted, and somewhat hairy, the edges marked with very small black dots. 31. A native of Europe.

*versicolor.* Yellow; wings transparent, variegated with blue and gold; the base of the abdomen, the under part, and anus black; the antennæ yellow. 32. A native of Europe.

31 species of this genus have been described in the last edition of the System of Nature.

### 76. Myrmeleon, *Lion-ant*, or *Ant-eater*.

Mouth with a sharp horny jaw, and mandible. Lip projecting. Feelers six. No stemmata. Antennæ thicker towards their outer edge. Wings deflected. Tail of the male armed with a pair of pincers, composed of two filaments nearly straight.

A. *The posterior Feelers much longer than the rest; jaw furnished with one tooth; Lip membranaceous and square, terminating abruptly, and emarginated.*

The insects of this family prey with the most savage ferocity upon ants, and lesser insects; and for the purpose of ensnaring them sink themselves into the sand, and form a kind of funnel or pit in which they lie buried, the head only appearing above the sand: into this hollow such insects as wander near it are sure to fall; and not being able to crawl up the sides of loose sand, are seized and devoured by the *lion-ant*. But if the sides of the pit do not give way, or the unlucky insect appears to be able to make its escape, its enemy, by throwing up with its head repeated showers of sand, forces it down till it comes within its reach. Larva is six-footed, oval and hairy, with exserted toothed jaws. Pupa enclosed in a ball composed of agglutinated sand or earth.

Wings clouded with brown, marked with a white spot on their posterior margin. 3. A native of Europe. The larva goes backwards; frequents sandy places, where it digs pits to ensnare other insects. **formicarius.*

B. *Feelers nearly equal, and filiform; the Jaw fringed; Lip horny, round and entire.*

The upper wings transparent, marked at the base with a double yellow spot; the under wings are yellow, and black at the base. 2. A native of Europe. Head black and hairy. *longicornis.*

Wings white, marked with a black spot at the edge; body variegated. 14. A native of Europe. Variegated with brown and yellow; the antennæ of the same length with the body, and black; club oblong. *australis.*

15 species of this genus have been described in the last edition of the System of Nature.

### 77. Panorpa, *Scorpion-fly*.

Mouth stretched out into a cylindrical snout, composed of a horny substance. Mandible, without teeth. Jaw divided at the point. Lip very long, covering the whole mouth, and like it formed of a horny substance. Feelers four, nearly equal. Antennæ filiform, and longer than the thorax. Tail of the male notched, of the female unarmed.

Wings equal, spotted with black. 1. A native of Europe; lives chiefly on dipterous insects. * *communis.*

Wings tapering towards the point, somewhat curved and fringed; female without wings. 3. A native of Europe *hyemalis.*

Europe. It is common when winter disappears. It is of a brownish yellow colour above.

10 species of this genus have been described in the last edition of the System of Nature.

### 78. Raphidia.

Mouth furnished with an arched mandible set with teeth. Jaw cylindrical and obtuse; lip round and entire; all of them formed of a horny substance. Feelers four, very short, nearly equal and filiform. Stemmata three. Wings deflected. Antennæ filiform, the same length of the thorax, which is lengthened out at the anterior part, and cylindrical. Tail of the female furnished with a loose curved bristle.

*_ophiopsis._ Wings without spots. 1. A native of Europe; in pine forests; feeding on other insects. Larva has six feet. The pupa active, very like the perfect insect in every point, except that it wants wings.

*_notata._ Wings marked on the edge with a brown spot. 2. A native of Britain. Black; a reddish brown spot on the head and legs, and furnished with a projecting sting of the same length with the abdomen.

## V. HYMENOPTERA.

Wings four, membranaceous for the most part. Tail of the female furnished with a sting.

### 79. Cynips, *Gall-fly.*

Mouth with a short jaw, furnished with one tooth, and membranaceous. The mandible arched, cleft at the tip, and with a short, cylindrical, and entire lip, all composed of a horny substance. Feelers four, short, unequal and capitated. Antennæ moniliform. Sting spiral, and for the most concealed.

The numerous excrescences or galls, found on the roots, branches, and leaves of various trees, are produced by the puncture of these insects. The larva is without feet, soft, cylindrical, and inhabits within the gall, feeding on the juices of the tree. The pupa resembles the perfect insect, except in having only the rudiments of wings.

_adscendens._ Of a brazen colour; the abdomen conical, ascending and joined to the trunk by a very narrow connection. 20. A native of Europe. Large; legs of a pale colour; the thighs black at the base.

*_rosæ._ Body black; the abdomen of a rusty colour, and black behind; the legs of a rusty colour. 1. A native of Bedeguar; on the rose.

*_quercus baccarum._ Black; base of the antennæ and legs yellowish. 4. A native of Europe. Forms roundish and transparent galls, about the size of a pea, on the under surface of the leaves of the oak; and comes out about the middle of summer.

*_quercus folii._ Black; thorax marked with lines; legs gray; thighs beneath black. 5. A native of Europe. Forms galls about the size of a hazel nut, on the under surface of the leaves of the oak.

*_quercus infera._ Black; antennæ and legs pale. 6. A native of Europe. Forms globular, opake, red galls, about the size of a hazel nut, on the under surface of the leaves of the oak.

*_quercus petioli._ Black; legs white; thighs brown. 7. A native of Europe. Forms hollow galls, convex at each end, on the footstalks of the leaves of the oak.

*_quercus pedunculi._ Gray; wings marked with a linear cross. 8. A native of Europe. Forms granulated connected galls, on the male flowers of the oak.

*_quercus corticis._ In galls on the bark of the oak. 9. A native of Europe. Forms a cup-shaped gall, the disk convex and surrounded with about twenty concave dots, sunk into the bark of the oak.

*_quercus ramuli._ Pale; abdomen and eyes black. 10. A native of Europe. Forms white woolly galls on the small branches of the oak.

*_quercus gemmæ._ In the terminal bud of the *quercus robur*. 11. A native of Europe. Found in the large imbricated galls on the terminal buds of the *quercus robur*. This fly is of a very dark green, slightly gilded. Its antennæ and feet are of a dun-colour, rather deep. It deposits its eggs in the oak buds, which produce one of the finest galls, leafed like a rose-bud beginning to blow. When the gall is small, the leaves are compressed, and lie over one another like the tiles on the roof of a house. In the centre of the gall there is a kind of hard nucleus, in the middle of which is a cavity, and in that is found the little larva, which feeds there, takes its growth, undergoes its metamorphosis, and breaks through the inclosure in order to get out. The whole gall is often near an inch in diameter, sometimes more when dried and displayed, and is attached to the branch by a footstalk. (Barbut, Insect. p. 233.).

_quercus calicis._ On the calyx of the oak and *ægilops*. 18. A native of Europe. Forms galls on the calyx of the *quercus robur*, sometimes used by tanners. They were called by the Romans *cerri*.

*_fagi._ Black, without spots. 12. A native of Europe. Forms galls of the shape of a pear, on the upper surface of the leaves of the common beech.

_rosmarini._ Body brown. 22. Forms tenacious globular galls, about the size of a hazel nut, filled with clear oil, on the branches of the *rosmarinus chilensis*.

_phragmitis._ Body black; the base of the antennæ and legs of a brick colour; the abdomen lengthened out into a broad tail. 25. It is lodged at the top of the stalk of the *arundo fragmitis*, which becomes dilated, and grows no higher.

28 species of this genus have been described in the last edition of the System of Nature.

### 80. Tenthredo, *Saw-fly.*

Mouth furnished with an arched mandible, formed of a horny substance, and notched in the inside. Jaw straight and blunt at the tip. Lip cylindrical and divided into three. Feelers four, unequal, and filiform. Wings plain and swelling out. Sting composed of two serrated laminæ, slightly projecting. Scutellum marked with two grains placed on its surface, at a distance from one another.

The male and female of many of the species of this genus vary in colour. They feed on the leaves of various plants; the female uses her sting in the manner of a saw, and cuts out spaces in the twigs or buds of trees, for the purpose of depositing her eggs; larva cylindrical, soft, with sixteen or twenty-eight feet; feeds on the leaves

leaves of plants, and when touched rolls itself up spirally. Pupa enclosed in a follicle, and is very like the perfect insect; the eggs increase in size every day till the larvæ burst from them.

* *Antennæ clavated.*

* *femorata.* Antennæ pale yellow; body black; thighs of the hind-legs very large. 1. A native of Europe; on the alder and willow. Larva green, marked on the back with a blue line, and on the sides with a yellow one.

*tristis.* Body black; antennæ pale yellow; wings brown at the tips. 56. A native of the Sundmore islands. Larva green, marked on the back with a blue line fringed with black and yellow.

* *vitellinæ.* Abdomen black above, reddish on the sides; the thighs of the hind-legs dentated. 5. A native of Europe; on the birch and willow; the antennæ yellow, and black at the tip. The larva is green, and spouts water from an opening a little above the anus.

* * *Antennæ without articulations, and thicker towards their outer edge.*

* *enodis.* Antennæ smooth; body of a bluish black. 11. A native of Europe; on the willow. Larva green, dotted with black, marked on the sides with a wrinkled yellow line, and furnished with an acute tail.

* *ustulata.* Body black; abdomen bluish; shanks of the legs pale. 13. A native of Europe; on the *rosa canina*. Wings of a faint rusty colour, marked with a brown spot. Larva green, marked with two white lines; the head of a brick-colour, marked with a dark-coloured band.

*cyanocrocea.* Head and thorax bluish: the abdomen of a saffron-colour. 6. A native of Britain; on umbelliferous plants: antennæ black; legs of many colours.

* * * *Antennæ pectinated.*

*cephalotes.* Body black; abdomen marked with four yellow belts. 64. A native of Europe; large; head large, three dots situated between the eyes; the thorax marked on the fore part with an interrupted yellowish streak; legs of a rusty colour.

* *dorsata.* Body whitish; head and back of the thorax and abdomen black. 65. A native of Britain; antennæ black.

* * * * *Antennæ feathered.*

* *pini.* Antennæ spear-shaped; the thorax somewhat hairy. 14. A native of Europe; very common in the fir-tree. The male black; the thighs and shanks of the legs of a tawney colour: female twice the size of the male; gray; antennæ serrated. Larva blue, and of a tawney colour at each end.

* * * * * *Antennæ filiform; furnished with seven or nine articulations.*

* *rustica.* Body black; the abdomen marked with three yellow belts; the posterior pair being interrupted. 16. A native of Europe; on the woodbine. Mouth whitish; the scutellum and thorax marked with a yellow spot; the legs yellow; the knees of the hind-legs black. Larva of an ash-colour, marked with triangular light brown dots on the back.

*cynipiformis.* Greenish yellow; legs tawney; the thighs of the hind-legs of a brass colour. 69. A native of Europe; in the pods of the vetch; about the size of a black ant; the thorax lengthened very much, resembling a *cynips*. Female bluish green, with a metallic lustre.

* *salicis.* Body variegated. 21. A native of Europe; on the poplar and willow. Larvæ feeding in parallel troops; flat, rough, yellow, and marked on each side with two rows of black dots; head black.

* *alni.* Body black; head and thorax red. 29. A native of Europe; on the leaves of the alder. When looked at, it attempts to conceal itself. The antennæ are black; the abdomen black, with a violet gloss; the fore legs reddish brown.

* *rapæ.* Body black; belly, legs, and scutellum whitish. 35. A native of Europe; on the leaves of the turnip. Small; whitish beneath; the edges of the wings black; the edges of the segments of the abdomen faint yellow; head and thorax variegated with white.

* *capreæ.* Body yellow; head and upper part of the thorax and abdomen black; wings marked with a yellow dot. 55. A native of Europe; on the willow and corinth. The larva yearly destroys the gooseberry and red corinth, but does not injure the black corinth; blue; the three first and three last segments tawney, marked with nine lines of dots.

*ribis.* Body black; the shanks and apophyses of the thighs of the hind-legs are white on their exterior sides. 88. A native of Europe; on the red corinth. The larva destroys the edges of the leaves of the red corinth; it is green; the head edged with black; the body wrinkled; six feet situated on the breast, are furnished with hooks; six on the abdomen are set close together, and two near the tail resemble papillæ.

* * * * * * *Antennæ setaceous, composed of many articulations.*

* *erythrocephala.* Body blue; head red. 40. A native of Europe; on the common pine. Male black; the mouth and shanks of the fore-legs pale yellow.

*populi.* Black, with a tinge of blue; mouth, feelers, and shanks of the legs yellow. 44. A native of Europe; on the poplar; wings brownish; the breast variegated with pale yellow on each side, edged with bright yellow; the abdomen pale yellow; spotted on the back with black.

* * * * * * * *The following species, and other five, seem doubtful.*

*intercus.* Black; legs yellow; antennæ slightly clavated. 50. A native of Europe; on the leaves of the burdock, the nightshade, and the *vulvaria*; it is lodged under the cuticle of the leaf; the antennæ shorter than the body, transparent and deeply articulated; the abdomen oval and pointed.

140 species of this genus have been described by Gmelin, in his last edition of the System of Nature.

### 81. Sirex, *Tailed Wasp.*

Mouth furnished with a thick mandible, composed of a horny substance, terminating abruptly at the tip; the

the jaw bent inwards, pointed, cylindrical, and fringed, which, together with the lip, is membranaceous, short, and entire. Feelers four; the posterior ones longer than the rest, and thicker on the outside. Antennæ filiform, composed of upwards of 24 articulations. Sting projecting, rigid, serrated. Abdomen closely attached to the trunk, terminating in a sharp point. Wings lance-shaped and plane.

The larvæ of this genus are six-footed, soft, and cylindrical; the head rounded: they perforate wood, and frequently eat their way into the bowels of other insects and their larvæ, particularly caterpillars, living upon and consuming their vitals: pupæ foliculated. The perfect insect lives on the nectar of flowers.

Body black; the abdomen yellow at the base and at the extremity. 1. A native of Europe; on fir trees. * *gigas.*

Abdomen black; thorax hairy, with a pale yellow mark before the wings. 3. A native of Europe; in decayed timber, particularly fir wood. * *spectrum.*

Abdomen yellow above, marked with black rings: head and legs pale yellow. 12. A native of Europe; mouth, thorax, and under part of the abdomen black. *phantoma.*

18 species of this genus have been described in the last edition of the System of Nature.

### 82. Ichneumon.

Mouth furnished with a jaw, straight, membranaceous, roundish at the tip, divided, expanded, and fringed; the mandible arched, sharp, and smooth; and with a lip cylindrical, membranaceous at the tip, and marginated. Feelers four, unequal, and filiform; situated in the middle of the lip. Antennæ setaceous, furnished with upwards of 30 articulations. Sting prominent, furnished with a sheath composed of two valves.

The whole of this singular genus are parasitical, deriving their nourishment from other insects. The fly feeds on the nectar of flowers; and when about to lay her eggs perforates the body of some other insect or its caterpillar, with its sting or instrument at the end of the abdomen, and there deposits them; these, after being transformed into larvæ, prey upon the intestines of their foster parents till they are metamorphosed into pupæ. The larva is without feet, soft, and cylindrical; pupa sometimes naked, sometimes covered with a follicle. It is a species of this genus which produces the animal cotton, of which M. Baudry des Loizeres gives an account (Vide *Second Voyage à la Louisiane, par Baudry des Loizeres*). A worm of considerable size, which Baudry calls *fly-carrier*, (well known to planters as the *manioc* or indigo worm,) is at one period of the year attacked by swarms of the *ichneumon fly*, which deposit their eggs in every pore of the worm. The insects are produced all nearly at the same time, and spin each of them a minute covering for itself. The manioc worm is now covered with a white case, which he with considerable difficulty shakes off, and, in a few days, the insects are again hatched from it, but in the form of flies, leaving the animal cotton behind them. This production is very abundant, as M. Baudry could collect several bushels of it in a short time. In his opinion, it possesses many advantages over the vegetable cotton.

#### A. *Scutellum whitish; the Antennæ marked with white rings.*

Scutellum white; the thorax without spots; the second, third, and fourth segments of the abdomen pale yellow; the rest white at the tip. 2. A native of Europe; the thighs of the four hind-legs black. * *raptorius.*

Black; the scutellum, the extremity of the abdomen, and a notched band on the anterior part of the abdomen, yellow; the legs, and connection between the abdomen and trunk likewise yellow. 221. A native of Italy. It forms cells composed of cemented clay, in chimneys and windows, arranged commonly in parallel rows, forming a cylindrical nest, each containing a brown, lucid follicle, in which the larva is lodged, together with the body of a spider in which the egg had been originally deposited. The upper wings are dark-coloured towards the tip. *seductor.*

#### B. *Scutellum whitish; Antennæ totally black.*

Black; the scutellum whitish; the divisions between the segments black; the second, third, and fourth segments, as well as the legs, are yellow. 90. A native of Europe. In the pupa of the *phalæna piniperda.* *equitatorius.*

Black; the scutellum yellowish; the under part of the antennæ reddish; the thorax armed on each side with a prickle; the abdomen black, marked with yellow belts; anus yellow. 168. A native of Britain. * *dimicatorius.*

Scutellum white; the thorax spotted; abdomen black; the base of the second segment, the third and sixth segments yellow. 93. A native of Britain. * *fasciatorius.*

#### C. *The Scutellum and Thorax of the same colour; Antennæ marked with rings.*

Black; the abdomen of a rusty colour, and black at the extremity. 116. A native of Europe. *migrator.*

Black; legs reddish; the feet of the hind-legs white at the tips. 199. A native of Britain. It smells of musk. * *obscurator.*

#### D. *The Scutellum and Thorax of the same colour; Antennæ black.*

Body and wings black, marked with a transparent spot like a crescent; abdomen scarlet. 28. A native of Britain; in gardens. *denigrator*

Black; legs reddish; the shanks of the hind-legs black, marked with white wings. 40. A native of Europe. In the larva of moths, particularly in the *phalæna turionellæ.* Antennæ of the same length with the body; the sting shorter than the abdomen. *turionellæ.*

Black; mouth and legs reddish; the abdomen joined to the trunk by a stalk, or narrow connection. 33. A native of Europe. In the pupæ of some species of butterfly. * *compunctor.*

Black; the abdomen curved like a scythe, reddish in the middle; the thighs of the hind-legs clavated; white at the base and at the extremity. 58. A native of Europe; in the larvæ of the bee and of the *sphex.* Having examined with its antennæ, where the sphex is, * *jaculator.*

and

and having discovered it, it flies away, and returns and places its egg on it.

E. *Antennæ pale yellow.*

*venosus.* Entirely yellow, except some black between the stemmata; wings white, with yellow veins. 354. A native of Europe.

*cinctus.* Black; antennæ and legs of a rusty colour; wings transparent, marked with a black speck. 60. A native of Europe; in gardens.

F. *Minute, with the Abdomen closely attached to the Thorax.*

*gregarius.* Black; the legs and side of the abdomen of a rusty colour. 204. A native of Europe; in the larvæ of butterflies; gregarious, and very frequent in the spring. Soon after they are hatched they spin each of them a white follicle for themselves, which are connected together in a cluster, from which they come forth perfect insects.

* *bedeguaris.* Shining green; abdomen golden-coloured. 63. A native of Europe; in the larvæ of the *cynips*, which produces the galls on the rose and the oak. The sting the same length with the body.

* *gallarum.* Of a bronze colour; abdomen black; shanks of the legs whitish. 64. A native of Europe; on the larvæ of the *cynips*, which produces the galls on the branches of the oak.

*puparum.* Body blue and gold; abdomen shining green; and legs pale. 66. A native of Europe; in the larvæ of flies and butterflies.

*cynipis.* Green and gold; the abdomen brown, marked with a pale-coloured belt at the base; legs yellowish. 68. A native of Europe; on the larvæ of the *cynips*, and on the pupæ of butterflies.

*globatus.* Black; legs of a rusty colour. 74. A native of Europe; in stalks of grain, within a roundish follicle, composed of white silk, common to a number of the insects.

**glomeratus.* Black; legs yellow. 75. A native of Europe; in the larvæ of butterflies. Soon after they are hatched, they spin each of them a yellow follicle for themselves; they deposite their eggs on the pupæ of butterflies soon after they have changed from larvæ.

418 species of this genus have been described in the last edition of the System of Nature.

### 83. Sphex.

Mouth furnished with an entire jaw; the mandible curved, notched, and formed of a substance like horn. Lip horny, and membranaceous at the tip. Feelers four. The antennæ in some species have upwards of 10 articulations. Wings in each sex incumbent and not folded. Sting pungent and concealed within the abdomen.

The insects of this genus are the most savage and rapacious of this class of animals; they attack whatever insects come in their way, and by means of their poisonous sting overcome and devour such as far exceed themselves in size; when they attack any insect, they give one stroke, and fall down as if dead, and quietly wait till the poison they have infused through their sting produce its effect. Their prey either serves as food for themselves or their young. Those of the division B. are to be found chiefly on umbelliferous plants; the larva is without feet, soft, and inhabits the body of some other insect, on the juices of which it feeds; the pupa has only the rudiments of wings; the perfect insect deposits her eggs in the bodies of other insects.

A. *Antennæ setaceous; Lip entire; Tongue wanting.* Evaniæ.

*appendigaster.* Body black; the abdomen very short, and attached to the back part of the thorax by a foot-stalk. 12. A native of Europe, America, and Africa. Sprinkled with concave dots; the thorax flattened behind; the abdomen oval, compressed and very smooth; wings transparent, short, and deflected.

B. *Antennæ filiform; the Lip emarginated, and furnished with a bristle on each side: Tongue bent inwards, and divided into three divisions for almost half its length.*

a. *Abdomen attached to the trunk by a stalk or narrow communication.*

* *sabulosa.* Black, hairy; the attachment of the abdomen to the trunk furnished with two articulations; the second and third segments of the abdomen of a rusty colour. 1. A native of Europe; on sandy ground, where it digs a hole with its fore-feet, like a dog, in which it buries the larva of a moth, on which it deposits an egg, and then shuts up the hole. The abdomen exceeds the wings in length about one half, and in the male is black on the back.

*figulus.* Smooth, black; the lip and the edges of the segments of the abdomen lucid. 11. A native of Europe; in holes of wood, in partitions, which have been formed and abandoned by other insects: these it cleanses by gnawing round them; and placing a piece of moist clay at the bottom, sticks a spider upon it. In the body of this spider it deposits its eggs, and then closes up the entrance with clay. The larva is pale, and very like the larva of a bee. Having consumed the spider, which had been enclosed along with it, it spins a yellowish brown membrane for itself, exactly adapted to its body. One female sphex forms a great many nests; she spends no more than two days in forming any one.

*insubrica.* Body black; fore-head, mouth, scutellum, and two bands on the abdomen, yellow. 98. A native of Italy; breeds in chimneys and in windows, in the same nest with the *ichneumon seductor*. It is about seven lines long, dotted; the shanks of the legs yellowish, and black at the extremities; wings transparent and dark-coloured at the tips.

b. *The Abdomen closely attached to the Thorax.*

* *viatica.* Downy and black; wings brown; the anterior part of the abdomen of a rusty colour, marked with black belts. 15. A native of Europe; in sandy ground: it digs holes in the sand, in which it buries the larva of a moth, after it has deposited an egg on it.

*spinosa.* Body black; the fore part of the thorax furnished with

with a prickle on each side; the lip and the breast of the colour of silver. 86. A native of England; smooth; wings transparent; legs reddish.

98 species of this genus have been described in the last edition of the System of Nature.

### 84. SCOLIA.

Mouth furnished with a curved sharp mandible, crenated on the inside. Jaw compressed, projecting, entire and horny. Tongue inflected and divided into three at the tip, very short. Lip projecting, membranaceous at the tip, and entire. Feelers four, equal, short, filiform, and situated in the middle of the lip. Antennæ thick and filiform: the first joint longer than the rest.

*sexmaculata.* Hairy, black; the abdomen marked with three pair of yellow spots. 6. A native of Europe; marked with a yellow spot both before and behind the eyes.

*quadripunctata.* Body black; the abdomen marked with four white dots, the wings of a reddish brown. 22. A native of Europo.

27 species of this genus have been described in the last edition of the System of Nature.

### 85. THYNNUS.

Mouth formed of a horny substance; the mandible incurved. The jaw short, and straight. Lip longer than the jaw, membranaceous at the tip, and divided into three, the middle division emarginated. Tongue very short and involuted. Feelers four, equal and filiform. Antennæ filiform.

*dentatus.* Abdomen black; the second, third, and fourth segments marked with two white dots. 1. A native of New Holland. Likewise the first segments are marked with a white dot on the sides.

13 species of this genus have been described in the last edition of the System of Nature.

### 86. LEUCOPSIS.

Mouth composed of a horny substance, and furnished with short jaws. The mandible thick, and furnished with three teeth at the tip. Lip longer than the jaw; membranaceous and emarginated at the tip. Feelers four, short, equal, and filiform. Antennæ short, straight, and clavated. Thorax furnished with a lance-shaped scale on its under side. Sting bent backwards, and concealed in a groove in the upper part of the abdomen.

*ælogaster* Abdomen attached closely to the trunk; scale of the thorax half the length of the abdomen. 2. A native of Europe; eyes black; forehead without spots; the posterior part of the thorax marked with a yellow fillet, and without dots. Smaller than the common wasp.

Three species of this genus have been described in the last edition of the System of Nature.

### 87. TIPHIA.

Mouth furnished with a membranaceous rounded jaw. The mandible arched, and acute. The lip short, furnished with three small projections, and composed of a substance like horn. No tongue. Feelers four, filiform, unequal, projecting, and situated in the middle of the lip. Antennæ filiform and arched.

Black; the thighs of the four hind-legs angular and reddish. 4. A native of England. * *femorata.*

Black; thorax spotted; abdomen marked with five yellow bands, the second interrupted. 6. A native of Europe, chiefly in England. * *quinquecincta.*

17 species of this genus have been described in the last edition of the System of Nature.

### 88. CHALCIS.

Feelers four, and equal. Antennæ short, cylindrical, and spindle-shaped; the first articulation a little thicker than the rest.

Shining black; the thighs of the hind-legs thickened, and marked with a white dot at their extremities. 6. A native of Europe. Feet white. *pusilla.*

7 species of this genus have been described in the last edition of the System of Nature.

### 89. CHRYSIS. *Golden-fly.*

Mouth composed of a horny substance, and projecting; is furnished with a linear jaw, and with a lip emarginated, and membranaceous at the tip, and much longer than the jaw. No tongue. Feelers four, projecting, unequal, and filiform. Antennæ short, and filiform; the first articulation longer than the rest. Body gilt and shining. Abdomen arched beneath, furnished with a scale on each side. The anus (in most of the species) is furnished with small projections. Sting is slightly projecting. Wings plane.

The insects of this genus commonly form their nests in holes made in walls.

Smooth, polished; the thorax green; the abdomen of a golden colour, and furnished with four small projections at the extremity. 1. A native of Europe; in walls. * *ignita.*

Smooth, shining; the thorax green; the abdomen of a golden colour; the anus furnished with two small projections. 4. A native of Europe; in walls. * *aurata.*

Smooth, shining; the thorax and abdomen blue; the anus furnished with three small projections. 5. A native of Europe; in walls. * *cyanea.*

Smooth, shining green; the thorax and superior part of the two first segments of the abdomen gilt; the anus furnished with four small projections. 6. A native of Europe; in walls of houses. *viridula.*

27 species of this genus have been described in the last edition of the System of Nature.

### 90. Vespa, *Wasp*.

Mouth composed of a horny substance. Jaw compressed. Feelers four, unequal and filiform. Antennæ filiform; the first articulation longer than the rest, and cylindrical. Eyes large and circular. Body smooth. Sting pungent, and concealed within the abdomen. The upper wings are folded in the males, females, and neuters.

These live mostly in numerous societies, constructing curious nests or combs, generally under ground; they prey upon other insects, especially bees and flies, and devour meal, bread, and fruit. The larva is soft, without feet, and feeds on the nectar of flowers and honey; the pupa quiescent, and has the rudiments of wings. Some of them are solitary, others live in swarms.

A. *No tongue.*

* *The Antennæ thicker towards their outer edge.*

* *crabro.* *Hornet.* The thorax black, marked on the fore part with reddish-spots; there is a double dot contiguous to the divisions between the segments of the abdomen. 3. A native of Europe. It has its nest in hollow trees, in out-houses, or any dry situation; its combs are very neatly constructed, and composed of a substance like coarse paper, or decayed parchment. They prey on other insects, particularly on bees. Their sting is very painful.

* *vulgaris.* Thorax marked on each side with a small interrupted line; the scutellum marked with four spots; the divisions between the segments of the abdomen dotted with black. 4. A native of Europe, about houses; they prey on flies, and rob bee-hives. They live in swarms composed of males, females, and neuters. The male has a yellow head, and long antennæ; an abdomen composed of seven yellow segments, marked with black triangular spots. They are destitute of stings, but are longer and larger than the neuters, though smaller than the females. The female has short antennæ; lip yellow; abdomen composed of six segments, marked on the sides with two black dots, and is furnished with a sting. There are frequently between two and three hundred females, and as many males, in a swarm of wasps. A single female in the spring that had been impregnated in the preceding autumn, lays the foundation of a swarm. It makes itself a hole in some dry situation, or fixes on a mole hole, where it hastily builds a few cells, and deposits its eggs; which in the course of about twenty days, pass through their different changes, and become perfect insects. Almost the whole of those produced from the first deposited eggs are neuters. As soon as they are fit to fly about, they commence their labours, enlarge their hole by removing the earth with their mouth, go out in quest of materials for forming new cells, which are composed of small fibres of wood, cemented together by a glutinous substance formed within the body of the animal. They may frequently be seen on rails, posts, &c. on reeds, or stalks of decayed vegetables, gnawing off small particles, which they convey to their nest, and deliver to those occupied in the construction of the work. The external covering of their nest is formed of several layers of thin leaves resembling paper, which are not in immediate contact with one another, and in that way they prevent external moisture from penetrating into the cells, which are arranged in flat combs placed over one another, each story being supported by a number of very neat pillars. The female continues to deposit her eggs, which are oblong and yellowish, during the whole summer, to the amount of many thousands. A few hundreds of those that are last deposed, produce males and females, which are impregnated in the autumn, and which, should they survive the winter, lay the foundation of new swarms in the spring. All the neuters and males perish in the beginning of winter.

* *parietum.* Body black; the thorax is marked with two dots; the scutellum is likewise marked with two dots, the abdomen with five yellow bands; the first of which is at a distance from the rest. 6. A native of Europe; about houses. It forms its nest in holes in wood.

* *muraria.* Black; thorax marked with two pale yellow spots; the abdomen marked with four yellow bands, the first at a considerable distance from the rest. 8. A native of Europe, in walls; the scutellum without spots; the shanks of the legs yellowish.

* *coarctata.* First segment of the abdomen funnel-shaped; the second bell-shaped, and very large. 11. A native of Europe, in gardens. It attaches its nest, which is globular, and constructed of the same materials with that of the common wasp, to the branches of trees; the abdomen black, the segments yellow at the edges; the first and second marked with two dots.

** *Antennæ filiform.* Crabrones.

*tridentata.* The abdomen marked with two yellow bands; the anus furnished with three small projections; wings black, white at the edge. 98. A native of Europe.

*fossoria.* Thorax without spots; the abdomen marked on each side with five yellow spots; legs black. 101. A native of Europe, in sandy situations. Head large, terminating abruptly in the fore part; mouth of a silver colour; the spots on the abdomen uniting so as to form a band.

B. *The tongue bent inwards, and divided into three at the point.* Bombyces.

*rostrata.* The upper lip conical and divided; the abdomen black, marked with waved yellowish bands. 152. A native of Europe, on sand hills. Their nests contain only a single larva.

*fasciata.* Black; lip roundish; the abdomen marked with six yellow bands; the first five of which are interrupted. 157. A native of Europe, covered with ash-coloured down; the thorax spotted with brown, the antennæ black, the first articulation yellow below, the last of a rusty colour; lip and legs yellow, the thigh black: the anus furnished with three small productions.

*ruficornis.* The lip nearly conical; the thorax brown, spotted with yellow; abdomen black, marked with six yellow bands; antennæ and legs of a rusty colour. 156. A native of Europe; head brown; mouth yellow: the bands on the abdomen broad, the first four interrupted.

160 species of this genus have been described by Gmelin in the last edition of the System of Nature.

### 91. Apis, *Bee.*

Mouth formed of a substance resembling horn; the lip and jaw membranaceous at the tip; tongue bent inwards. Feelers four, unequal and filiform. Wings plane. The females and neuters have a pungent sting concealed within the abdomen.

The insects of this genus live some of them in large societies, and some are solitary; their food is the nectar of flowers, honey, and ripe fruit; the larva is soft and without feet; the pupa resembles the perfect insect. The larvæ of the neuters are very numerous, and placed in hexagonal cells; the larvæ of the males are turgid and obtuse in the fore-part, and tapering behind.

#### A. *The Tongue divided into five at the point; the Feelers very short.*

_* centuncularis._ Black; the under part of the abdomen covered with yellow wool. 4. A native of Europe. It forms several nests under ground, very neatly composed of the leaves of roses. There are several species which form similar nests in the trunks of trees or in walls, composed sometimes of the leaves of the rose, at other times of those of the horse chesnut.

_* punctata._ Black, covered with ash-coloured hairs; abdomen black; the segments of the abdomen marked on each side with a white dot; the scutellum entire. 59. A native of Britain; on flowers.

_mellifica._ *Common Honey Bee.* Downy; the thorax grayish; abdomen brown; thighs of the hind-legs fringed with hairs; on the inside marked with transverse striæ. 22. A native of Europe; in hollow trees; but they are more frequently domesticated, and kept in hives. This well known and busy insect lives in great swarms, composed of females or queens, males or drones, and neuters or working bees. The female is larger and longer than the rest, the abdomen being about one-third longer than the wings; the antennæ have ten articulations; the feet reddish. The males are larger than the neuters; their wings are longer than the body; their antennæ have eleven articulations; the trunk is covered with long hairs, and is of a tawney colour. The neuters as well as the females are gray on the thorax, and are furnished with a sting, of which the males are destitute; their antennæ have fifteen articulations; they are furnished with two stomachs. A swarm consists commonly of one female, from 1000 to 1500 males, and of nearly 20,000 neuters (vide Bee). They construct regular combs, composed of hexagonal cells, with wax which is formed within the body of the insect. Reaumur and others have supposed, that the wax was formed from the farina of flowers, which the neuters collect and carry home on their legs, and their opinions have been implicitly followed. But Mr Huber, member of the Society of Natural Philosophy and Natural History of Geneva, by a set of very accurate experiments and observations, has clearly proven that the wax is formed from honey (vide *Journal de Physique, &c. Pluviose* An. XII.). We shall give here his own account of the experiments he has made. "It has been thought strange that the word wax should seldom occur in a book which treats of bees alone; but nevertheless, as in the course of my observations I had not attended to the products of their industry, I could only have repeated what had been said by Swammerdam and Reaumur, and that did not seem to me to be necessary. I knew that these insects collected abundantly upon the antheræ of flowers; that they are acquainted with the method of opening them, of gathering their dust, keeping it in the cavities of their hind legs, and carrying it to their hives. It had been observed that the particles of this dust swell in water, and that when one of them bursts, an oily liquor runs out, which floats on its surface, but did not mix with it. From these experiments, repeated on the dust of a great number of flowers, it was concluded that they contain the principle of wax; but it was admitted that these must undergo a peculiar elaboration in the body of the bee, since, according to the experiments of Reaumur, a flexible wax could not be made from the dust of the antheræ. It will be seen here from several passages in my work that I had adopted this opinion; a single observation of Burnons, (the name of Mr Huber's secretary), changed all my ideas. The true origin of wax might have been sooner known, had there been any suspicion that it was not already discovered. I shall now state how I was led to doubt, and what I have done to verify my new conjectures.

"I was in Switzerland in 1793: the farmer of the estate on which I resided had many bees; and the greater part of his hives having been stocked in former years, the combs with which they were filled reached to the stands, consequently there was no room to construct new ones. We remarked, however, that the working bees carried in a considerable quantity of this fecundating powder. There was also in the same apiary, some swarms of that year, the hives having only been stocked a day or two; in some of them the combs were only begun; in others they were larger; but in all of them there were vacancies to fill up, and much work to do. We observed with astonishment, that the bees of these swarms did not carry in the pollen; and that, nevertheless, they worked with activity in the construction of new combs, and in lengthening those already commenced. Where, therefore, did they procure materials for their edifices? After these observations, we suspected that it was not from the dust of the stamina, and that they had a very different use for it than that for which it was believed to be intended. We, however, found that it was impossible to explain these extraordinary facts, without abandoning the hypothesis of Reaumur, by supposing that the bees of the old hives stored up so much pollen in their combs for their future wants, while those of the new swarms did not carry it outwardly on their legs, in the infancy of their establishment, because they had no cells in which they could deposit it; it might be sufficient to enable them to construct their combs, if they were at liberty to fly to the flowers, procure their pollen, and return to their hives after having filled their stomachs, where it must be elaborated, and converted into perfect wax. It was to obviate these doubts, that I undertook the following experiments.

"*First Experiment.*—On bees in confinement, with honey alone for their nourishment. Must pollen be ate by bees, to be in a state to produce wax? This was the first question which I thought it necessary to investigate: the method of trying the experiment was obvious;

it was only required to keep the bees within their hives, and thus prevent them from collecting or eating the fecundating powder. On the 24th of May, Burnons lodged a swarm in a straw-hive, with as much honey and water as was necessary for their consumption; and he closed the doors, so that the bees could not get out, and the air be at the same time renewed.

" At first the bees were very uneasy, but became calm on removing the hive to a cool dark place; their captivity lasted five days; they were permitted to come out into a room, the windows of which were shut; we then examined the hive more conveniently. We first noticed that there was no honey left in the vessel which had been filled with it, with the sole intention of feeding the confined bees; and were more astonished to see five combs of the most beautiful wax, suspended from the roof of the hive; they were perfectly white, and very brittle. This result was very remarkable; however, before forming a conclusion from it, that the honey with which these bees were fed, had enabled them to produce the wax, it was necessary to inquire, whether it could not also be explained in another manner. The bees which I had employed had doubtless collected the dust while they were at liberty. They might have done so the evening before, or on the very same day of their confinement, and might have enough in their stomachs, and in the cavities of their legs, to extract from it all the wax which we found in their hives. But if it was true that it had been obtained from the fecundating powder, previously obtained, this source was not inexhaustible, and the bees being unable to procure any more, they would soon cease to construct combs, and fall into the most complete inaction. It was necessary, therefore, to repeat the same trial, to render it decisive.

" The 28th, Burnons returned this swarm into its hive; after having taken out all the combs, he shut them up as before, with a fresh supply of honey. This experiment was not long, for on the evening of the second day we perceived the prisoners working with new wax. The next day the hive was inspected, and we found five combs, as heavy and as regular as those made during the first captivity. We afterwards repeated this experiment five times successively, with the same bees, and the same precautions: we always found that the honey had disappeared, and that new wax was produced. This result was so invariable during this long seclusion, that we could no longer doubt that the honey alone had supplied them with all the elements of their wax, without the assistance of the fecundating dust.

" *Second Experiment.*—On a hive from which honey was excluded, and in which only pollen and fruits, for the nourishment of the bees, were left, I thought it would not be useless to make the inverse of the preceding experiment; it would show me whether the pollen could not supply the want of honey, when the bees were deprived of it, and enable them to produce wax.

" I therefore enclosed a swarm in a bell-glass, in which had been placed a comb, whose cells contained only pollen, and the sole nourishment of the bees was fruit.

" These bees did not make combs, nor did they form a single cell during eight days, which was the time of their captivity. I was going to repeat this experiment, when Burnons remarked, that the free bees were, in some measure, in the same state as those we had confined; there being no honey at that time in the flowers, they found only pollen, and did not work in wax.

" It may perhaps be asked, how I was satisfied of this: to which I answer, bees wax is white at first, the cells soon become yellow; and in time, this colour grows browner; and in older hives have acquired a blackish tinge. It is, therefore, very easy to distinguish the new cells from those which had been some time formed, and consequently to know whether the bees are really making combs, or whether that work is suspended; it is sufficient to raise the hives, and to notice the lower edge of the combs.

" The odour exhaled by the hives, and the shape of the bees, are indications, by which it may always be known whether there is honey in the flowers: if they are combined, there can be no further doubt; and, particularly, if a great number of bees return to the hive, which are remarkable for the bulk and form of their bellies. These which are filled with honey, have the abdomen cylindrical; the name of wax-making bees belongs to them exclusively: the bellies of the labouring bees, which have other functions, always preserve their ovoid form, and their volume is never sensibly augmented; the name of *nursing bees* is proper for these.

" The farmers of the neighbouring villages kept their bees in baskets, or in cases of different forms; and I was able to visit a very great number, without going to any great distance from my habitation.

" In 1793, an intemperate spring had retarded the separation of the swarms; there had not been any in the country before the 24th of May; but towards the middle of June there were several in the vicinity of my residence. At that time the fields were covered with flowers, the bees collected much honey, and the new swarms worked at the wax with vigour.

" On the 18th, Burnons visited 65 hives; at the entrance of all of them he observed wax-making bees. Those which returned to old hives, not having to construct cells, deposited their honey in the combs, or distributed it among their companions; those belonging to the young swarms converted their honey into wax, and hastened to construct combs for the reception of their young bees.

" It was showery on the 19th; the bees went abroad, but brought home only pollen. The weather was cold and rainy until the 27th. We were desirous of knowing if this had prevented their working. On the 28th, all the hives were lifted. Burnons found that the work had been stopped; the combs which he had measured on the 19th, were not at all increased, and were of a citron yellow; nor was there a single white cell in any of these hives.

" On the first of July, the chesnuts and limes were in blossom; the thermometer indicated the twentieth degree; the wax-making bees re-appeared; they carried away great quantities of honey, which, as he had before observed, was employed in augmenting the provisions of the old hives, and enabling the young swarms to construct new combs. The greatest activity was observable among them; the gathering of honey, and the production of wax continued, until the middle of this month. July 16th, the heat remained the same; the field flowers, as well as those of the chesnut and limes, were completely withered; they yielded no more honey, their pollen alone attracted the working bees, and they collected

collected it abundantly; but there was not any wax produced; the combs were not lengthened; those of the young swarms did not fill more than two-thirds of their hives.

" August 9th. It had not rained for six weeks; the heat was very powerful, nor was there any dew to allay it during the night; the black wheat, which had been in flower for some days, did not offer any honey to the bees; they found only pollen.

" On the 10th of August, it rained for several hours; next day, the black wheat had the odour of honey; in fact it might be seen glittering in the expanded flowers. The bees found enough to feed them, but too little to induce them to work at new wax.

" On the 14th, the drought recommenced, and lasted to the end of the month; no more honey appeared upon the flowers; and when we visited the 65 hives for the last time, we found, 1st, That the bees had not produced any wax after the middle of July. 2d, That they had stored up a great quantity of pollen. 3d, That the supply of honey was much lessened in the old hives, and that hardly any remained in the new swarms, that which they had collected in the spring having been employed in the preparation of wax. The pollen, therefore, has not this property, and no farther doubt remained on this head. This year had not been stormy, and I have since ascertained, by a great number of observations, that electricity is singularly favourable to the secretion of honey by the flowers; the bees never collect it in greater abundance, nor is the preparation of wax ever more active, than when the wind is in the south, the air humid and warm, and a storm gathering.

" Heat too long continued, and the drought which is the consequence of it, cold rains, and principally a north wind, suspend it entirely.

" *Third Experiment.* On the use which the bees make of the fecundating powder. In the second experiment, the bees did not touch the pollen which I had placed within their reach, and as its quantity was not sensibly diminished during this trial, I was induced to believe it was not an aliment proper for them.

" I also knew that the new swarms were liable to perish from hunger in the middle of summer, and even when the country was covered with flowers, if a particular temperature, which is too uncommon in our climate, did not favour the secretion of honey in their nectaria. What, therefore, is the use of the pollen they collect with such avidity during eight months of the year, and of which they lay up such abundance (A)? This question remained to be investigated.

" I had a hive in divisions, the queen of which was barren; its combs did not contain any pollen, but they had much more honey; the two narrowest sides of this hive were formed of panes of glass, through which the surfaces of the exterior combs might be seen, and the conduct of the bees observed.

" I took away the queen on the 16th of July; but to console the working bees, I removed the first and twelfth combs, in which there was not any thing to interest them; and I supplied their places with two combs, the cells of which were filled with eggs and worms of all ages. I carefully cut away all the cells in which pollen could be perceived, and shut up the hive with a grating. My intention will be guessed; I wished to know whether these insects could support their young without this fecundating powder. The next day nothing extraordinary occurred; the bees sat on their eggs, and seemed to nurse them.

" On the 18th, after sunset, a great noise was heard in the hive. Anxious to see what occasioned it, we opened the shutters, and observed that all was in confusion; the incubation was stopped; the bees ran over the combs in disorder; we saw thousands precipitate themselves on the stand, those which were nearest to the mouth eagerly gnawing the grating; their intention was no longer doubtful, they wished to get out of their confinement.

" I was fearful of destroying them by continuing to prevent them from yielding to their instinct; they were therefore set at liberty. The whole swarm came out, but the hour was unfavourable to their collecting: the bees did not go far from the hive, the darkness and the chilness of the air soon compelled them to return, and probably calmed their agitation; for we saw them quietly reascend their combs, and order appeared, to us, to be re-established. This moment was taken to close the hive again. On the 19th, we saw two royal cells begun on one of the combs of the nursery: the evening of this day, and at the same hour as the day before, we heard a great tumult in the closed hive; it was in a general confusion, and we were again obliged to permit the swarm to come out. The 20th was the fifth day of their captivity. We thought it had been of sufficient duration, and were also very impatient to examine the nursery, and to see what was the cause of this periodical agitation of these bees: Burnons therefore opened the first and twelfth windows, and drove the bees from the combs, suffering them to take their flight in a room, the windows of which were shut. He first noticed that the royal cells had not been continued, that they did not contain any worm, and that there was not an atom of the jelly which serves for the nourishment and the cradle of the larvæ of the queens. He sought in vain for eggs, for worms, and for the liquid in the common cells; all had disappeared. Had these worms died of hunger? Had we, by withdrawing the fecundating powder, deprived the bees of every means of nourishing the larvæ?

" To ascertain this, it would be sufficient to restore them their pollen, and observe the issue. The bees were, therefore, again returned to their prison, after having substituted young worms for those which had been suffered to die.

" On the 22d, we found that the bees had fastened these combs, and that they were again in a state of incubation; we then gave them some pieces of combs in which other bees had stored up the fecundating powder; and

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(A) Reaumur was of opinion that the bees of a well-stocked hive, might collect at least a hundred pounds of this substance in the course of a year; but having remarked that the weight of wax, fabricated in the same time, did not exceed two pounds, he concluded that the bees extract only a very small portion of the true wax from this native wax, that the greatest part of it is required for their nourishment, and that the rest is discharged from their bodies in the form of excrement.

and the better to observe what they did with it, we took some of the pollen out of the cells, and laid it exposed on the stand of the hive. In a few minutes, the bees discovered the pollen in the combs, and that which we had taken out; they took it grain by grain in their jaws, and conveyed it into their mouths; those which had eaten most voraciously reascended the combs, and placed themselves, at first, upon the cells of the young worms, which they entered head foremost, and remained there a greater or less length of time. One of the windows of the hive was now opened cautiously, Burnons powdered the bees which ate the pollen, and watched them for some hours; he observed that the marked bees always reascended the nursery, and immediately entered the cells of the young bees.

" The 23d, we found the royal cells begun.

" The 24th, we drove the bees from off the young worms; and we remarked,

" 1st. That all of them had the jelly, as in the common hives.

" 2d. That the worms had grown larger, and were forwarder in their cells.

" 3d. That others had been shut up again: and,

" 4th. That the royal cells had been lengthened.

" The 25th, we withdrew the pieces of comb which we had placed on the stand, and found that the quantity of pollen was certainly diminished; we afterwards replaced them in the hive with other cells filled with the fecundating powder.

" The 26th, the royal cells had been closed during the night, as well as several of the common ones.

" The 27th, I restored these bees to liberty. Burnons examined the cells with the greatest attention, and found jelly in all those which still contained worms, but most of them were shut with a lid of wax: he examined some of the latter, and found the worms employed in spinning cocoons of silk.

" All the worms therefore had been tended as in the natural hive. In this second trial we did not perceive any disorder in this hive; there had not been the least agitation: it is true some of the working bees attempted to go out in the course of the day; but finding it impossible, they reascended the combs quietly, which were never left for an instant. The hive being abundantly supplied with honey, and with the pollen necessary for their young, left them nothing to wish for; and they were still more happy when a queen was born, who afterwards became pregnant, and laid a great number of eggs. After these two experiments, there could be no more doubt that the fecundating powder was the aliment proper for the young bees, and that the want of this substance was the cause of their death, and of the evident anguish of their nurses during their first captivity.

" *Fourth Experiment*.—On bees deprived of honey and pollen, and which it was attempted to feed with sugar. I wished to know, if it was the saccharine part of the honey which enabled the bees to produce wax. Burnons confined a swarm in a glazed hive; one pound of Canary sugar was their sole aliment. He put a second swarm into another hive, and endeavoured to feed them with very coarse raw sugar; and to obtain a term of comparison, a third swarm was shut up in the same manner, and fed with honey. The bees of the three swarms produced wax; those fed with the different qualities of sugar produced it sooner than the swarm which had only had honey, and they produced a greater quantity. A pound of Canary sugar reduced to syrup, and clarified with white of egg, yielded 10 gros, 52 grains, of a wax not so white as that which the bees extract from honey. An equal weight of raw sugar, gave 22 gros of very white wax. Maple sugar produced the same effect. This experiment having been repeated seven times successively, always employing the same bees, we could not doubt that sugar contains the principles of wax; and concluded that it was the saccharine part of the honey which had this property.

" *Conclusion*. These observations shew,

" 1st. That the wax comes from the honey.

" 2d. That the honey is also a food of the first necessity to the bees.

" 3d. That flowers do not always contain honey, and that the secretion of honey depends in a great measure on the state of the atmosphere.

" 4th. That it is the saccharine part of the honey which enables the bees to produce wax.

" 5th. That raw sugar yields more wax than honey or refined sugar.

" 6th. That the dust of the stamina does not contain the principles of wax.

" 7th. That this dust is not the food of the adult bees, and that they do not collect it for themselves.

" 8th. That the pollen affords the only aliment which is proper for their young; but that this substance must undergo a peculiar elaboration in the stomachs of the bees, to be converted into an aliment; which is always appropriated to their sex, their age, and their wants; since the best microscopes do not shew the particles of pollen, or their coverings in the liquor, prepared by the working bees."

Hairy, black; wings of a violet colour. 38. A native of Europe, and of India. It pierces the trunks of decayed trees, or posts, and forms longitudinal excavations, in which it constructs several nests; having placed one at the bottom of the hole, it deposits an egg in it, fills it with a mixture of honey and pollen of flowers, closes it up, and commences another; it proceeds in this way till the cells occupy the whole length of the perforation; the eggs are so placed in the cells, that the head of the larva points downwards towards the exit. *violacea.*

*Humble-bee.* Hairy, black; thorax marked with a yellow belt; anus white. 41. A native of Europe. It forms a nest at a considerable depth under ground, and collects a good quantity of honey. *terrestris.*

Hairy, black; the anus of a tawney colour. 44. A native of Europe; in heaps of stones, or in old walls. It collects a considerable quantity of honey. *lapidaria.*

Black; slightly covered with reddish hairs; abdomen smooth, marked with three bands, white above, and reddish beneath. 147. A native of Europe. It somewhat resembles A. *mellifica*, but less. It comes out very early in the sprink. *præcox.*

B. *The Tongue divided into three at the extremity.*

* *The Lip furnished on each side with two membranaceous bristles.* Andrenæ.

Abdomen brown, marked with five whitish belts; the anus furnished with two small projections. 136. A native of America. It forms its nest in walls, of leaves of *bidentata.*

of trees neatly folded up; the fore legs are long and yellow; the feet fringed.

*dichroa.* Black; anus of a rusty colour. 137. A native of Europe; in groves.

* * *Lip without bristles, compressed, and entire; posterior Feelers tongue-shaped.* Nomadæ.

*suecica.* Covered with ash-coloured hairs; the abdomen smooth and black; the second and third segments of the abdomen of a rusty colour. 200. A native of Europe; in groves.

*variegata.* The thorax and abdomen variegated with white; the legs of a rusty colour. 24. A native of Europe. It sleeps all night fixed to the flowers of the *geranium phæum*. The scutellum sometimes of a rusty colour, and sometimes white; the first and second segments of the abdomen marked with two white spots; the third, fourth, fifth, and sixth, marked with four.

*morio.* Very hairy, and black; the jaws broad, and marked on the outside with elevated lines, and rounded at the points; wings of a reddish violet-colour. 214. A native of the south of America. One of the largest of this genus.

### 92. FORMICA, *Ant*, or *Emmet*.

Feelers four, unequal, with cylindrical articulations, placed at the tip of the lip, which is cylindrical, and nearly membranaceous. Antennæ filiform. A small erect scale placed between the thorax and abdomen. The females and neuters have a sting concealed within the abdomen. The males and females have wings; the neuters none.

This is a gregarious, and proverbially industrious family, consisting, like bees, of males, females, and neuters. The last are the well known little insects, who construct the nests or ant-hills, who labour with such unremitting assiduity for the support of themselves and the idle males and females, and who guard with such ferocity the larvæ, or what are commonly called ant eggs. They wander about all day in search of food or materials for the nest, and assist each other in bringing home what is too cumbersome for such as have attempted it. They every day bring out of the nest, and expose to the warmth of the sun, the new hatched larvæ, and feed them till they are able to provide for themselves. In the evening they consume together whatever has been collected during the day, and do not, as is commonly supposed, lay up any store for the winter, but probably become torpid or die. They are peculiarly fond of *aphides*, and are themselves eagerly sought after by the ant-eaters, and various birds. The puncture inflicted by their sting, occasions a hot painful itching sensation. They contain a peculiar acid. See CHEMISTRY *Index*.

* *herculanea.* Black; the abdomen oval; legs of a rusty colour. 1. A native of Europe, and America; lodge in the trunks of decayed trees.

*viatica.* Of a rusty colour; the abdomen oval and black. 23. A native of Europe; runs very quickly; the tip of the jaws black; the abdomen smooth.

* *rufa.* Black; the thorax compressed; the legs of a rusty colour. 3. A native of Europe; it lodges in sandy hills, in woods; it is large, and has no sting.

* *fusca.* Black; the mouth, the tip of the thorax, and legs, of a rusty colour. 4. A native of Europe; in woods.

* *rubra.* Of a brick colour; eyes black; a black dot under the abdomen. 7. A native of Europe. It lodges under stones in woods. They inflict a very painful puncture.

* *caespitum.* Black; two knots on the filament which connects the abdomen to the trunk; the scutellum furnished with two small projections. 11. A native of Europe; in dry meadows, under moss. The males and females, in the month of August, leave their nest about mid-day, when the weather is serene, and fly about in the air. The abdomen oval.

*omnivora.* The thorax marked with raised dots; the filament which joins the abdomen to the thorax is furnished with two knots; the body of a brick colour; the abdomen small. 12. A native of America. It is very destructive to all sorts of provisions. Small. The abdomen brown, covered with white hairs scarcely perceptible.

*vaga.* Black; abdomen oval and hairy. 50. A native of Europe; on decayed trees. It gnaws holes in the wood under the bark, and forms a number of passages for itself.

*glabra.* Black, smooth; the scale placed between the thorax and abdomen, furnished with two small projections; the divisions between the segments of the abdomen whitish; legs reddish. 53. A native of Europe.

55 species of this genus have been described in the last edition of the System of Nature.

### 93. MUTELLA.

Mouth formed of a substance like horn; without a tongue. Jaw membranaceous at the tip. Lip projecting, resembling an inverted cone; at the extremity of which are placed four unequal feelers, with conical articulations. Antennæ filiform. Wings wanting in most species. Body downy. The posterior part of the thorax turned back. The sting is pungent, and concealed within the abdomen.

*occidentalis.* Scarlet; the abdomen marked with a black belt. 1. A native of Europe. The antennæ, eyes, legs, and under part of the body black; the sting long and filiform.

*diadema.* Black; the base of the abdomen marked with two yellow dots; the middle with an interrupted yellow streak; the extremity with a small white line. 10. A native of South America. Large; the lower part of the head marked with a white band; the thorax marked with two white lines, and with white on the inferior part.

*aurata.* Bluish; the abdomen marked with a large golden-coloured spot. 13. A native of New Holland.

* *europæa.* Black; the thorax reddish; the edges of the segments of the abdomen white. 4. A native of Europe; in woods of maple.

*halensis.* Hairy, black; the thorax reddish; the abdomen marked with two white dots, and with a white band on the posterior part. 15. A native of Europe; the upper part of the shanks brown.

27 species of this genus have been described in the last edition of the System of Nature, published by Gmelin.

## VI. DIPTERA.

WINGS two. Poisers clavated; one placed behind each wing under a little scale.

### 94. OESTRUS. *Gad-fly, Breeze.*

A sucker drawn back within the lips, which are connected, and furnished with a small pore. Feelers two, of two articulations, orbicular at the tip, and seated in a depression on each side of the mouth. Antennæ short and setaceous.

The face of this singular genus is broad and depressed, and has some resemblance to the ape. They are extremely troublesome to horses, sheep, and cattle, depositing their eggs in different parts of their bodies, and occasioning painful tumours, and even death. The larva is without feet, thick, short, soft, and composed of several segments; they are sometimes furnished with hooks. They lurk within the bodies, or under the skin, of horses, oxen, &c.; and feed on their juices during the winter. The pupa is without feet, oval, and incapable of motion, covered with a hard light brown crust. The perfect insect lives but for a short time.

* *bovis.* Wings brown, without spots: the abdomen black, white at the base, and of a tawney colour at the extremity. 1. A native of Europe. It deposits its eggs on the backs of oxen, and lodges them under the skin. The larva, when young, is smooth, white, and transparent; as it advances in age, it becomes brownish, and when full grown and ready to be changed into a pupa, it acquires a dark-brown colour. It is lodged in a sack formed in the cellular substance immediately under the skin, and occasions a very considerable tumour on the back of the animal. The sack communicates with the air by a very narrow opening, next to which the anus of the animal is placed. Through the anus a yellow purulent matter is discharged; and near the anus are situated two spiracula. There is a small indentation on the opposite extremity of the larva, which is situated at the bottom of the sack, surrounded by two or three papillæ, which forms the mouth. It has a number of dots on its surface, disposed in transverse interrupted lines. Two distinct and different kinds of lines are seen on each segment; the uppermost of them is narrower, and consists of larger dots. Underneath this is a broader line, and the dots considerably smaller. The first are easily seen, by using the lens, to be hooks bent upwards, or towards the tail of the insect. On examining the broader line of small dots, with a tolerably powerful magnifier, they are also found to be hooks, but turned in an opposite direction, that is, downwards in the sack, and towards the head of the insect. These hooks, it is probable, are occasionally erected by the muscles of the skin; and according to the series of them used by the larva, it is raised or depressed in the sack; and by this motion, and consequent irritation, a more or less copious secretion of pus is occasioned for its sustenance.

This singular arrangement of hooks round the body of the larvæ, in this instance, serves the same purpose as the legs in other larvæ, enabling them to move about in the sack, and to crawl out of it when about to change into pupæ.

They never change their skin like most other larvæ, the same serving them through their growth; and it at length also serves to form the shell of the pupa. After leaving the sack, and previous to their becoming pupæ, they contract themselves, and assume a different figure.

They continue in the state of pupæ from about the latter end of June until about the middle of August, when the fly appears. Full grown larvæ are sometimes to be met with on the backs of cows in the month of September, which probably remain in the state of pupæ till the ensuing spring. The perfect insect, on leaving the hard crust which surrounds it, forces open a very remarkable, marginated, triangular valve, which may be traced in the skin of the larvæ, and is situated on one side of the smaller end.

The *oestrus bovis*, in its perfect state, is the largest of the European species of this genus, and is very beautiful.

The pain it inflicts in depositing its eggs is much more severe than any of the other species. When one of the cattle is attacked by this fly, it is easily known by the extreme terror and agitation of the whole herd: the unfortunate object of attack runs bellowing from among them to some distant part of the field, or the nearest water, while the tail, from the severity of the pain, is held, with a tremulous motion, straight from the body, in the direction of the spine; and the head and neck are also stretched out to the utmost. The rest, from fear, generally follow to the water, or disperse to different parts of the field. When the oxen are yoked to the plough, the attack of this fly is attended with real danger, as they become perfectly uncontroulable, and will often run with the plough directly forwards, through the hedges, or whatever obstructs their way. There is provided, on this account, a contrivance in many ploughs, to set them immediately at liberty.

The strongest and healthiest beasts seem constantly to be preferred by it, and commonly have the greatest number of botts, wormuls, or warbles, on their backs; dealers are frequently guided in their choice of cattle by this circumstance. The female fly is very quick in performing the operation of depositing her eggs: she does not appear to remain on the back of the animal more than a few seconds.

*buccatus.* Gray, marked with a white band, and dotted with black. 6. A native of Carolina.

*trompe.* Black, hairy; wings of a sooty colour; their outer edge bright black; head, thorax, scutellum, and anus, grayish-yellow. 7. A native of Lapland. The larvæ occupy the frontal sinus of the rein-deer; the animal sometimes in the spring, forces out great clusters of larvæ by sneezing. This is the largest species of the genus.

*tarandi.* Wings without spots; the thorax yellow, marked with a black band; the abdomen tawney, and bright yellow at the extremity. 2. A native of Lapland. It deposits its eggs on the back of the rein-deer. Such is their dread of it, that they every year leave the woods, and take refuge in the mountains. A very great proportion of them fall victims to this insect, before they are three years old. Those who escape with life are very much emaciated, and have their skins spoiled.

* *equi.* *Botts.* Wings whitish, marked with a black band in the middle, and two black dots. A native of Europe. (*Vide* Transactions of the Linnæan Society, vol. iii. p. 326.). The forehead white and downy; top of the head brown; the eyes black, and distant from one another; thorax brown, with a dark-coloured centre; the abdomen yellowish brown, the divisions between the segments of the abdomen marked with black spots and dots; the scutellum furnished with two tufts of hair; wings marked near the base with a very small black dot, in the middle with a black band, and towards the extremity with two black spots. The male is distinguished by a brighter yellow; the female by a deeper brown, and by the extremity of the abdomen, which is long, bent inwards, and black, terminating in a bifid style. It deposits its eggs on the hairs of the knees or sides of horses, which, when the animal licks itself, are conveyed by the tongue into the stomach. The body of the larva is composed of eleven segments, all of which, except the two last, are surrounded with a double row of horny bristles directed towards the truncated end, and are of a reddish colour except the points, which are black. These larvæ attach themselves to every part of the stomach, but are generally most numerous about the *pylorus;* and are sometimes, though much less frequently, found in the intestines. Their numbers in the stomach, are very various, often not more than half a dozen; at other times more than an hundred; and if some accounts might be relied on, even a much greater number than this. They hang most commonly in clusters, being fixed by the small end to the inner membrane of the stomach, to which they adhere by means of two small hooks or *tentacula*. When they are removed from the stomach they will attach themselves to any loose membrane, and even to the skin of the hand. For this purpose they sheath or draw back the hooks almost entirely within the skin, till the two points come close to each other; they then present them to the membrane; and keeping them parallel till it is pierced through, they expand them in a lateral direction, and afterwards, by bringing the points downwards towards themselves, they include a sufficient piece of the membrane, and remain firmly fixed for any length of time. These hooks, the better to adapt them to this purpose, appear to have a joint near their base.

The larvæ attain their full growth about the latter end of May, when they quit their hold of the internal membrane of the stomach, and pass along with the food through the intestinal canal. From the end of May till the beginning of July they may be seen in the dung which drops from the horse; when they reach the ground they seek out some convenient situation, and become pupæ, and remain in that state for about six or seven weeks. The mode pursued by the perfect insect to obtain for its young a situation in the stomach of the horse, is truly singular, and is effected in the following manner.—When the female has been impregnated, and the eggs are sufficiently matured, she seeks among the horses a subject for her purpose; approaching it on the wing, she holds her body nearly upright in the air, and her tail, which is lengthened for the purpose, curved inwards and upwards: in this way she approaches the part where she designs to deposit the egg; and suspending herself for a few seconds before it, suddenly darts upon it, and leaves the egg adhering to the hair; she hardly appears to settle, but merely touch the hair with the egg held out on the projected point of the abdomen. The egg is made to adhere by means of a glutinous liquor secreted with it. She then leaves the horse at a small distance, and prepares a second egg, and poising herself before the part, deposits it in the same way. The liquor dries, and the egg becomes firmly glued to the hair: this is repeated by various flies till 400 or 500 eggs are placed sometimes on one horse.

The inside of the knee, or those parts of the body of the animal that are liable to be licked, are chosen by the fly from instinct, as the proper places for depositing its eggs. The well-known disease in horses called the *botts*, which frequently proves fatal, is supposed to be occasioned by the larvæ of this insect.

*nasalis.* Wings without spots; the thorax of a rusty colour; abdomen black, covered with yellow hairs. 3. A native of Europe. This insect is said to deposit its eggs in the nostrils of horses, mules, asses, and of goats; and the larvæ occupy the fauces. Body black; thorax destitute of furrows; the head and abdomen covered with yellow hairs, except the first segment, which is covered with white ones.

* *hæmorrhoidalis.* Thorax yellow, marked with a black band; wings white, marked with black bands. 4. A native of Europe. It deposits its eggs on the lips of horses, occasioning a titillation, which causes the animal, when attacked by it, to move his head about violently, and gallop about with every appearance of distress. The larva of this insect needs not to be particularly described, as it resembles in almost every respect that of the *equi*. Its habits are the same, being seen in the stomach of the horses, occupying the same situation as those of the *equi*, from which they can only be distinguished by their smaller size and greater whiteness. When it approaches maturity it acquires a red colour. It is frequently seen adhering to the extremity of the rectum; which circumstance, along with its colour, has occasioned it to receive the name of *hæmorrhoidalis*. In about two days after it has left the body of the horse, it is changed into a pupa, in which state it remains nearly two months.

* *ovis.* Wings faintly dotted; the abdomen variegated with white and black. 5. A native of Europe. The larva occupies the frontal sinus of the sheep; they are flat on the one side; and convex on the other; of a whitish colour; and nearly of the same size with the larvæ of the *O. equi*. When young these larvæ are perfectly white and transparent, except the two horny plates, which are black. As they increase in size, the upper side becomes marked with two transverse brown lines on each segment, and some spots are seen on the sides. When full grown they fall through the nostrils, and change to the pupa state, lying on the earth. The insect deposits its eggs on the inner margin of the nostrils of the sheep. The moment the fly touches that part of the sheep, they shake their heads, and strike the ground violently with their fore feet; at the same time holding their noses close to the earth, they run away, looking about them, on every side, to see if the fly pursue. They do not, like the horses and cows, take refuge in the water; they have recourse to a rut, or dusty road, or a gravel pit, where they crowd together during the

heat of the day, with their noses held close to the ground, which renders it difficult for the fly conveniently to get at the nostril.

*antilopæ.* Wings dotted with brown, and marked with a brown band; body hairy, of a grayish yellow colour; the abdomen marked with three rows of blackish spots. 8. A native of Asia. It deposits its eggs under the skin of the back of the antelope. About the size of the *musca carnaria.*

*fasciculosus.* Yellow and downy; the anus furnished with three tufts of black hairs. 9. A native of Siberia; head and eyes black.

*hominis.* Entirely brown. 10. A native of South America. Deposits its eggs under the skin of the abdomen of the natives, or of people residing in countries where they are prevalent. The larvæ continue six months under the skin; if they be disturbed, they penetrate deeper, and produce very troublesome ulcers which sometimes prove fatal.

10 species of this genus have been described in the last edition of the System of Nature.

### 95. Tipula, *Crane-fly.*

Mouth furnished with a very short proboscis, membranaceous, and grooved on the back, receiving a bristle; with a short sucker without a sheath; and with feelers two, equal, filiform, and longer than the head. Antennæ in most of the species filiform.

Most of this genus have a great resemblance to the gnat. They feed on various substances. The larva is soft, without feet, and cylindrical; its head is furnished with a small projection, and terminates abruptly; they feed on the roots of plants; they are eagerly sought after by crows and other birds. The pupa is cylindrical, and is furnished with two horns on the anterior extremity, with small projections behind.

#### A. *Wings expanded.*

* *pectinicornis.* The antennæ pectinated; the wings marked with a black spot; the thorax yellowish. 1. A native of Europe; in moist places. The abdomen reddish at the base, marked with a yellow band in the middle, black at the tip.

* *oleracea.* Wings transparent, with a brown rib along the edge. 5. A native of Europe. It does a great deal of mischief in gardens, corn fields, and meadows, by consuming the roots of pot-herbs, growing corn, and grass.

* *hortorum.* Wings transparent, sprinkled with very faint spots. 6. A native of Europe; in gardens, destroying the crops.

* *triangularis.* One half of the wings brown, marked with white triangular spots. 111. A native of Scotland.

* *variegata.* Black; the base and sides of the abdomen red, spotted with yellow. 7. A native of Europe; in gardens.

**pratensis* The thorax variegated; abdomen brown, spotted with yellow on the sides; the forehead tawney. 10. A native of Europe; in meadows. It is very destructive to the roots of grass.

*cornicina.* Wings transparent, marked on the edge with a brown spot; the abdomen yellow, marked with three brown lines. 12. A native of Europe. Very destructive to the roots of plants, and much sought after by crows.

* *regelationis.* Wings transparent and shining; body of a brownish ash colour. 21. A native of Europe. This species appears very early in the spring; and may be seen dancing in the air in great numbers in mild weather.

#### B. *Wings incumbent.* Culiciformes.

* *plumosa.* Thorax greenish; wings white, marked with a black dot; the antennæ feathered. 26. A native of Europe; in marshy places.

* *littoralis.* Greenish; wings spotted; the fore legs very long. 27. A native of Europe; on the sea coast.

*johannis.* Black, smooth; wings white, marked with a black dot; the antennæ short; legs black. 41. A native of Europe; in shaded places.

* *pomonæ.* Black, smooth; wings transparent, marked with a black dot; the thighs of a rusty colour. 101. A native of Britain, and Norway; on the flowers of fruit trees.

*florilega.* Black, silky. 45. A native of Europe; on the flowers of fruit trees, which it injures very much. It frequently blasts the hopes of the farmer.

* *hortulana.* Wings transparent; the outer edge black. 46. A native of Europe. It is very destructive to asparagus, and to the flowers of fruit trees. The thorax and abdomen sometimes black, sometimes red.

*moschifera.* Wings of an ash colour; the thorax and abdomen yellow. 123. A native of Chili. This insect has a very pleasant smell, and is made use of by the young girls of Chili for perfuming their clothes.

* *tritici.* Of a tawney colour; wings white and transparent, hairy on the margins; the eyes black. A native of England. Larva leaps; without feet; is orange-coloured, and marginated; the margin folded with papillæ; the head acute; the tail terminating abruptly. The pupa is narrow, acute at both ends, and reddish.

126 species of this genus have been described in the last edition of the System of Nature.

### 96. Diopsis.

The head furnished with two filiform horns, without articulations, much longer than the head, on the tops of which the eyes are placed.

*ichneumonea.* 1. A native of North America and Guinea. Reddish; antennæ very small and setaceous; the horns of a rusty colour; the eyes which terminate the horns are globular and black; the thorax black; furnished with two yellow tapering projections behind, and with a single one on each side; wings transparent, and marked with a black dot before; the abdomen clavated, and attached to the trunk by a narrow stalk: the two last segments of the abdomen black; the legs yellow; the thighs of the legs clavated. It resembles an *ichneumon*, and is about the size of the red ant.

Only one species of this genus has been described in the last edition of the System of Nature.

### 97. Musca, *Fly.*

Mouth furnished with a fleshy projecting proboscis, with two equal lips, with a sucker furnished with bristles, and with two short feelers. Antennæ short (in most species).

Flies live chiefly in dunghills; their larvæ are without feet,

feet, composed of several segments, nearly cylindrical, and becoming smaller behind. The larvæ of the flies of the first and second divisions, live in the water, have a breathing hole at their head, are bearded, and live on aquatic animalculæ; those of the fourth division live on rubbish; those of the third on dung, putrid animal substances, and on small insects; some of them particularly on *aphides*: they remain fixed on a leaf, and with their snout collect and devour the *aphides*. The pupæ are immoveable, and most of them covered with a hard skin; the pupæ of the flies of the first and second divisions are cylindrical, and covered with the skin of the larvæ, which becomes hard.

### A. *The Sucker composed of a single valve; the Antennæ connected at the bases, and sharp at the points.* Bibiones.

*plebeja.* Of an ash colour, and hairy; the abdomen conical; the edges of the segments white. 1. A native of the north of Europe. The thorax is sometimes yellow, and abdomen of a rusty colour.

*margi- ata.* Black; the abdomen conical; the edges of the segments white; the wings spotted. 130. A native of Europe.

### B. *Sucker without a sheath.*

### a. *Those which have a single bristle.*

### † *The Antennæ pointed and connected at the base.* Stratiomyes.

*chamæ- on.* The scutellum pale yellow, and furnished with two small projections; the abdomen black, marked on the sides with yellow bands. 3. A native of Europe; on flowers. The larva lives in fresh water.

*kginosa.* Body black; the scutellum without projections; the abdomen white, and black at the extremity. 22. A native of Europe. The forehead yellow; the joints of the legs white; the shanks of the legs pale.

*vallata.* The scutellum marked with six projections; the abdomen and thighs yellow. 166. A native of Britain; on hedges. Wings of a faint rusty colour; incumbent and plain; the nerves of the wings marked with a brown dot in the middle; the poisers yellow; the feet, and lower extremity of the shanks of the legs, brown.

*ectarea.* Black; antennæ cylindrical and perfoliated; wings white. 24. A native of Europe; on the flowers of apple trees. It drinks the nectarious juice, and lodges all day long within the flower; it is very small, and not larger than a common flea; body oblong; legs long.

### †† *The Antennæ short and clavated, furnished with a bristle.*

### * *Feathery, or with hairy feathered Antennæ.*

*inanis.* Brown; the abdomen transparent, marked with three black belts. 61. A native of Europe; in thickets.

*pellucens* Black; the first segment of the abdomen white, and transparent. 62. A native of Europe; in shaded places.

*cæsar.* Shining green; legs black. 64. A native of Europe; on carrion.

*ornicina.* Thorax of a shining copper colour; the abdomen of a greenish yellow with a metallic lustre; legs black. 169. A native of Europe. The sides of the lips of a shining silver colour.

Shining; the thorax blue; the abdomen green. 65. A native of Europe; on carrion. * *cadaverina.*

The thorax black; the abdomen shining blue; the forehead tawney. 67. A native of Europe and America; on carrion; they consume dead bodies very quickly; they likewise feed on milk. * *vomitoria.*

Black; the thorax marked with pale lines; the abdomen shining, and chequered. 68. A native of Europe; on carrion. The eyes reddish; the anus tawney. The larvæ likewise infest bee-hives. * *carnaria*

*Common house-fly.* The thorax marked with lines; the abdomen chequered, and pale on the under side at the base. 69. A native of Europe and America; in houses. The larvæ live in horse dung. * *domestica.*

Brown; the thorax blue and downy, marked with three eminences; the tip of the scutellum and thighs yellow. 390. A native of Europe; very destructive to olives. The female deposits a great number of eggs in the month of July, on the fruit of the olive; the larvæ consume the pulp. *oleæ.*

### ** *The Antennæ furnished with a naked bristle.*

Smooth, black; the abdomen wrinkled on the upper side, marked with white steaks; wings brown. 14. A native of Europe; in windows. *fenestrata.*

Blackish; the tip of the scutellum of a faint brick colour; the abdomen chequered. 78. A native of Europe; on the caterpillars of moths and butterflies, and likewise on the roots of cabbage and colewort, rendering the root knotty; the tips and base whitish; thorax black, marked with lines. * *larvarum.*

Black; the abdomen of an ash-colour, marked with black bands. 79. A native of Europe; on the roots of the radish. * *radicum*

Hairy and whitish, marked with a black line on the back, with several black lines along the sides. 208. A native of Europe; on the roots of the turnip, which it destroys, and causes to appear as if rotten; it attacks those turnips chiefly that have been sown in light sandy soil. The larva is white, without feet; the head is pointed and tipt with black; it undergoes its transformation about September. Pupa is oblong, brown, composed of several segments, and becomes a perfect insect in May. *napobrassicæ.*

Of an ash colour; the thorax marked with five black spots; the abdomen marked with very faint spots. 83. A native of Europe. It is to be seen flying about in swarms before rain. *pluvialis.*

Hairy and ash-coloured; the extremity of the thighs and shanks of the legs of a rusty colour. 212. A native of Britain; and feeds on other flies. * *rapax.*

Black; the abdomen pale; the eyes of a rusty colour. 87. A native of Europe; in cellars. * *cellaris.*

Black; the abdomen of an ash-colour; the wings yellowish at the base. 88. A native of Europe. They fly about very much in the air immediately before rain, and collect about the mouths of horses in great swarms, particularly about the summer solstice. The larvæ are sometimes found in the human stomach. * *meteorica.*

Shining black, eyes brownish; wings shining red and green. 216. A native of Europe; in oats, which it destroys *avenæ.*

destroys by gnawing the stalks when young. Larva yellowish and without feet.

*frit. Black; the poisers and feet of the hind legs, and abdomen, pale green. 90. A native of Europe; on the ears of barley. It is so frequent in Sweden, that it has been calculated that one-tenth of the grain is consumed by it annually.

*pumilionis. Black; the under part of the head, and two lines on the thorax, yellow; the poisers white; the legs of an ash-colour, and black at the tip. 217. A native of Europe. The larva has a sharp head, black at the extremity; the body white, composed of ten segments; it is changed into a pupa about the end of May. The pupa is yellow, shining, and composed of several segments; the perfect insect appears about the middle of June. At what time it deposits its eggs is not well ascertained. The larvæ are perceived early in the spring, in the centre of the stalks of wheat and rye, very near the root. In all probability the eggs have been deposited in the month of October, or end of September, as the early sown grain is found to be most affected. White wheat is more liable to be injured than red. The stalks in which the larva is lodged, do not advance in growth, but continue dwarf, whence the insect has received the name of *pumilionis*. The stalks become yellow in the beginning of summer, and decay; others commonly spring up from the same root, and supply their place. This insect first attracted notice in England in the spring of the year 1791, when it excited some alarm, as fears were at first entertained that it was the Hessian fly, which had done so much mischief in America. Some plants of infected wheat were sent to Mr Markwick by a friend in the neighbourhood of Battle. Mr Markwick succeeded in obtaining the perfect insect from them, of which he has given an account. (*Vide* Transactions of the Linnean Society, p. 76. tab. 15.) Some of the infected wheat was likewise sent by Arthur Young to Sir Joseph Banks, who ascertained the insect to be the *musca pumilionis* described in Gmelin's System of Nature, and not the Hessian fly. An account of this fly, and of the mischief caused by it, was first published in the Transactions of the Royal Academy of Sciences at Stockholm for the year 1778, by Mr Ob. Bjerkander, who discovered it on the young shoots of the rye, in the month of May; and in such quantity, that in some fields he found three or four stalks affected in a square foot.

petronella. Livid; the forehead red; the legs long, and of a light red colour; the joints of the legs black. 96. A native of Europe. It may be seen running about on the surface of stagnant water.

sonchi. Wings transparent, marked on the edge with a black spot; the eyes green. 121. A native of Europe; on the receptacles of the flower of the sow-thistle. Thorax brown, with a pale scutellum; the abdomen black, oval, and greenish beneath; the edges of the segments whitish; tail with an obtuse style; wings with two brown nerves; legs of a brick colour.

### b. *Sucker furnished with three bristles.* Ragiones.

vermilio. Of an ash-colour; the abdomen marked with three rows of black dots; the thorax spotted; the wings without spots. 17. A native of Europe; in loose sand.

colombaschensis. Black; the divisions between the segments of the abdomen, the shanks of the legs, and feet white. 324. A native of Europe and Asia. It is about half the size of the common gnat, and is most frequent in the beginning of spring and end of summer, in Servia, Russia, and Siberia, where it insinuates itself into the bodies of cattle, which it frequently destroys, as its bite proves fatal in a few hours. Smoke is very offensive to it; and in the places where it prevails the people have recourse to it, as their only mode of defence.

papatasi. Antennæ, body, and wings hairy. 325. A native of Europe. It is very troublesome in Lombardy in the night time, during the whole summer. It is very minute; eyes black, dotted with white; the wings, when the insect is at rest, diverge so as to form an obtuse angle; the abdomen red.

acuminata. Black; the abdomen long, slender, and tapering towards the extremity; the wings spotted, the thighs reddish yellow; the shanks of the legs and feet brownish. 226. A native of Europe.

### c. *The Sucker furnished with four bristles.* Syrphi.

#### || *Bristle of the Antennæ feathery.*

*bombylans. Black; the abdomen hairy, and reddish behind. 25. A native of Europe; among bushes.

*apiaria. The anterior part of the thorax yellow; the extremity of the abdomen white; the wings of a rusty colour at the tip. 528. A native of Europe; the posterior part of the thorax, the forehead, and abdomen black; wings obscure.

#### || || *The Bristle of the Antennæ simple and smooth.*

conopsea. Black, without hairs, the sides of the thorax marked with yellow lines, the abdomen with three yellow lines. 21. A native of Europe; among bushes.

*pendula. The thorax marked with four yellow lines; the abdomen with three interrupted yellow bands. 28. A native of Europe. The larva lies in stagnant water, and is suspended by a long filiform tube through which it breathes.

*tenax. Thorax gray; the abdomen brown; the thighs of the hind legs compressed. 32. A native of Europe; in dunghills, in necessaries, and in putrid water. The larva is very tenacious, and difficultly destroyed by pressure.

*pyrastri. Very slightly hairy, black; the thorax without spots; the abdomen marked with six white circular spots. 51. A native of Europe; and feeds on the *aphides* on the leaves of the pear tree.

*merthastri. Black; not hairy; the thorax spotted; the abdomen marked with four yellow belts, the scutellum yellow. 54. A native of Europe; on flowers, chiefly on the mint. The perfect insect feeds on honey, the larva on aphides.

saltatrix. Naked; yellow; the upper part of the abdomen brown; the thorax marked with three brown lines. 60. A native of Europe; in meadows, where it leaps about on the ground like a grashopper; the longitudinal line on the thorax, somewhat broad, marked with an oblong black spot, and with a black line on each side towards its extremity; poisers white.

360 species of this genus have been described in the last edition of the System of Nature, published by Gmelin.

### 98. TABANUS, *Ox-fly*.

Mouth furnished with a straight, projecting, and membranaceous proboscis; with a small and oval head; with two equal lips; with a long projecting sucker, which can be concealed in a groove on the back of the proboscis. Sheath of one valve, and furnished with five bristles. Feelers two, equal, clavated, and sharp at the points. Antennæ short, cylindrical, approaching to one another, pointed, and composed of seven articulations.

These insects live by sucking out the blood of various animals, of which they are very greedy. The larvæ are found under ground, in moist meadows: the colour of the eyes vanishes when the insect is dead, but may be restored by placing it in warm water.

*bovinus.* Eyes greenish; the back of the abdomen marked with long triangular white spots. 4. A native of Europe. It is very troublesome to horses, and horned cattle; their bite is painful; they even molest the human species in very warm weather; they are most frequent in moist situations.

*randi-us.* Eyes green; the segments of the abdomen yellow on the edges: legs reddish. 7. A native of Europe. They wound the tender horns of the rein-deer, and spoil their shape; they are met with in Italy, and the southern parts of Europe, as well as in Lapland.

*llucens.* Black; eyes marked with bands; first segment of the abdomen bluish; the shanks of the legs pale.

*paganus* The anterior parts of the eyes green, marked with three tawney bands; the abdomen marked on both sides with rusty-coloured spots. 25. A native of Britain.

*tropicus.* Eyes marked with three purple bands; the sides of the abdomen of a rusty colour. 14. A native of Europe; very troublesome to cattle, especially to horses, immediately before rain.

*pluvialis* Eyes green, marked with four waved bands; wings dotted with brown. 16. A native of Europe.—This little animal fixes on the hands, face, and legs, and excites a painful inflammation in the part where it has drawn blood.

*cæcuti-ns.* Eyes green, dotted with black; wings without spots. 17. A native of Europe. It is extremely troublesome in hot weather, especially before rain, fixing on the hands and face, or any uncovered part; it draws blood very dexterously, and leaves an inflamed bloody puncture behind.

38 species of this genus have been described in the last edition of the System of Nature published by Gmelin.

### 99. CULEX, *Gnat*.

Mouth furnished with a sheath of one piece, flexible, and set with five bristles. Feelers two, composed of three articulations. Antennæ filiform.

The insects of this genus live on the juices of the larger animals, and are eagerly sought after by poultry, and small birds. The larva lives in stagnant waters, and has a small cylindrical respiratory tube, near the tail; the head is armed with hooks to seize on the aquatic insects upon which it feeds; it is devoured by ducks, and water fowl. The pupa is curved and oval, with respiratory tubes near the head. They continue but a short time in the state of larva and pupa. The perfect insect deposits her eggs in clusters on the surface of the water, where they remain for a few days until they are hatched. Gnats in this country, however troublesome they may be, do not make us feel them so severely, as the musquito does in foreign parts.

* *pipiens.* Of an ash colour; the abdomen marked with eight brown rings. 1. A native of Europe, and the northern parts of Asia and America; in the neighbourhood of fresh waters, and in marshy places. It is larger in more southerly climates, and its bite occasions more pain and inflammation. When on the wing it makes a constant shrill noise, whence it has received its name *pipiens*. The male is not easily distinguished from the female by its pectinate antennæ: it is more troublesome, and its bite more painful, than that of the female. Ducks, and other aquatic fowls, feed their young with them; different species of the *libellula* likewise devour them. They sometimes insinuate themselves into the lungs and intestines of quadrupeds, where their bite excites a fatal inflammation. The natives of countries where they are very troublesome, have recourse to the smoke of different vegetables as a defence. In warm climates they are frequently compelled to make use of gauze curtains, which they draw close round them when asleep. They are said to shine in the dark.

*annulatus.* Brown; the abdomen and feet marked with white rings; the wings spotted. 8. A native of the north of Europe; the snout half the length of the body.

* *bifurcatus.* Brown; the thorax faintly marked with lines. 3. A native of Europe; in marshy situations.

* *pulicaris.* Brown; wings white, marked with three obscure spots. 10. A native of Europe; it creeps about a great deal; its bite is succeeded by a brown spot.

13 species of this genus have been described by Gmelin, in the last edition of the System of Nature.

### 102. EMPIS.

Sucker with a sheath of one piece, furnished with three bristles, and an inflected proboscis. Feelers short, and filiform. Antennæ setaceous.

The minute insects which compose this genus, live by sucking out the blood and juices of other animals.

* *borealis.* Black; wings nearly round, and of a rusty colour. 1. A native of Europe; they may be seen dancing in the air in great numbers in the evening when the weather is good.

* *pennipes.* Black; the hind legs long and feathered. 2. A native of Europe; it is frequently found on the leaves of the *geranium sylvaticum*, and *cardamine pratensis*.

* *livida.* Livid; thorax marked with lines, the base of the wings and legs of a rusty colour. 3. A native of Europe; it is frequently to be found on the *heracleum spondylium*; the upper part of the abdomen very dark brown; wings oblong, marked with brown veins.

Of

* *cinerea.* Of an ash colour; thorax without spots; legs pale; wings brown at the tip. 9. A native of Europe; on umbelliferous plants.

19 species of this genus are described in the edition of the System of Nature published by Gmelin.

### 101. STOMOXYS.

Sucker consisting of a sheath of one piece, and furnished with enclosing bristles. Feelers two, short, bristle-shaped, and composed of three articulations. Antennæ setaceous.

The insects of this genus live by sucking the blood and juices of other animals; those of the division *rhingiæ* principally attack insects of the orders *lepidoptera* and *diptera*.

A. *The Sheath convoluted, and bent at the base, with an angular flexure, and furnished with two bristles.*

* *calcitrans.* Gray; antennæ slightly feathered; legs black. 4. A native of Europe. It resembles the common fly very much in every respect, except in the snout, and in having the segments of the abdomen marked with two black spots. It is very troublesome to horned cattle; by getting about their feet, it causes them to kick, and stamp with their feet: before rain it bites more frequently. It does not spare the human species, particularly in autumn.

* *irritans.* Of an ash colour, and somewhat hairy; the abdomen spotted with black. 5. A native of Europe. This species is very frequent, and troublesome to cattle; by fixing on their backs, it causes them to keep their tails almost in constant motion to lash it off.

*pungens.* Of an ash colour, with black thighs. 6. A native of Europe. It is very troublesome to cattle, resembles *St. irritans*, but much smaller wings; whitish, without spots; the abdomen sometimes of dark colour.

B. *Sheath covering the mouth, and furnished with bristles.* Rhingiæ.

* *rostrata.* Thorax faintly marked with lines; the snout, legs, and abdomen of a brick colour. 8. A native of Europe. Very troublesome to cattle; about the size of the common fly; wings pale.

*lineata.* Thorax marked with lines; abdomen black, marked on the sides with yellow spots. 9. A native of Europe. The lip long, yellow, with a black emarginated tip, and formed of a horny substance enclosing the proboscis. The antennæ black, with a rusty-coloured knob, and furnished with a bristle; the thorax marked with four white lines; the scutellum of a brick colour; wings whitish; legs yellow; the thighs marked with a white belt.

Only 9 species of this genus have been described by Gmelin in the last edition of the System of Nature.

### 102. CONOPS.

Mouth furnished with a projecting snout, which is bent with an angular flexure. Antennæ clavated, and pointed at the extremity.

The insects of this genus live by sucking the blood and juices of other animals.

A. *Sucker furnished with a short valve of one piece, and with a single bristle.*

* *vesicularis.* Blackish; back part of the head vesicular, the abdomen yellowish and black at the base. 4. A native of Europe; in groves.

* *macrocephalus.* Black; six segments of the abdomen yellow on the edges; antennæ and legs reddish. 5. A native of Europe; in groves.

B. *The Sucker bent both at the middle and at the base, with an angular flexure. Sheath consisting of two pieces, the two pieces which compose the Sheath equal.* Myopæ.

* *ferruginea.* Of a rusty colour; the abdomen cylindrical, and bent inwards; the forehead reddish. 8. A native of Europe; in groves.

*atra.* Abdomen cylindrical, and bent inwards; body black. 2. A native of Europe; among bushes.

14 species of this genus are described in the edition of the System of Nature published by Gmelin.

### 103. ASILUS.

Mouth furnished with a sucker, composed of a horny substance, projecting, straight; consisting of two pieces, and turgid at the base. Antennæ filiform.

They prey on other insects, especially those of the *lepidopterous* and *dipterous* orders.

* *crabroniformis.* The abdomen hairy; on the fore part there are three of the segments black; behind yellow and bent inwards. 4. A native of Europe. The larva lies under ground. This is the largest species of the genus which is to be met with in Britain. Its sting is very painful.

*epiphium.* Hairy, black; the thorax white at the base. 19. A native of Europe.

* *ater.* Hairy, black; with a whitish band. 7. A native of Europe. It rests by leaning on its breast, with its legs spread. Claws white.

*diadema.* Black; wings black; the forehead white. 22. A native of Europe. Band and wings wholly black.

* *tipuloides.* Of an ash colour, without hairs; legs of a rusty colour; feet black. 14. A native of Europe.

*striatus.* Black; the thorax marked on each side with an ash-coloured line; the poisers yellow. 44. A native of Europe.

Gmelin has described 48 species of this genus, in his last edition of the System of Nature.

### 104. BOMBYLIUS, *Buz-fly.*

Mouth furnished with a sucker, very long, setaceous, straight, and composed of two valves, the valves unequal, and likewise with three bristles. Feelers two, short, and hairy. Antennæ tapering towards the point, and connected at the base.

The species of this genus feed on the nectarious juice of flowers, which they collect when on wing.

** major.* *Humble Bee.* Wings with a broad black waved outer edge; body black, with thick yellowish down. 1. A native of Europe.

** medius.* Wings dotted with brown; body yellowish and white behind. 2. A native of Europe. It is to be met with very early in the spring.

*minimus.* Wings brownish at the base; body yellowish, and hairy; snout and legs black. 7. A native of Europe. Very small; antennæ black; wings white.

*griseus.* Hairy; wings white, brown at the base; thorax black, marked with white lines; abdomen grey. 11. A native of Europe; on compound flowers. Wings marked with two black dots in the middle.

*virescens.* Wings white, without spots; body hairy, and greenish; the snout short. 12. A native of Europe; on flowers. Thickly covered with greenish hair.

There are 15 species of this genus described in the last edition of the System of Nature.

### 105. HIPPOBOSCA.

Mouth furnished with a short, cylindrical, straight sucker, composed of two equal pieces. Antennæ filiform. Legs furnished with many claws.

The species of this genus live on the blood of other insects.

*equina.* *Horse-fly.* Wings obtuse; thorax variegated with white; legs terminating in four claws. 1. A native of Europe and America.—They are very troublesome to horses; they hide themselves under the hairs, and attach themselves firmly to the skin, by means of their crooked claws.

*avicu-aria.* Wings obtuse; thorax of one colour. 2. A native of Europe; on the bodies of various birds, especially swallows. Wings longer than the body by one half, marked with black veins; the hind part of the abdomen flattened and dotted.

*hirundi-is.* Wings tapering towards the extremity; legs terminating in six claws. 3. A native of Europe; on the bodies and nests of swallows.

*ovina.* No wings. 4. A native of Europe; among the wool of sheep. The abdomen distended, pale, obtuse, marked on each side with a double waved white line, and on the back with a red spot; legs hairy, the claws set in pairs.

There have been only five species of this genus hitherto described.

## VII. APTERA.

WINGS none in either sex.

### 106. LEPISMA.

Mouth furnished with four feelers, two setaceous, and two capitated. Lip membranaceous, round, and emarginated. Antennæ setaceous. Body covered with scales laid over one another, like tiles on the roof of a house. Tail furnished with bristles. Legs six, formed for running.

These in their various stages of existence prey upon sugar, decayed wood, and putrid substances. The larvæ and pupæ are six-footed, active, and swift.

** saccharinum.* Scaly, and resembling silver; tail triple. 1. A native of America; among sugar. They have been introduced into Europe, and are frequently to be met with among books and furniture. They run very quickly, and are not easily caught. Antennæ whitish, of the same length with the body. It is furnished with two scutella which enclose the thorax; two segments of the abdomen less than the rest; the tail furnished with three long bristles standing at a distance from each other, and with two pair of very small ones under the anus.

** polypus.* Leaping; tail triple; segments of the abdomen hairy on each side beneath. 2. A native of Europe; in sandy situations, among stones and rubbish, and takes prodigious leaps by means of the springs under its tail; brownish; the antennæ the length of the body; the fore feet placed very near the mouth; each segment of the abdomen is furnished with a spine beneath.

*terrestre.* Naked; tail triple. 3. A native of Europe. It resembles the *podura*, but larger, wholly white, and cylindrical; the antennæ obtuse, and half the length of the body.

There are seven species of this genus described by Gmelin.

### 107. PODURA, *Spring-tail.*

Mouth furnished with four feelers, slightly clavated; the lip divided. Eyes two, composed of eight facets. Tail forked, bent under the body, and acting like a spring. Legs six, formed for running.

The insects of this genus, through all their stages, feed on vegetables. The larva and pupa have six feet, and are active, and very much resemble the perfect insect.

** viridis.* Nearly globular, and green. 1. A native of Europe; on plants of different kinds, especially on the seminal leaves of the buck wheat (*polygonium fagopyrum.*)

** nivalis.* Oblong, and ash coloured, with black marks. 6. A native of Europe; among bushes, in wood. It is frequently to be seen in the winter on the snow, in the footsteps of men and other animals.

** aquatica.* Black, and lives in water. 12. A native of Europe. Assembles in troops, early in the morning, on the banks of pools and fish-ponds.

** fimetaria* White; lives on land. 13. A native of Europe; found very early in the spring on recently ploughed land.

31 species of this genus have been described in the last edition of the System of Nature.

### 108. TERMES, *White Ant.*

The mouth furnished with two jaws, formed of a horny substance. Lip likewise formed of a horny substance; is divided into four, the division linear and sharp. Feelers four, equal and filiform. Antennæ moniliform in most species. Eyes two.

These insects might with more propriety be placed under

under the order *Neuroptera* or *Hymenoptera*, most of them having either two or four wings in the perfect state. They are very destructive, and destroy provisions, cloths, furniture, books, and timber of whatever magnitude, leaving a thin shell not thicker than paper; in houses they are not only troublesome, but dangerous, as they destroy the beams which support the floors and roofs, and occasion them to fall in.

*fatale.* Brown above; the thorax is composed of three segments; wings pale, furnished with a rib or nerve of a brick colour. 1. A native of India and Africa. Larva small, about a quarter of an inch long, furnished with six feet, pale with a roundish brick-coloured head, without eyes; mandible short and strong, antennæ as long as the thorax; the abdomen oval. Pupa larger; about half an inch long, with a very large oval polished head, without eyes; jaws projecting, as long as the head, forked, without teeth, sharp and black; thorax and abdomen palish. The perfect insect both male and female has a brown head, antennæ yellowish and globular, prominent black eyes, the segments of the thorax margined, the abdomen variegated with white streaks, wings twice the length of the body, legs yellowish. Of the white ant we have a very curious and interesting description, in the Philosophical Transactions for 1781, by Mr Henry Smeathman of Clement's Inn. According to this account, the works of these insects surpass those of the bees, wasps, beavers, and other animals, as much at least as those of the most polished European nations excel those of the least cultivated savages. With respect to the interior construction, and the various members and dispositions of the parts of the building, they may come into comparison with some of the most celebrated works of man himself. The most striking parts of these structures are the royal apartments, the nurseries, magazines of provisions, arched chambers and galleries, with their various communications; the ranges of Gothic shaped arches, projected, and not formed by mere excavation, some of which are two or three feet high, but which diminish rapidly like the arches of aisles in perspective; the various roads, sloping staircases, and bridges, consisting of one vast arch, and constructed to shorten the distance between the several parts of the building, which would otherwise communicate only by winding passages. In some parts near Senegal, their number, magnitude, and close arrangement, make them appear like the villages of the natives. But these and many other curious instances of the great sagacity and powers of these insects cannot be understood, without viewing the plates in which their feeble frames, and comparatively stupendous works are delineated. See Phil. Trans. above referred to. The economy of these industrious insects appears to have been very attentively observed by the ingenious author, as well as their buildings. There are three distinct ranks or orders of them, constituting a well regulated community. These are, first, the larvæ, labourers, or working insects; second, the pupæ, soldiers, or fighting order, who do no kind of labour, and are about twice as long as the former, and equal in bulk to about fifteen of them; and lastly, the winged or perfect insect, which may be called the nobility of the state, for they neither labour nor fight, being scarcely able to defend themselves. These only are capable of being elected kings or queens; and nature has so ordered it, that they emigrate within a few weeks after they are elevated to this state, and either establish new kingdoms, or perish within a day or two. The first order, the working, are most numerous, being in the proportion of 100 to one soldier. In this state they are about a quarter of an inch in length, and twenty-five of them weigh about a grain, so that they are not so large as some of our ants. See Plate DI. fig. 1. and 2. The second order, or soldiers, have a very different form from the labourers, and have been by some authors supposed to be the males, and the former the neuters; but they are, in fact, the same insects as the foregoing, only they have undergone a change of form, and approached nearer to the perfect insect. They are now much larger, being half an inch long, and equal in bulk to 15 of the labourers, (fig. 3. and 4.). The third order, the insect in its perfect state, varies its form still more. The head, thorax, and abdomen, differ almost entirely from the same parts in the labourers and soldiers; and besides this, the animal is now furnished with four fine large brownish, transparent wings, with which it is at the time of emigration to wing its way in search of a new settlement. It differs so much from the other two, that they have not hitherto been supposed to belong to the same community. In fact, they are not to be discovered in the nest, till just before the commencement of the rainy season; when they undergo the last change, which is preparative to the formation of new colonies. They are equal in bulk to two soldiers, and about 30 labourers (see fig. 5.), and by means of the wings with which they are furnished, they roam about for a few hours, at the end of which time they lose their wings, and become the prey of innumerable birds, reptiles, and insects; while probably not a pair out of many millions of this unhappy race, get into a place of safety, fulfil the first law of nature, and lay the foundation of a new community. In this state, many fall into the neighbouring waters, and they are eaten with avidity by the Africans. The author found them delicate, nourishing, and wholesome, without sauce or other help from cookery, than merely roasting them in the manner of coffee. The few fortunate pairs who happen to survive this annual massacre and destruction, are represented by the author as being casually found by some of the labourers, that are continually running about on the surface of the ground, and are elected kings and queens of new states. Those who are not so elected and preserved, certainly perish, and most probably in the course of the following day. By these industrious creatures, the king and queen elect are immediately protected from their innumerable enemies, by being inclosed in a chamber of clay, where the business of propagation soon commences; their voluntary subjects, then employed in constructing wooden nurseries, or apartments entirely composed of wooden materials, seemingly joined together with gum. Into these they afterwards carry the eggs produced from the queen, lodging them there as fast as they can obtain them from her. The author even furnishes us with plausible reasons to believe, that they here form a kind of garden for the cultivation of a species of microscopical mushrooms, which Mr Konig, in an Essay on the East Indian Termites, read before the society of naturalists of Berlin, conjectures to be the food of the young insects. But perhaps the most wonderful, and at the same time best authenticated part of the history of these singular insects is that which relates to the queen or mother of the community in her pregnant state. After impregnation, a very extraordinary change begins to take place in her body, or rather in her abdomen only. It gradually increases in bulk, and at length becomes of such an enormous size as to exceed the bulk of the rest of her body 1500 or 2000 times. She becomes 1000 times heavier than her consort, and exceeds 20,000 or 30,000 times the bulk of one of the labourers. In this state, the matrix has a constant peristaltic or undulating motion, the consequence of which is (as the author has counted them), (fig. 8.) the protrusion of a great many thousands of eggs in twenty-four hours. These eggs, says the author, are instantly taken from her body by her attendants, of whom there always are a great number in the royal chamber and the galleries adjacent, and carried to the nurseries, which are sometimes four or five feet distant in a straight line. Here, after they are hatched, the young are attended and provided with every thing necessary, until they are able to shift for themselves, and take their share of the labour of the community. Many curious and striking particulars are related of the great devastations committed by this powerful community, which construct roads, or rather covered ways, diverging in all directions from the nest, and leading to every object of plunder within their reach. Though the mischiefs they commit are very great, such is the economy of nature, that it is probably counterbalanced by the good produced by them, in quickly destroying dead trees, and other substances, which, as the author observes, would, by a tedious decay, serve only to encumber the surface of the earth. Such is their alacrity and dispatch in this office, that the total destruction of deserted towns is so effectually accomplished, that in two or three years a thick wood fills the space, and not the least vestige of a house is to be discovered. From the many singular accounts here given of the police of these insects, we shall mention one respecting the different functions of the labourers and soldiers, or the civil and military establishments in this community, on an attempt to examine their nest and city.

On making a breach in any part of the structure with a hoe or pickaxe, a soldier immediately appears and walks about the breach, as if to see whether the enemy has gone, or to examine whence the attack proceeds. In a short time he is followed by two or three others, and soon after by a numerous body, who rush out as fast as the breach will permit them, their numbers increasing as long as one continues to batter the building. During this time they are in the most violent agitation and bustle, while some of them are employed in beating with their forceps upon the building, so as to make a noise that may be heard at three or four feet distance. On ceasing to disturb them, the soldiers retire, and are succeeded by the labourers, who hasten in various directions to the breach, each with a burden of mortar in his mouth ready tempered. Though there are millions of them, they never stop or embarrass each other; and a wall gradually arises that fills up the chasm. A soldier attends every 600 or 1000 of the labourers, seemingly as a director of the works; for he never touches the mortar, either to lift or carry it. One in particular places himself close to the wall which they are repairing, and frequently makes the noise above mentioned; which is constantly answered by a loud hiss from all the labourers within the dome; and at every such signal they evidently redouble their pace, and work as fast again. The work being completed, a renewal of the attack constantly produces the same effects. The soldiers again rush out and then retreat, and are followed by the labourers loaded with mortar, and as active and diligent as before. Thus, says the author, the pleasure of seeing them come out to fight or to work alternately may be obtained as often as curiosity excites or time permits; and it will certainly be found, that the one order never attempts to fight, or the other to work, let the emergency be ever so great. The obstinacy of the soldiers is remarkable. They fight to the very last, disputing every inch of ground so well as often to drive away the negroes, who are without shoes, and make the white people bleed plentifully through their stockings. Such is the strength of the buildings erected by these puny insects, that when they are raised to little more than half their height, it is always the practice of the wild bulls to stand as centinels upon them while the rest of the herd is ruminating below. When at their full height of ten or twelve feet, they are used by Europeans as places to look out from over the top of the grass, which here grows to the height of thirteen feet, upon an average. The author has stood with four men on the top of one of these buildings, in order to get a view of any vessel that might come in sight. These termites indeed are frequently pernicious to mankind, but they are also very useful and even necessary; one valuable purpose which they serve is to destroy decayed trees and other substances, which, if left on the surface of the ground in hot climates, would in a short time pollute the air. In this respect they resemble very much the common flies, which are regarded by mankind in general as noxious, and at best as useless beings in the creation; but it is certainly for want of consideration. There are not probably, in all nature, animals of more importance; and it would not be difficult to prove, that we should feel the want of one or two species of large quadrupeds much less than one or two species of these despicable looking insects. Mankind, in general, are sensible that nothing is more disagreeable than putrid substances, and nothing more pestiferous.

*destructor.* Of a brick colour above, head black; antennæ yellow. 4. A native of America, Africa, and India. They build strong oval nests round the branches of trees. It very much resembles the *T. fatale*, but is only half the size, the lower stemmata are impressed with a dot on the centre; wings brownish, marked with a yellowish rib. Larva pale brown; head black, conic, and projecting forwards.

*arda.* Black; segments of the abdomen tipt with white; legs pale. 5. A native of Africa; and resembles in economy the *T. fatale*. It builds a nest of a cylindrical shape, two or three feet high, of brown clay and vegetables mixed up together, with a round vaulted dome, surrounded by a prominent terrace. Larvæ or labourers have a pale head, without eyes; mandibles short, furnished with teeth; thorax and abdomen oval, grayish lead colour; legs of a brick colour. Pupæ or guards have a very large brick-coloured head, clavated and swelled out before, oval and extended behind;

mandible projecting and forked; antennæ of a brick colour, as long as the head, without eyes; thorax small; abdomen oval, grayish lead colour; legs of a brick-colour. Perfect insect less than the former ones, with incumbent black wings, and pale brick-coloured legs.

*mordax.* Black; segments of the abdomen tipt with white; legs black. 6. A native of Africa. Builds cylindrical houses. Larva and pupa like the last, but much less.

*capense.* Pale yellow; wings transparent, edged with brown. 7. A native of India and Africa. Larva furnished with two black eyes; and wanders about in the daytime in troops like the common ant.

*fatidicum.* Abdomen oval; mouth pale; eyes brown; antennæ setaceous. 3. A native of Europe.

* *pulsatorium.* Abdomen oblong; mouth red; eyes yellow; antennæ setaceous. 3. A native of Europe and America. Frequent in houses, in old books, wood, decayed furniture, museums, and is rarely found with wings. The female beats like the ticking of a watch, and is often mistaken for the *ptinus pulsator*.

*divinatorium.* Abdomen transversely furrowed; mouth brown; eyes black. 7. A native of Europe; found in books, and is very active and lively. Body whitish.

These eight species are all that have been described by Gmelin: other two, the *morio* and *flavicolle*, have been described since.

### 106. Pediculus, *Louse*.

**Mouth furnished with a sucker, which the insect can stretch out or draw back at pleasure; without feelers or proboscis. Antennæ of the same length with the thorax. Eyes two. Abdomen flattish. Legs six, formed for running.**

The insects of this genus live by sucking the juices of animals. The larvæ and pupæ have six feet, and are active, resembling the perfect insect.

Abdomen ash-coloured, and lobed. 1. There are two varieties of this species, the one softer and whiter, occupying the body and clothes, the other harder and darker-coloured, occupying the heads of those that do not attend to cleanliness, particularly of children.

* *humanus* The louse which infests the human body makes a very curious appearance through a microscope. It has such a transparent shell or skin, that we are able to discover more of what passes within its body than in most other living creatures. It has naturally three divisions, the head, the breast, and the tail part. In the head appear two fine black eyes, with a horn that has five joints, and is surrounded with hairs standing before each eye, and from the end of the nose or snout there is a pointed projecting part, which serves as a sheath or case to a piercer or sucker, which the creature thrusts into the skin to draw out the blood and humour which are its destined food; for it has no mouth that opens in the common way. This piercer or sucker is judged to be 700 times smaller than a hair, and is contained in another case within the first, and can be drawn in or thrust out at pleasure. The breast is very beautifully marked in the middle; the skin is transparent, and full of little pits; and from the under part of it proceed six legs, each having five joints, and their skin all the way resembling shagreen, except at the ends, where it is smoother. Each leg terminates by two claws, which are hooked, and are of an unequal length and size. These it uses as we would a thumb and middle finger: and there are hairs between these claws as well as all over the legs. On the back part of the tail there may be discovered some ring-like divisions, and a sort of marks which look like the strokes of a rod on the human skin: the belly looks like shagreen, and towards the lower end it is very clear and full of pits: at the extremity of the tail there are two semicircular parts all covered over with hairs, which serve to conceal the anus. When the louse moves its legs, the motion of the muscles, which all unite in one oblong dark spot in the middle of the breast, may be distinguished perfectly, and so may the motion of the muscles of the head when it moves its horns. We may likewise see the various ramifications of the veins and arteries, which are white, with the pulse regularly beating in the arteries. But the most surprising of all the sights is the peristaltic motion of the guts, which is continued all the way from the stomach down to the anus. If one of these creatures be placed on the back of the hand, when hungry, it will thrust its sucker into the skin; the blood which it sucks may be seen passing in a fine stream to the fore part of the head, where falling into a roundish cavity, it passes again in a fine stream to another circular receptacle in the middle of the head; from thence it runs through a small vessel into the breast, and then to a gut which reaches to the hinder part of the body, where, in a curve, it turns a little upwards; in the breast and gut the blood is moved without intermission with a great force, especially in the gut, where it occasions such a contraction of the gut, as is very surprising. In the upper part of the crooked ascending gut above mentioned, the propelled blood stands still, and seems to undergo a separation, some of it becoming clear and waterish, while other black particles are pushed forwards to the anus. If a louse is placed on its back, two bloody darkish spots appear, the larger in the middle of the body, the lesser towards the tail: the dark bloody spot, in or over which the bladder seems to lie. This motion of the systole and diastole is best seen when the creature begins to grow weak; and on pricking the white bladder, which seems to be the heart, the creature instantly dies. The lower dark spot is supposed to be the excrement in the gut.

The posterior part of the abdomen emarginated; legs formed like claws. 2. A native of Europe. It is found about the hairs of the groin, and sometimes, though rarely, on the eyebrows of people who do not attend to cleanliness. The antennæ have five articulations; the hind part of the abdomen hairy. * *pubis.*

The abdomen orbicular, marked with a white line; scutellum composed of three lobes; the snout white. 3. A native of America. It gets into the legs of the naked inhabitants, where it draws blood, and depositing its eggs in the wound occasions foul and malignant ulcers. *ricinoides.*

8. A native of Europe; on sheep. * *ovis.*

The abdomen is marked with eight transverse rusty-coloured lines. 9. A native of Europe; on horned cattle. * *bovis.*

66 species of this genus are described in the last edition of the System of Nature, all of which occupy the bodies of different animals.

### 110. Pulex, *Flea.*

Mouth without jaws or feelers. The snout long, and bent inwards. A sheath of two pieces, consisting of five articulations, covered at the base with two oval scales, and furnished with a single bristle. Lip round, fringed with sharp points, which are bent backwards. Antennæ moniliform, projecting, and becoming thicker towards their outer side. Eyes two. Abdomen compressed. Legs six, formed for leaping.

The genus *pulex* is rather doubtful; it approaches in many respects to the insects of the order hemiptera. They live on the juice and blood of other animals. Larva without feet, cylindrical, active, and furnished with two spines under the tail.

*_irritans._ The snout shorter than the body. 1. This familiar insect is to be met with everywhere; it lives by sucking the blood of other animals, and is very troublesome to many of them, especially to the hare and rabbit. They deposit smooth round eggs at the roots of the hair of the animals on which they feed, on blankets, and articles made of wool, fur, &c. From these eggs are hatched the larvæ, resembling small white shining worms, which feed on the scurfy substance adhering to the cuticle of animals, or on the downy matter collected on clothes. About a fortnight after they are hatched, they acquire a considerable size, and become very active; when disturbed they roll themselves up into a ball. After they have acquired their full size, they retire into some undisturbed situation; they form small bags for themselves composed of silky threads, which they spin from their mouths. These bags are very white internally; but on the outside they are of the colour of dust, and are very little discernible. They remain in the state of pupa about 14 days. It continues to be of a white colour till the second day before its escape from the bag, when it acquires a dark colour, becomes firmer, and is transformed into a perfect insect.

The flea, when viewed in the microscope, exhibits a very singular appearance. It is covered all over with black and hard scales, which are curiously jointed, and folded over one another, so as to comply with all the nimble motions of the creature. These scales are polished, and are beset about the edges with short spikes in a very beautiful and regular order. Its neck is finely arched, and somewhat resembles the tail of a lobster. Its eyes are very large and beautiful. The sucker contains a couple of lances or darts; which, after the sucker has made an entrance, are thrust farther into the flesh, to make the blood flow from the adjacent parts, and occasion that round red spot, with a hole in the centre of it, which remains for some time after the puncture of a flea, commonly called *flea-bite*. A proper view of the sucker with its two lances is not easily obtained, as the insect puts out its sucker only at the time of feeding. The best way of obtaining a view is to cut off the head, and subject it to the microscope by itself. There is an hospital at Surat where a number of fleas are kept, and some poor creature, for pay, allows himself to be fixed down and fed upon by them.

*Chigur.* Snout of the same length with the body. *penetrans.* 2. A native of America. This insect is very troublesome in the sugar colonies, penetrating into the feet of the inhabitants, where it lodges its eggs and causes malignant ulcers. Body reddish brown. The female produces a very great number of eggs, and when pregnant the abdomen swells to 100 times the size of the rest of the body. It penetrates chiefly under the nails of the toes, and eats its way onwards, depositing its eggs, which are exceedingly minute, in a bag. It is discovered by the uneasy itching it occasions, and must be extracted with great caution and dexterity; for if the bag be burst, and if any of the eggs or animals remain, a very troublesome ulcer ensues, which sometimes renders the limb useless. The slaves who go barefooted are chiefly exposed to this calamity, and they are most dexterous at extracting them.

There are only two species of this genus described in the last edition of the System of Nature published by Gmelin.

### 111. Acarus, *Tick* or *Mite.*

Mouth without a proboscis. The sucker with a cylindrical sheath, composed of two pieces. Feelers two, compressed, equal, and of the same length with the sucker. Eyes two, placed on the sides of the head. Legs eight.

The insects of this genus are very minute, and very prolific: they abound everywhere; most of them live on the juices of other animals. The larva and pupa have six feet, (those of the division *trombidium* have eight feet); they are active, and very much resemble the perfect insect.

#### A. *The Antennæ are filiform, compressed; and of the same length with the legs.*

Transparent; convex above and flattened beneath; *ursellus.* marked in the middle with a blackish spot. 36. It is very common in waters, on the *mucus* which covers the spawn of frogs. Very small, slow, inoffensive, and legs terminating in three nails.

Oval, almost globular; abdomen marked at the base * *ricinus.* with a round brown spot; antennæ clavated. 7. A native of Europe; it is very common on oxen and dogs.

Second pair of legs very thick. 8. A native of * *crassipes.* Europe; and very common. It is active, gregarious, frequently to be found in gardens among the earth in spring.

Thorax angularly cruciform; the legs, terminating * *vespertilionis.* in hooks, and longer than the body. 9. It is found on the body of the bat (*vespertilio murinus*) of an uncommon figure, resembling the *phalangium*. It cannot walk on a flat surface.

Commonly called *Red Spider*. Transparent and reddish; *telarius.* the abdomen marked on each side with a brown spot. 14. A native of Europe; on various plants, particularly those that are not exposed to the weather, or shut up in hot-houses. It forms webs of parallel threads, by which it sometimes suffocates plants in green-houses.

It is frequently to be found on the leaves of the lime-tree in autumn.

* *siro.* *Cheese-Mite.* Whitish; head and thighs of a rusty colour; the abdomen bristly. 15. A native of Europe; in flour, cheese, &c. which have been long kept. The cheese-mite is a very minute species; to the naked eye they appear like moving particles of dust. But the microscope shows them to be perfect animals, having as regular a figure, and performing all the functions of life as perfectly, as creatures that exceed them far in size. The head is small in proportion to the body, and has a sharp snout; they have two small eyes, and are very quick-sighted, when they have once been touched by a pin, they artfully avoid another touch. The extremities of their legs are furnished with two little claws, with which they take hold of any thing. The hinder part of the body is plump and bulky, and ends in an oval form, from which issue out some long hairs. Other parts of the body are thinly beset with long hairs. The males and females are easily distinguished. The females are oviparous; and from their eggs the young ones are hatched, in the space of 12 or 14 days in warm weather, but in colder weather longer time becomes requisite. They are very minute when first hatched, and cast their skin several times before they arrive at their full growth, but do not materially change their appearance. They are very tenacious of life, and may be kept alive several months without food. Mr Leeuwenhoek had one that lived 11 weeks on the end of a pin, on which he had fixed it for microscopical observations. They may be kept a long time between two concave glasses, and occasionally subjected to the microscope. In this way they may be seen *in coitu*, conjoined tail to tail, and this is performed by an incredibly swift motion. They are very voracious animals, and have been often seen eating one another. Their manner of eating is by thrusting one jaw forward and drawing the other back alternately, and in this manner, as it were, grinding their food; after they have done feeding they seem to ruminate.

*scabiei.* *Itch-insect.* White; legs reddish; the four posterior legs are furnished with a very long bristle. 50. In the pustules occasioned by the itch. It is generally thought to be the cause of the itch, though some hold a contrary opinion; the manner, however, in which the itch is communicated, seems to confirm the former opinion.

* *lactis.* Abdomen oval and obtuse, furnished with four bristles the same length with the body, which incline downwards. 16. It is found in cream that has been long kept, and in milk vessels that have not been kept clean.

*dysenteriæ* Legs furnished with two bristles; the abdomen oval, furnished behind with four horizontal bristles of the same length with the body. 17. It is found in casks and vats, in which beer has been kept; they are most frequently found about the top or near any chink in the vessel; they are likewise found very frequently within the cask, and are said to walk about on the top of the beer from 10 o'clock at night till 10 o'clock in the morning; during the day they conceal themselves in the chinks of the cask.

* *baccarum.* The abdomen turgid and red, and dark-coloured on the sides. 23. It is found on the fruit of the corinth and gooseberry.

The abdomen reddish; the hind-legs very long and filiform. 24. A native of Europe; on different species of flies.

Abdomen red, marked on each side with scarlet dots. 26. It is to be found on bees, wasps, dragon-flies, &c.

Oval, and reddish; the anus whitish. 27. It is found on many insects, particularly on the common black beetle; which, on that account, has been called the *lousy beetle:* they run very quickly.

The posterior part of the abdomen crenated; the scutellum oval, and somewhat tawney; the snout divided into three. 6. A native of America; they fix on the legs of travellers and suck the blood; they adhere so closely, that they are removed with difficulty; the fore-legs are furnished with short prickles, near their junction with the body.

The first pair of legs very thick, and furnished with claws; the second pair very long, and furnished with two bristles at the extremity. 62. Found in books kept in damp places, particularly about the backs, where the sheets have been glued together. It is very injurious, and not visible without the help of a glass.

Hemispherical, pale, and smooth. Legs equal. 31. It is found in troops on the body of the *acarus crassipes.*

Oval; furnished with several long hairs at the extremity of the abdomen; the legs are furnished with a single bristle. 61. Found on the bodies of insects and other subjects of natural history which are kept in too moist places, and is more destructive to museums than even the *ptinus fur*, and not visible to the naked eye.

### B. *Antennæ setaceous.* Trombidia.

The abdomen hairy, red, and obtuse behind; the fore legs whiter than the rest. 20. A native of Surinam and Guinea; very hairy; it becomes white when immersed in spirits of wine.

The abdomen of a blood colour, flat, and downy, turned up behind. 22. A native of Europe and America; is said to be poisonous if swallowed.

82 species of this genus have been described in the last edition of the System of Nature.

## 112. HYDRACHNA.

Head, thorax, and abdomen united. Feelers two, jointed. Eyes two, four, or six. Legs eight.

The insects of this genus are inhabitants of the water, swim with great velocity, and prey on the larvæ of *tipulæ* and *monoculi*. They deposit red spherical eggs, which in about a month acquire a linear form, and produce six-footed larvæ furnished with a single proboscis, which, after they have changed their skin several times, become perfect insects furnished with eight feet.

### A. *Eyes two.*

#### * *Those which are furnished with a Tail.*

Globular; eyes red. 1. It is to be found in ditches containing water: male greenish and spotted; female bluish and without spots, and double the size of the male.

Oval,

*uccinator* Oval, red, and black behind; furnished with a yellow cylindrical tail, and straightened at the base. 3. It is found on the banks of rivers; black beneath, eyes reddish, legs black.

*apillator.* Purple and globular, furnished with a papilla on each side of the tail; legs black. 12. It is to be found early in the spring in overflowed meadows.

* * Furcatæ. *Back marked with a fork.*

*rassipes.* White and oval; the disk black and marked with a reddish fork, and furnished with papillæ near the anus; fore legs thick. 13. It is found in fish ponds and ditches containing water; the legs twice or thrice the length of the body, which renders it easily to be distinguished. It is transparent; breast whitish; eyes black; when walking freely, it directs its legs forwards; after it has gone a few steps, it extends its legs horizontally, and rests as if it were dead, and a little afterwards it renews its motion.

*lavicornis* Reddish and oval; marked with a yellow fork, feelers clavated, legs pale. 15. It is found in marshes; eyes small and black, feelers and legs white.

* * * *Glabræ.*

*espiciens.* Round and red, marked with several spots; the eyes placed on the under part of the body. 23. It is to be found in ditches full of water; it resembles the *H. maculata* in every respect, except the positions of the eyes; flattish, wrinkled, full of dimples, marked with nine spots; eyes blackish; legs yellowish.

*ersicolor.* Nearly square, marked with white, blue, and brown spots. 44. It is found in places overflown with water; white above, brown beneath, edge yellowish; the feelers and legs white and transparent.

B. *Eyes four.*

*ılcarea.* Round, brown, and very white in the middle. 45. It is to be found, though rarely, in moist places; eyes black, feelers pointed, legs pale and transparent.

*aculata.* Oval and red; marked on the back with black spots. 48. It is found in wet ditches; shining; eyes black; legs yellow and transparent; feelers yellow, sometimes long, sometimes short.

C. *Eyes six.*

*umbrata.* Round and red, marked with several spots. 49. It is found in woody marshes; smooth, somewhat depressed, marked with more than ten obscure spots, blackish beneath; eyes black; feelers very small, tipt with black; legs yellow.

49 species of this genus have been described in the last edition of the System of Nature.

### 93. Phalangium.

Mouth furnished with two filiform feelers; the mandible composed of a substance like horn; the second joint furnished with a sharp tooth, moveable, and furnished with a claw. Antennæ none. Two eyes on the top of the head contiguous, and two lateral eyes. Legs eight. Abdomen (for the most part) round.

The insects of this genus in their various stages of transformation prey on the smaller insects and worms; the larvæ have eight feet, active, and resemble the perfect insect.

A. *Sucker a conical tube.* Pycnogona.

** grossipes* Feelers four; body filiform; legs very long. 1. A native of the north of Europe; found in the Norwegian seas; very slow, and very minute; it is composed of several articulations, and has a very narrow linear tail; it enters the shells of muscles, and consumes their contents.

** balænarum.* Feelers two; body oval. 6. It is found in the north seas, under stones; it is red on the back, the sucker projecting, straight, obtuse at the extremity, and perforated with a round entire perforation; the feelers inserted at the base of the sucker, and almost equalling it in length; the legs jointed and angular.

B. *Without a sucker.*

*moria.* Body oval and black; the under part of the body and legs pale. 10. A native of Europe; it is to be found on rocks.

** opilio.* *Long-legged spider*, or *shepherds spider*. Abdomen oval and gray, beneath white. A native of Europe and America; wandering about in the night time.

** cancroides.* Abdomen inverted, oval and flattish; claws smooth, the fingers hairy. 4. A native of Europe; in confined shaded places, in boxes and damp cellars; it feeds on *termites* and *mites*, and moves like a crab; it is destructive to collections of dried plants; it likewise enters the skin of the human body, and excites a very painful pimple about the size of a pea.

*acaroides.* Abdomen cylindrical, the claws smooth; head furnished with an appendage. 5. A native of America; in confined places in tropical countries. Its bite is said to be dangerous; yellowish, the claws oval.

*araneoides* Claws notched, and hairy; body oblong. 15. A native of Italy, Africa, Persia, and the southern shores of the Volga; its bite occasions very violent pain, livid tumors, delirium, and sometimes death; soft, lurid, and woolly, the claws very turgid.

15 species of this genus have been described by Gmelin in the last edition of the System of Nature.

### 114. Aranea, *Spider.*

Mouth furnished with short horny jaws; the lip round at the tip. Feelers two, bent inwards; jointed and very sharp at the extremity: in the males they are clavated, and have the organs of generation placed in them. Antennæ none. Eyes eight; sometimes six, though seldom. Legs eight. The anus is furnished with papillæ, with which the insect spins threads, and forms its web.

These insects, through every stage of their existence, prey upon other insects, especially those of the order *Diptera;* they even do not spare those of their own genus or species: from the papillæ at the end of the abdomen they throw out at pleasure a number of fine threads, which they unite in various ways for the purpose of entangling their prey. They every year cast their old skin, which they perform by suspending themselves in some solitary corner, and creeping out of it.

The young ones have the power of ascending the air to a great height; to accomplish which, they climb up some eminence, and are wafted about by the winds, filling the air with their threads. They are destroyed by the sphex and ichneumon.

Linnæus has subdivided this genus according to the number and position of their eyes.

### A. *Eyes eight.*

1. *Eyes placed thus,* : ∷ :

*fasciata.* Of a silver colour; the abdomen marked with yellowish bands; the legs surrounded with brown rings. 48. A native of the island of Madeira.

* *diadema* Abdomen nearly globular and reddish; brown, marked with a white cross composed of dots. 1. A native of Europe, on trees; it is a very beautiful insect.

* *aquatica* Brown; abdomen oval and of an ash colour; the back brown, marked with two dots. 39. A native of Europe, in stagnant waters, where it dives to the bottom in search of its food. It takes up its winter quarters in an empty snail shell, the aperture of which it closes up with a web; jaws black, claws red.

2. *Eyes placed thus,* : ∷ :

*latro.* Thorax hairy, and of an ash colour; the abdomen oval, black, and spotted with red. 95. A native of America; large, the thorax oval, legs black, thighs pale.

* *domestica.* Abdomen oval and brown, marked with five black spots nearly contiguous, the anterior ones larger than the others. 9. A native of Europe, in houses, and about windows; feeds chiefly on flies.

3. *Eyes placed thus,* . ˙ ˙ . ⁝

* *globosa.* Black; sides of the abdomen of a blood-red colour. 69. A native of Europe, in meadows.

4. *Eyes placed thus,* ⁖ ⁖ . .

*argentata.* Abdomen white, and brown behind, and marked round the edge with six small projections. 70. A native of South America.

5. *Eyes placed thus,* : : ⁚ ⁚

*fumigata.* Abdomen oval and brown, marked at the base with two white dots. 16. A native of Europe, in meadows; it watches near the nests of the larvæ of different insects, and waits their coming out, when it seizes on one after another, and sucks out their substance.

* *saccata.* Abdomen oval, of a brownish colour. 40. A native of Europe, in gardens, and carries its eggs behind it enclosed in a bag; legs livid, marked with unequal brown rings set close together.

*Eyes placed thus,* : : : :

*extensa.* Abdomen long, of a silver colour tinged with green, the legs extended longitudinally. 22. A native of Europe, in woods; its legs are applied closely to the branches.

*nidulans.* Shining black; the abdomen hairy and black. 73. A native of America; it forms a nest under ground, and spins a large cylindrical web, which is covered with a lid; its bite is very painful, and frequently occasions fever and delirium, which is soon removed by a gentle sudorific; thorax marked with a large depressed circular spot; abdomen oval; legs equal.

7. *Eyes placed thus,* : : ⁚ ⁚

Black, thorax marked with a white line on the back. 79. A native of Britain.

Marked with triangular black spots on the back of the abdomen; the legs spotted with black. 34. A native of the south of Europe, particularly Italy and Barbary. It is found in caverns in argillaceous soil; its bite was formerly supposed to be curable by nothing but music; though it occasions a great deal of pain, it is almost never fatal.

8. *Eyes placed thus,* . . ... ...

Oval and oblong; thorax hairy, white; abdomen and legs black, marked with yellow bands. 32. A native of Europe.

9. *Eyes placed thus,* . . . . . . . .

Black, abdomen oval, forehead white, and leaps on its prey. 84. It is to be found frequently in woods about Vienna; abdomen marked with two compressed dots.

10. *Eyes placed thus,* ˙ . : : ˙ .

Thorax orbicular and convex, with a transverse central excavation. 31. It is a native of South America, among trees, where it preys upon the larger insects, and even small birds, dropping into their nests, and sucking their blood and eggs; it is of so enormous a size, that its fangs may be compared to the talons of a hawk, and its eyes are very large.

11. *Eyes placed thus,* ¨ . . ....

Of a grayish rusty colour, and slightly clouded; thorax globular, and slightly heart-shaped; abdomen somewhat triangular, and marked with a faint longitudinal cross. 85. A native of Europe, on oak and other trees; abdomen marked with four impressed dots on the back; papillæ three.

12. *Eyes placed thus,* : ⋯ : ...

Abdomen oval, obtusely conic behind, variegated with brown and white; beneath black. 86. A native of Europe, among bushes; it spins and spreads out a web, to the surface of which it attaches the insects it has ensnared, after it has sucked out their juice. Thorax black, slightly tinged with rusty colour, and nearly double behind; legs gray, marked with brown rings; abdomen marked with a whitish spot, beneath resembling a horse shoe; papillæ four.

13. *Eyes placed thus,* ˙ . . .. . ˙

Hairy; body oval, black, variegated with brown. 99. A native of Europe.

### B. *Eyes six, placed thus,* . : : .

Abdomen greenish, the sides yellow. 30. A native of Europe; in gardens.

C. *Eyes* - - - - -

** holosericea.* Abdomen oval, oblong, and silky; marked underneath near the base with two yellow dots. 29. A native of Europe. It is found within the leaves of plants which it rolls up.

*venatoria.* Thorax orbicular, smooth, and black; abdomen oval, downy and brown. 33. A native of America. It constructs a tenacious cylindrical nest about a foot in length, furnished with a lid.

96 species of this genus have been described by Gmelin, in the last edition of the System of Nature.

### 115. SCORPIO, *Scorpion.*

Legs eight; likewise two claws situated on the fore part of the head. Eyes eight; three placed on each side of the thorax, and two on the back. Feelers two, furnished with claws, and projecting. Lip bifid. Antennæ none. Tail long, jointed, terminating in a sharp crooked sting. On the under side, between the breast and abdomen, are two excrescences resembling combs.

Scorpions have been conceived to be the most malignant and poisonous of all animals. Though this opinion be now very generally exploded, there are none of the insects we are acquainted with so formidable. It is true the effect of their sting differs greatly, according to the circumstances of the constitution of the person receiving the wound, as well as of the animal itself, the heat of the climate in which it lives, and the degree of violence with which the wound may have been inflicted.

The common European scorpion certainly is not of so terrible a nature as is commonly supposed; its sting being very rarely productive of bad consequences. But the large scorpions of Africa, which are said to be nearly a foot in length, may well be supposed capable of inflicting a wound of the most severe pungency, and of the most dreadful malignity. The poison is evacuated through three very small *foramina* near the tip of the sting; viz. one on each side of the tip, and the other on the upper part. A diversity of opinion has subsisted among naturalists, relative to the slit or foramen in the fangs of spiders, through which their poison is evacuated; and the same variety of opinion has prevailed with respect to the *foramina* in the scorpion's sting. The celebrated Redi, assisted by the best microscopes he could procure, was not able to discover them, though he was well convinced of their existence, from having perceived the minute drop of poison exsude from near the tip of the sting. Others have denied the existence of the foramina; but Valisnerius and Leeuwenhoek have both described two, viz. one on each side of the tip, and which in shape are inclining to triangular; besides these a third has sometimes been seen, so that the sting of the scorpion can with greater facility discharge its venom, than that of any other animal. The poison is whitish, and is contained in a small bladder near the tail. When this bladder is pressed, the poison may be seen issuing out through the foramina of the sting.

Maupertuis has made many experiments with the scorpion of Languedoc, the results of which were by no means uniform. He provoked one to sting a dog in three places of the belly, where the animal was without hair. In about an hour after the animal seemed greatly swollen and very sick. He then cast up whatever he had in his bowels, and for about three hours continued vomiting a whitish liquid. The belly was always greatly swollen when the animal began to vomit, but this operation always seemed to abate the swelling; thus alternating for the space of three hours. The poor animal after this fell into convulsions, bit the ground, dragged himself along on his fore feet, and at length died five hours after he had been stung. There was no partial swelling round the wound inflicted, as is usual after the sting of a wasp or bee; but the whole body was inflated, and there only appeared a red spot on the places stung. Two days afterwards the same experiment was tried on another dog, and even with more aggravated cruelty; yet the dog seemed no way offended by the wounds, but howling a little when he received them, continued alert and well after them, and soon after was set at liberty, without shewing the smallest symptoms of pain. The experiment was repeated with fresh scorpions upon seven other dogs, and three hens, but not the smallest deadly symptom was seen to ensue. He put three scorpions and a mouse into the same vessel, and they soon stung the little animal in different places. The mouse thus assaulted, stood for some time on the defensive, and at last killed them all one after another, and did not seem to have received any material injury itself, at least no fatal consequences followed, though it had received several severe wounds. From hence it appears, that many circumstances which are uterly unknown must contribute to give efficacy to the scorpion's venom. Whether the nature of its food, long fasting, the season, age of the insect, or the part of the body which it wounds, add to or diminish the malignity of the poison, still remains to be ascertained. The insects employed by Maupertuis were newly caught, seemingly vigorous, and were of different sexes. The result of these experiments may serve to shew, that many of the boasted antidotes which are given for the cure of the scorpion's sting, owe their success more to accident than to their own efficacy. The scorpions of tropical climates are very large, and perhaps more venomous. Helbigius, who resided long in the east, says that he was often stung by the scorpion, and never suffered any material injury from the wound, though a painful tumour generally ensued, which was cured by rubbing with a piece of iron or stone, as he had seen the Indians do, until the part became insensible. Seba, Moore, and Bosman, give a very different account of the scorpion's malignity; and assert that without the speedy application of proper remedies, the wound proves fatal. Several fabulous anecdotes have been recorded of these animals by the older writers on natural history, which are totally unworthy of notice. The most remarkable of these is, that scorpions sometimes commit suicide, when they find themselves in a situation from which they cannot make their escape. It is said that a newly caught scorpion, placed in a circle formed with pieces of burning charcoal, runs round endeavouring to effect its escape, but finding no exit, it applies its tail to the back part of its head, and stings itself to death. Scorpions are viviparous, and produce about forty or fifty young ones at a time, which are completely shaped, and undergo no farther change, except casting their skin from time to time like spiders. They feed on flies, spiders, worms, &c. and even on one another.

***australiæ.*** The comb-like excrescences placed between the breast and abdomen, composed of six teeth; claws smooth. 7. A native of the South sea islands.

***maurus.*** Comb composed of eight teeth; claws nearly heart-shaped and pointed. 1. A native of Africa.

***carpathicus.*** Combs composed of six teeth; claws nearly heart-shaped and smooth. 2. It is found on the Carpathian mountains, and in Switzerland.

***afer.*** Combs furnished with thirteen teeth; claws nearly heart-shaped and hairy. 3. A native of India and Persia; and is the largest and most formidable species.

***americanus.*** Combs furnished with fourteen teeth; the claws fringed with hair; toes filiform. 4. A native of South America. It is eaten by the natives of California.

***chilensis.*** Combs furnished with sixteen teeth; claws somewhat angular. This is a variety of the former.

***europæus.*** Combs furnished with eighteen teeth; claws angular. 5. A native of the south of Europe and north of Asia. It is viviparous.

***hotentotus.*** Combs furnished with twenty-two teeth; claws smooth; the tail rough. 8. A native of Africa, in the neighbourhood of Sierra Leone. Body of a dark brown colour, and marked with raised lines; legs pale.

***australis.*** Combs furnished with thirty-two teeth; claws smooth. 6. A native of Africa.

These are all the species of the scorpion that have been described in the last edition of the System of Nature.

### 116. CANCER, *Crab*.

Legs eight, (seldom six or ten), likewise two claws. Feelers six, unequal. Eyes two, placed at a distance from one another, and set on moveable stalks in most species. Mandible composed of a horny substance, and thick. The lip triple. The tail jointed and without a sting.

These live chiefly in water; and feed on insects, worms, dead fish, and dead bodies of any kind. They every year cast their shell, which is performed with much difficulty and pain; during the change they become weak and sickly.

#### A. *Antennæ four.*

#### † *The last articulation bifid; the Tail short.*

#### ‡ *The Thorax smooth,*

#### || *And entire on the sides.*

***cursor.*** The posterior parts of the sides of the thorax furnished with sharp points; the tail bent back. 1. A native of the Mediterranean and Indian seas. About sunset it leaves the water, and runs about the sands with great velocity.

***pennophylax.*** Thorax orbicular, unequal and fringed; four dorsal legs. 5. A native of America, within the shell of the *chama lazarus*, to which it gives notice of the approach of the cuttle-fish.

****pisum.*** Thorax orbicular, obtuse; the tail of the same length with the body. 6. A native of the Mediterranean seas. About the size of a pea; the tail very obtuse; the legs smooth and without spines; claws somewhat oblong; toes equal.

Thorax nearly square; edge somewhat sharp; the legs compressed. 8. It is found in the open sea, particularly on the *fucus natans*, and runs about on the surface of the water.

Very smooth; the anterior part of the thorax flattened on the sides; the tail is carinated and knobbed in the middle. 9. A native of the Asiatic seas. It resides within the shell of the *pinna*. The ancients supposed that this was a friendly connection formed for mutual defence: that the *pinna* being destitute of eyes, and thus exposed, when he opened his shell, to the attacks of the cuttle-fish and other enemies, was warned of their approach by his little lodger, on which he immediately shut his shell, and both were safe.

*Land Crab.* The first joint of the legs prickly; the second and third joints set with tufts of hair. 11. A native of South America. This species resides in the woods. In the Bahama islands they are so numerous that the ground seems to move as they crawl about. At breeding time they generally make to the sea-shores, for the purpose of washing off their spawn, and depositing it in the sand, and no obstruction will make them turn aside from the straight road, when they are on their progress towards the sea. They are esteemed very excellent food. They feed on vegetables, but when they have fed on the manchineel apple they are reckoned poisonous. When taken, they will seize the person's finger with their claw, and endeavour to escape, leaving the claw behind, which for the space of a minute after it has been separated from the body, continues to squeeze the finger closely. They vary in size and colour; the light coloured ones being esteemed the best food.

#### ‖ || *Thorax marked along the sides with incisions.*

Thorax marked with one small projection, one of the claws larger than the other; the eyes long. 14. A native of Jamaica. It conceals itself under stones, and utters a cry when caught, and pinches severely.

The thorax furnished with two projections on each side; claws very long. 110. A native of England. Found in the sea near Weymouth. The claws are three times the length of the body.

Hairy; thorax notched on both sides; the hind-legs terminating in two nails. 24. A native of the Indian seas. Black; the extremities of the claws smooth and white. It is reckoned poisonous.

*Common Crab.* Thorax marked on each side with nine obtuse folds; the tips of the claws black. 27. A native of both the European and Indian seas. This is the crab most generally used in this country for the table; they are in season and heaviest in the summer; and cast their shells in the winter and spring. They frequent rocky shores.

#### ‡ ‡ *Thorax hairy or prickly on the upper side.*

Thorax hairy, marked with knobs, and oval; furnished with a beak which is divided at the extremity; claws oval. 30. A native of the European seas. This species is supposed to be injurious to oyster-beds; on this account the fishermen, when they meet with them in the course of dredging, are careful not to return them into the water, but carry them on shore, and destroy them.

*maja.* Thorax prickly; claws turgid and covered with spines; the fingers of the claws covered with tufts of hairs; legs six. 41. A native of the Norwegian seas.

* *horridus* The thorax set with spines, and covered with knobs; claws oval; tail carious. 43. A native of the Asiatic and Norwegian seas. There is a large variety of this found on the east coast of Scotland, which has its legs and claws covered with spines.

§ § *Antennæ set on stalks; the last articulation of the posterior pair bifid; Tail long and without leaves.* Paguri Fabricii. Parasitici.

*latro.* Thorax divided into four; the tail simple and big-bellied beneath. 56. A native of East India, in holes of rocks. Wanders about on land by night in search of cocoa-nuts, on which it feeds. To procure them it mounts the trees, and having detached the nuts, and let them drop to the ground, it descends and tears them open with its claws. This species is eatable, except the intestines.

*ernhar- dus.* Claws heart-shaped, and covered with sharp points; the claw on the right side larger than the other. 57. A native of the European seas. This species being destitute of shell towards the tail, takes possession of the empty shells of different species of cochlea, changing from one to another as it increases in size; the tail, which is soft and without a shell, is furnished with a hook to secure itself in its habitation.

*iogenes.* Claws smooth and downy; the claw on the left side larger than the other. 53. A native of the American and Asiatic seas. It occupies the empty shells of different species of cochlea.

*aput mor- uum.* Downy, covered with a hemispherical cap. A native of the Mediterranean sea. It is of a dirty gray colour; hemispherical and without spines. It very much resembles a skull or death's head, whence it has received its name; it is about the size of a chesnut. The cap proceeds, as it were, from the hind-legs, and is turned over the body; the fingers of the claws equal and naked at the tips; the extremity of the legs sharp.

*aranei- rmis.* Claws rough; the tail callous at the extremity, and furnished with a hook. 143. It is found in the fissures of the rocks on the sea-shore near Edinburgh. It occupies the empty shells of the *nerita* or *turbo*.

*rugosus.*] Thorax wrinkled, ciliated, and prickly on the fore part; the beak furnished with three small projections, the claws filiform. 149. A native of the Mediterranean and north seas. It is found on the sea-shore near Banff in Scotland. This is the *C. Banffius* of Pennant, and the *C. Brachiatus* of Shaw.

§ § § *Antennæ set on stalks, the posterior pair cleft; Tail long.*

‡ *The shell of the Thorax covering the Thorax completely.* Astaci. Lobsters.

|| *The posterior Antennæ bifid.*

*gamma- s.* *Lobster.* Thorax smooth; the beak notched on the sides, marked on the upper side, at the base, with a double tooth. 62. It inhabits the sea, on rocky shores. This is reckoned the most delicate species; and is most in request for the table. They chiefly frequent deep clear water. They are taken in wicker-baskets, with holes on the sides, which allow the lobsters to enter, and prevent their egress; or with small nets attached to iron hoops. They breed in the summer months, and deposit many thousands of eggs in the sand. They cast their shell annually, and when any of their legs or claws happen to be torn off they grow again. They are in season from October to May. Lobsters are said to be very much alarmed at thunder, so much so as sometimes to cast their claws.

* *astacus.* *Craw-fish.* Thorax smooth, the beak notched on the sides, with a single tooth on each side at the base. 63. It inhabits fresh waters; it lodges in holes in the clayey banks of rivers or lakes. It is reckoned a delicacy, and is much in request as food.

* *halecum.* Antennæ projecting; beak tapering towards the extremity; eyes globular and prominent. 156. A native of the north seas. This little animal is very abundant, and is the principal food of the herrings and cod-fish.

|| || *The posterior Antennæ divided into three.*

* *squilla.* *Prawn.* Thorax smooth; the beak serrated above, beneath furnished with three small projections; the edge of the thorax furnished with five small projections. 66. Native of the European seas. The beak is sometimes straight, sometimes crooked. There is a smaller variety of this, called in London the *white shrimp*, which is white when boiled. Prawns are much relished by most people; and are very abundant in sandy shores.

* *crangon* *Shrimp.* Thorax smooth; beak short and entire; the moveable toe of the claw longer than the other. 67. A native of the northern seas. This species is reckoned the most delicious of the genus. It is very plentiful on the sandy shores of Britain.

‡ ‡ *The shell of the Thorax not covering the Thorax completely.* Squillæ Fabricii.

*mantis.* Claws furnished with a single fang; crooked, compressed, and notched; without a moveable toe. 76. A native of the Mediterranean and Asiatic seas. It is reckoned a delicacy by the Italians.

|| || || *Antennæ set on stalks, and simple.* Gammari Fabricii.

*ampulla.* Claws consisting of a single fang; legs fourteen; the thighs of the hind-legs compressed and dilated. 170. A native of the north seas. Large, almost white; the beak short, curved, and sharp; the tail composed of six leaves or plates; the last articulation bifid.

* *pulex.* Claws four, furnished with a single fang, and destitute of a moveable toe; legs ten. 81. A native of Europe. It is frequent on the sea-shore, in wells, ditches, rivulets, and likewise in the salt lakes of Siberia; it swims on its back, and leaps. It is injurious to fishermen by eating their nets, and also hurtful to fishes, by exciting ulcers on their gills. It shines in the dark.

B. *Antennæ two.*

|| *Two arched Scales in place of the posterior Antennæ.* Scyllari Fabricii.

* *arctus.* The scales of the antennæ fringed with prickles. 75. A native of almost every sea.

|| || *Scales none; Antennæ fringed with thickly-set hairs.* Hippæ Fabricii.

*cancharus* Thorax wrinkled and oval; claws compressed and prickly along the edges. 72. A native of South America and India.

181 species of this genus have been described by Gmelin, in the last edition of the System of Nature.

### 117. Monoculus.

Legs formed for swimming; very long; from four to eight. Body covered with a shell, composed of from five to ten segments, growing smaller towards the tail. Antennæ two; those of the male thicker and shorter than those of the female. In some species they are wanting. Sometimes one eye, more frequently two, approaching very near to one another. Feelers four, constantly in motion while the animal is swimming; the posterior pair are very small, and bent like hooks.

The insects of this genus live in water; some of them are found in the sea, others in rivers, but most of them in stagnant waters; they have been called *monoculi* from the circumstance of some of them having but one eye, or two eyes placed so close together as to appear but one. Some of them are viviparous, some oviparous.

A. *Those which have one Eye.*

§ *Body covered with a hard Crust.*

‡ *Antennæ none.* Polyphemus Mulleri.

*oculus.* Feelers two, long and divided; tail inflected. 10. A native of Europe. To be found in lakes and marshes from May to September. It swims on its back, frequently in large swarms; eye very black, occupying almost the whole of its head.

‡ ‡ *Antennæ two or four.* Cyclopes Mulleri.

§ *Antennæ four.*

* *quadricornis.* Tail straight, and divided at the extremity. 6. A native of Europe; in fresh waters. Body grayish or greenish, smooth or covered with hair; legs eight and hairy. Female with an oval bag on each side of the tail, which contain the eggs. The antennæ in the male are much thicker and shorter than in the female; the tail is composed of four articulations; in the female it is furnished with two small spines. When viewed in the microscope they are found to have two eyes placed very close together. They are very frequent even in the purest water, and are often swallowed along with it.

† † *Antennæ two.*

§ *Antennæ linear.*

* *rubens.* Reddish; tail straight and forked. 13. A native of Europe; in marshes, lakes, and rivulets: it is to be met with throughout the whole year. The antennæ as long as the body; legs eight.

|| || *Antennæ nearly clavated.*

*claviger.* Antennæ stiff; tail bifid. 18. Inhabits, though rarely, the rivers of Germany; and glides slowly along, alternately on its back, belly, and sides; and sometimes raises itself upright. Upper part of the body white, beneath red; legs eight; tail very small and without articulations.

§ § § *Antennæ dilated.*

*crassicornis.* Antennæ short; tail furnished with two sharp points. 19. A native of Europe; in marshes. It is very rare. Body composed of five segments; the antennæ swelling from the base to the middle, and becoming sharp towards the extremity.

§ § § § *The tip of the Antennæ terminating in three points.*

*curticornis* Antennæ very small and straight; body without articulations; claws smooth; tail furnished with two bristles. 20. Inhabits salt water.

§ § § § § *Antennæ bent backwards.*

*chelifer.* Antennæ short; body without articulations, furnished with claws; tail furnished with two bristles. 21. Inhabits salt water.

§ § § § § § *Antennæ of the (male) furnished with little hooks.*

*brevicornis.* The bristles of the tail very short. 22. Inhabits salt marshes. It very much resembles the *M. quadricornis;* the top of the antennæ in the female larger, and forked at the extremity.

† † *Those which have a bivalved Shell.*

‡ *Head exposed; two-branched Antennæ; legs from eight to twelve.* Daphniæ Mulleri.

§ *Tail bent inwards.*

* *pulex.* The posterior part of the shell set with sharp points. 4. It is found everywhere in stagnant waters, and in great abundance. It is a frequent cause of the water assuming the colour of blood. The shell is yellowish; the abdomen, intestines, and ten legs red. The female is three times the size of the male; and produces from eight to twelve green eggs; the back is marked with a large square spot resembling a saddle.

§ § *Tail bent downwards.*

*crystallinus.* The shell without prickles; the head furnished with two short projecting horns. 29. A native of the north of Europe; in lakes and rivers. White and oblong; very transparent; viviparous, and furnished with twelve hairy feet.

§ § § *Tail bent backwards.*

*pediculus.* Tail bent backwards. 5. A native of Europe; in fresh water.

§ § § §

§ § § § *Tail straight.*

*tifer.* The anterior angles of the shell furnished with a tuft of bristles. 30. A native of Europe; in stagnant waters; transparent, of an oblong oval form; antennæ divided into three, furnished with eight or more hairy legs; the extremity of the tail terminating in two hooks.

‡ ‡ *Head concealed; Antennæ two, and hairy; Legs eight.* Cytheræ Mulleri.

*iridis.* Shell kidney-shaped and downy. 31. A native of Europe; found on various species of *fucus* and *conferva;* the extremity of the antennæ terminating in three points; the fore-legs formed like hooks.

‖ ‖ ‖ *Head concealed; Antennæ two, like hairs; Legs four.* Cyprides Mulleri.

*conchaceus.* Shell oval and downy. 7. Found in clear stagnant waters; the antennæ white or yellowish, and stretched out; swims very swiftly, with ten bristles. It is green, opaque; feet yellowish; abdomen nearly bilobed and orange-coloured, marked in the middle with a black circle. It conceals itself within its shell, and swims on its belly. It resembles a muscle in miniature, is very minute, and seldom exceeds the tenth part of an inch.

† † † *Those with shells consisting of one valve.*

‡ *Legs four; Antennæ two.* Amymonæ Mulleri.

*satyrus.* Shell oval; antennæ obtuse, and extended in a vertical direction. 46. It is frequent in clear fresh water; it is agitated at intervals with a tremulous motion; the shell is flat and membranaceous; antennæ rigid, furnished with three very short bristles at the extremity; the fore-legs thick and bifid; tail terminating abruptly, eight-cleft in the middle. The insect is transparent.

‖ ‖ *Legs six; Antennæ two.* Nauplii Mulleri.

*racteatus* Shell orbicular, and without spines or bristles. 52. It is rare; found in clear fresh water; the shell very transparent; the antennæ resembling legs; the legs terminating in three bristles; the eye not conspicuous.

B. *Eyes two.* Binoculi.

† *Those with shells composed of one valve.*

§ *Eyes two, placed beneath; Antennæ two; Legs four to eight.* Arguli Mulleri.

*delphius.* Legs eight. 55. Found in rivers.

§ § *Eyes situated on the back; Antennæ two or six; Legs varying in number.* Limuli Mulleri.

*lyphemus.* Shell orbicular; suture in the middle of the form of a crescent; tail triangular, long and tapering. 1. A native of the Indian seas, particularly in the neighbourhood of the Molucca islands. It is likewise found on the shores of Carolina. It is the largest of all known insects; sometimes it grows to the length of four feet. It is frequently found in pairs, male and female. It is very rarely found among petrifactions. There are seven spines on the anterior part of the back of the shell: legs 14.

Shell oblong; the suture before of the form of a crescent; tail composed of two bristles. 3. A native of Europe; in ditches, ponds, &c.; and though dried in summer, when the water has evaporated, yet they revive when the water returns. This is the largest species to be found in Britain. * *apus.*

§ § § *Eyes placed on the sides; Antennæ two, setaceous; Legs eight or ten.* Caligi Mulleri.

Body short; tail bifid, and composed of one thin flap. 2. A native of the European seas. Found on flounders, cod-fish, salmon, &c. adhering on the outside between the scales; running swiftly both on the fish and on the water. * *piscinus.*

† † *Those with Shells composed of two valves; Head not inclosed within the shell; the Eyes placed on the sides; Antennæ two or four, resembling hairs, and placed beneath; Legs eight and more.* Lynceæ Mulleri.

Tail inflected; shell globular. 60. A native of Europe. It is found about the edges of stagnant waters, and among duck-weed. It is very minute; the shell is reddish; antennæ two; legs twelve; tail furnished with a small hook at the extremity and concave beneath; the ovaria green. * *sphæricus.*

66 species of this genus have been described in the last edition of the System of Nature.

## 118. Oniscus.

Jaw terminating abruptly, and furnished with small teeth. Lip bifid. Feelers unequal, the posterior ones being longer than the others. Antennæ setaceous. Body oval. Legs fourteen.

The species of this genus feed on the leaves of plants, on filth, and on the juices of animals; some of them are very injurious to the fruit of wall-trees; they undergo no other change but a change of skin. They are found under stones, in old walls, houses, and woods; some species live in water.

Abdomen covered with two thin plates; the tail semioval. 1. A native of the European seas. Viviparous; and is very injurious to fishes. * *asilus.*

Antennæ four; tail long and sharp. 5. Inhabits the sea. It swims very quickly. It lives on crabs and fishes; the fishermen dislike it very much. * *entomon.*

Oval, and of a brownish ash-colour; tail obtuse and entire. 15. A native of Europe; under stones. When touched it rolls itself up into a hard motionless ball; from which circumstance it has received the name of *armadillo.* * *armadillo.*

Oval; tail obtuse, furnished with two simple appendages. 14. A native of Europe; in houses, walls, woods, &c. The young are contained in a follicle of four valves on the abdomen of the mother. This species was formerly used in medicine. * *asellus.*

38 species of this genus have been described in the last edition of the System of Nature.

### 119. Scolopendra.

Antennæ setaceous. Feelers two, filiform; articulated and connected within the jaws. Lip divided and marked with small projections. Body flattish. Legs very numerous; one on each side of each of the segments of the body.

These insects live in decayed wood, about houses, under stones, and some of them in fresh water. They feed on other insects in every stage of their existence. The larvæ differ but little from the perfect insect, except that they have fewer feet. The pupæ likewise are active, and very much resemble the perfect insect. All the European species are small, but in tropical countries they are to be seen a foot long and an inch and a half in circumference.

* *lagura.* Twelve legs on each side; body oval; tail furnished with a white tuft of hairs. 1. A native of Europe; in mossy ground.

* *forficata* Legs fifteen on each side. 3. A native of Europe and America. Very frequent under stones.

*gigantea.* Legs seventeen on each side. 4. A native of America.

*morsitans.* Legs twenty on each side; eyes eight. 5. A native of America and India. Body composed of 22 segments; the antennæ consisting of 20 articulations. It is much dreaded on account of its bite, which is said to be poisonous.

* *electrica* Legs 70 on each side; body linear. 8. A native of Europe; in close damp places, and shines in the dark.

*phosphorea.* Legs 76 on each side. 9. A native of Asia. It shines in the dark like the *lampyris*; it is said that this insect has dropt from the air into a ship 100 miles from land, in the Indian and Æthiopian seas. Head oval, yellowish, and marked with two grooved lines, and a third transverse line; body filiform, and is about the thickness of a goose-quill, marked with two parallel yellow lines; antennæ tapering, of a rusty colour, and consisting of 14 articulations.

12 species of this genus have been described in the last edition of the System of Nature.

### 120. Julus.

Antennæ moniliform. Feelers two, filiform and jointed. Body semicylindrical. Legs very numerous, two on each side of every segment of the body.

The insects of this genus feed on other insects, particularly *acari*. The larva and pupa have many feet, are active, and resemble the perfect insect.

Legs 20 on each side. 1. A native of the European seas. *ovalis.*

Legs 134 on each side. 9. A native of America. This is the largest species of the genus. It bites severely, but is not poisonous. *maximus.*

Legs 120 on each side. 5. A native of Europe; in sandy places, and on the hazel. **sabulosus*

12 species of this genus have been described in the last edition of the System of Nature.

The following table exhibits the number of species included under each order.

| | |
|---|---|
| Coleoptera | 4087 |
| Hemiptera | 1427 |
| Lepidoptera | 2570 |
| Neuroptera | 174 |
| Hymenoptera | 1265 |
| Diptera | 692 |
| Aptera | 679 |
| In all | 10,894 |

## GENERAL OBSERVATIONS.

Though the definition of an insect which we have already given from Linnæus be perfectly correct, (viz. a small animal breathing through pores on its sides, furnished with many feet and moveable antennæ, covered with either a hard crust, or a hairy skin), it may not be improper to mention, more at large, those circumstances which form the line of distinction between insects and other animals.

1. Insects are not furnished with red blood, but instead of it their vessels contain a transparent lymph. This may serve to distinguish them from the superior animals, but it is common to them with many of the inferior; though Cuvier has lately demonstrated the existence of a kind of red blood in some of the *vermes*.

2. They are destitute of internal bones, but in place of them are furnished with a hard external covering to which the muscles are attached, which serves them both for skin and bones; they are likewise without a spine formed of vertebræ, which is found in all the superior classes of animals.

3. They are furnished with articulated legs, six or more; this circumstance distinguishes them from all other animals destitute of a spine formed of vertebræ.

4. A very great number of insects undergo a metamorphosis: this takes place in all the winged insects.

5. They frequently change their skin in the progress of their growth.

6. A very great number of insects are furnished with jaws placed transversely.

7. The wings, with which a very great number of insects are furnished, distinguish them from all other animals which are not furnished with a spine composed of vertebræ.

8. Insects are oviparous; scorpions and aphides during the summer months are viviparous.

9. Insects have no nostrils.

10. Insects are destitute of voice.

11. They are not furnished with a distinct heart composed of ventricle and auricle.

12. Incubation is not necessary for hatching their eggs.

### *The Organization of Insects.*

When we wish to become thoroughly acquainted with natural objects, we must not confine ourselves to an examination of their external appearance and configuration,

guration, but ought to examine their internal structure and their component parts; and extend our inquiries to every thing which relates to them. Insects, like all other organized bodies which form the animal and vegetable kingdoms, are composed of fluids and solids.

In the four superior classes of animals, viz. quadrupeds, birds, reptiles, and fishes, the bones form the most solid part, and occupy the interior part both of the trunk and limbs; they are surrounded with muscles, ligaments, cellular membrane, and skin. The matter is entirely reversed in the class of insects; the exterior part is most solid, serving at the same time both for skin and bones; it enclose the muscles and internal organs, gives firmness to the whole body, and by means of its articulations, the limbs, and different parts of the body, perform their various motions. In many insects, such as the crab, lobster, &c. the external covering is very hard, and destitute of organization; it is composed of a calcareous phosphate, mixed with a small quantity of gelatine, formed by an exudation from the surface of the body. As its great hardness would check the growth of the animal, nature has provided a remedy; all of these crustaceous insects cast their shell annually. The skin of most of the other insects, though composed likewise of calcareous phosphate, is softer and organized, being formed of a number of thin membranes adhering closely to one another, and putting on the appearance of horn. It owes its greater softness to a larger proportion of gelatine. The muscles of insects consist of fibres formed of fasciculi; there are commonly but two muscles to produce motion in any of their limbs, the one an extensor, the other a flexor. These muscles are commonly attached to a tendon composed of a horny substance, connected to the part which they are destined to put in motion. The articulations of insects are formed in a variety of ways; Cuvier, in his Comparative Anatomy, tom. i. page 445. has given a very minute account of them. Though Linnæus, and several others following him, have asserted that insects have no brain, yet it is certain that at least a number of the larger kind, as the lobster, crab, &c. have a soft substance similar to brain, from which the optic and other nerves take their rise; besides, when this substance is irritated, the animal is thrown into convulsions; hence we would conclude, that insects have a brain as well as the animals of the four superior classes, though it be smaller in proportion to their body.

In most insects the brain is situated a little above the œsophagus; it divides into two large branches, which surround the œsophagus, and unite again under it, from which junction a whitish nervous chord proceeds, corresponding to the spinal marrow of the superior animals, which extends the whole length of the body, forming in its course twelve or thirteen knots or ganglions, from each of which small nerves proceed to different parts of the body. Those who deny that insects have no brain, lay much stress on this circumstance, that many insects are capable of running about after they have been deprived of their heads; the *hippobosca*, in particular, is frequently instanced, which moves about quite readily, and is even said to copulate after its head has been cut off. The ganglions which are formed in the course of the larger nerves, perform in a great measure the function of the brain, indeed each of these ganglions may be viewed as a subordinate brain; in this way it may be easily conceived how the various parts which derive their nerves from any one of these ganglions, may be enabled to perform their different functions, after they have been separated from the other parts of the body, and deprived of all connexion with the brain.

Whether insects be endowed with any senses different from those of the superior animals, cannot easily be ascertained, because we are only acquainted with the five which we ourselves enjoy. It appears pretty evident that they possess vision, hearing, smell, and touch; as to the sense of taste we are left to conjecture, for we are acquainted with no facts, by which we can prove that insects enjoy the sense of taste, nor do we know of any by which we can prove that they do not.

The eyes of insects are of two kinds; the one compound, composed of a number of lenses, large, and only two in number; the other are small, smooth, and vary in number from two to eight. The small lenses which form the compound eyes are very numerous; they amount in some insects to many hundreds. Leeuwenhoek has counted 800 of them in the eye of a fly. Pugett says he observed upwards of 14,000 in the eye of a butterfly. The eyes of insects are without eyelids, and are covered externally with a hard smooth substance. Cuvier has given the anatomy of the eye of a dragon-fly. The internal surface of the lenses is covered with a black varnish. Under each of the lenses of which the eye is composed, there is a small nervous fibre, attached to the edge of the black covering which lines the internal surface of each lens by one extremity, and by the other to a membrane which is of the same extent with the cornea, which Cuvier calls the *choroide*. It is easily detached from the small nervous fibre, and appears to the naked eye, finely radiated with black and white; behind this there is still another membrane composed entirely of medullary substance, which is connected on each side with the hemisphere of the brain.

Whether insects from the compound nature of their eyes see objects multiplied, or enjoy only single vision, cannot be ascertained; were objects to be seen multiplied in proportion to the vast number of lenses of which the eyes of insects are composed, vision would certainly be very confused; and were we to be guided by analogy, we might naturally enough suppose that insects saw objects single with their compound eyes, as we ourselves see objects single with two eyes.

The eyes of insects, according to Swammerdam, do not contain the same humours which are found in the eyes of animals which compose the superior classes. The external membrane which covers the eyes, varies in colour in different insects; in many of the dipterous insects, particularly the gad-fly, it is agreeably variegated.

The far greater number of insects have only two eyes, like the animals of the superior classes; some have three, e. gr. the *scolopendra*; some four, e. gr. *gyrinus*; some six, e. gr. *scorpions*; some eight, e. gr. *spiders*.

The eyes of insects are commonly immoveable; crabs, however, have the power of moving their eyes.

That insects are endowed with the sense of hearing can no longer be disputed, since *frog-hoppers*, *crickets*, &c. furnish us with undeniable proofs of the fact. Nature has provided the males of these insects with the means of calling their females, by an instrument fitted to produce a sound, which is heard by the latter. The

male

male and female *death-watch* give notice of each others presence, by repeatedly striking with their mandibles against old wood in houses, or decayed trees, their favourite haunts. Their ears have been discovered to be placed at the root of their antennæ, and can be distinctly seen in some of the larger kinds, as the lobster.

That insects enjoy the faculty of smelling, is very evident. It is the most perfect of all their senses. *Beetles* of various sorts, *nitidulæ*, the different species of *dermestes*, *sylphs*, *flies*, &c. perceive at a very considerable distance, the smell of ordure and dead bodies, and resort in swarms to the situations in which they occur, either for the purpose of procuring food or laying their eggs. The common blue flesh-fly, is attracted by the strong smell of the *arum dracuntium*, which very much resembles that of carrion, and deposits its eggs on it: these flies are likewise deceived, and deposit their eggs on the flowers of the *stapelia hirsuta*, which has a very cadaverous smell. But though we can thus easily prove the sense of smell among insects, it is difficult to discover the seat of that particular sense. Several naturalists have supposed that it resides in the antennæ. Dumeril, in a disertation published in 1799, attempts to prove, that it must be situated about the entrance of the spiracula or respiratory organs, as Baster had previously supposed. Notwithstanding his arguments, Latreille is still disposed to follow the opinion of those who believe the antennæ to be the organs of smell. His reasons for favouring this opinion are:—

1. Smell is produced by the action of air, impregnated with odoriferous particles, on the nervous or olfactory membrane, which transmits the sensation.

If insects be endowed with an organ, furnished with similar nerves, capable of receiving impressions from air charged with odoriferous particles, such organs may be regarded as that of smell. Should the antennæ present a tissue of many nerves, what inconvenience can result from supposing that this tissue is capable of transmitting odour? Would not this hypothesis, on the contrary, be more simple, and more consonant to anatomical principles, than that which fixes the seat of smell at the entrance of the spiracula?

2. Many male insects have their antennæ more developed than the females; a fact easily explained, if we admit that these organs are the seat of smell.

3. It is certain that most of these insects which live or deposit their eggs on putrid animal or vegetable matters, stagnant waters, &c. are almost uniformly distinguished by a greater developement of the antennæ; such, for example, as the beetle, sylphs, leather-eaters, tipulæ, &c. These required a more perfect sense of smell, and are organized accordingly.

4. A great many insects which are entirely rapacious, have simple antennæ; and those which are characterised by similar manners, and which are sedentary, have none at all; as for instance some of the spiders.

5. Insects discover their habitations and food by the sense of smell. Latreille deprived several insects of their antennæ, and found they instantly fell into a state of stupor or derangement, and seemed to be incapable of recognising their haunts or their food, though placed close by them. Such experiments deserve to be prosecuted. With this view, were the antennæ of dung-beetles to be coated with varnish, and the animals placed near excrement (their usual food), a decisive proof would be obtained; for were they readily to find their way to the excrement, it may be fairly inferred that the antennæ were not the organs of smell. Should the reverse take place, an opposite conclusion might naturally be drawn.

6. Nerves terminate the antennæ, the articulations of which, though externally covered with a pretty thick membrane, are hollow, lined within with a soft substance, which is often of a watery consistence, the extremities of which, when exposed to the air, may receive impressions from it.

Some have imagined the antennæ to be the organs of touch; but Latreille contends that such an opinion is by no means supported by facts, and alleges that the shortness of the antennæ in most species, and the way in which most insects carry their antennæ, seem to prove the contrary. He thinks their antennæ ill adapted to become the organs of touch, because they have a hard and scaly covering. He is rather inclined to believe that the sense of touch, at least in certain species, is situated in the paws or extremities of the fore legs. The palpi or feelers in spiders and some other insects, seem to possess the sense of touch in an eminent degree; but many are disposed to consider these palpi rather as the organs of taste. Though we have no direct proof that insects enjoy the sense of taste, yet we may naturally enough suppose that they do, both from analogy and from the circumstance that most insects prefer some particular kinds of food to all others; many of them will rather die of famine, than eat any other kind of food than that which is peculiar to them. The superior part of the œsophagus has been supposed by some to be the seat of the organ of taste.

### *Aliment of Insects.*

INSECTS feed on a great variety of substances; there are few things either in the vegetable or animal kingdoms which are not consumed by one or other of them. The leaves, flowers, fruit, and even the ligneous parts of vegetables, afford nourishment to a very numerous class; animal bodies both dead and alive, even man himself, is preyed on by many of them; several species of the louse, of acarus, of the gnat, and the common flea, draw their nourishment from the surface of his body; the *gigger* or *chiegoe*, (*pulex ulcerans*), penetrates the cuticle, and even enters his flesh. A species of gad-fly (*œstrus hominis*) deposits its eggs under his skin, where the larvæ feed; the *phalena pinguinalis* frequently finds its way into his stomach, where it sometimes proves a fatal lodger. Other caterpillars insinuate themselves into different cavities of his body. All the inferior animals have their peculiar parasitical insects which feed on them during their life.

There are some insects which can feed only on one species. The caterpillars both of moths and butterflies, which feed on the leaves of some particular vegetable, would die without being able to taste any other. There are others which can make use of two or three kinds of vegetables, but which never attain full perfection, except when they are fed on one particular kind; for example, the common silk-worm, which eats readily all the species of mulberry, and even common lettuce, neither attains so great a size, nor produces so much silk, as when fed on the white mulberry. Although that species of coccus which produces the lac, feeds on the *ficus religiosa*, *ficus indica*, *rhamnus jujuba*, and *plaso* Hort. Malabar. yet the lac collected from the *ficus religiosa*, is very much superior in quality. That species of coccus which produces the cochineal, if it will at all feed on any other species of vegetables, never affords a dye equal to that which is to be obtained from it when fed on that particular species of cactus called *coccinellifera* by Linnaeus. There are a great many which feed indiscriminately on a variety of vegetables, which from that circumstance receive the title of *polyphaga*. Almost all herbivorous insects eat a great deal, and very frequently; and most of them perish if deprived of food, for but a short time. Carnivorous insects can live a long while without food, *e. g.* the *carabus*, *dytiscus*, *cicindela*, spiders, &c. As many insects cannot transport themselves easily in quest of food, to places at a distance from one another, nature has furnished the perfect insects of many species with an instinct, which leads them to deposit their eggs in situations where the larvæ, as soon as hatched, may find that kind of food which is best adapted to their nature.

Most of the butterflies, though they flutter about and collect the nectarious juice of a variety of flowers as food for themselves, always deposit their eggs on or near to these vegetables destined by nature to become the food of their larvæ. The various species of *ichneumon* deposit their eggs on the bodies of those insects on which their larvæ feed. The *sirex* (tailed wasp) and *sphex* are likewise careful to deposit their eggs in situations where their larvæ, when hatched, may find subsistence. The *ichneumon seductor*, after having killed an insect (most commonly a spider) deposits an egg on it, and then shuts it up in a cell which it forms of clay. The *sphex figulus* likewise deposits its eggs on the body of spiders which it has killed, and encloses it in a cell composed of clay. Some insects, at different periods of their existence, make use of aliment of very different properties: the larvæ of some are carnivorous, while the perfect insect feeds on the nectarious juice of flowers: e. g. *sirex*, *ichneumon*, &c. The larva of most of the lepidopterous insects feed on the leaves and young shoots of vegetables, while the perfect insects either take no food at all, or subsist on the sweet juice which they extract from flowers; indeed the construction of their mouths prevent them from taking any other than fluid food.

The alimentary organs may be divided into four parts. 1. Those of Mastication; 2. Deglutition; 3. Digestion; and, 4. Excretion. The organs of mastication vary considerably in different insects. Amongst those animals, some subsist on solid food; therefore must be furnished with tentacula (or pincers) for its comminution. Others subsist on liquid food; and are furnished with suckers, which vary in form in different insects. Sometimes with a trunk formed of a double sheath twisted in a spiral form, as is to be seen in the butterfly and the sphinx. Sometimes with a sharp stiff beak bent towards the breast; such as in the bug, the frog-hopper, and boat-fly. At other times with a fleshy proboscis ending in two moveable lips, or in a sucker composed of several syphons, inclosed in a sheath consisting of two valves, which is the case in the dipterous insects; such as the common fly, the horse fly, the gnat, &c.

Amongst insects which have jaws, some, such as those of the orders *Coleoptera* and *Aptera*, have these parts hard and composed of a horny substance, and subsist on matters of a considerable degree of tenacity. Those coleopterous insects which have six feelers feed on living insects; and those which have only four, feed on putrid animal or vegetable substances. The other insects furnished with jaws (such as many of the order *Hymenoptera*), have these parts soft and membranaceous, and consequently subsist on liquid or very succulent food.

There are no salivary glands to be met with in the mouths of insects, but a set of floating vessels secrete a fluid, varying in colour in different insects, very similar to saliva.

The organs of deglutition present nothing very remarkable. The œsophagus is a straight short tube, reaching from a little way under the brain to the first ganglion of the nerves, which perhaps may be considered as the cerebellum of insects. In the insects without jaws, deglutition is performed by a tube composed of annular muscular fibres. The trunk of the butterfly, the proboscis of the common fly, and the beak of hemipterous insects, may be considered as part of the œsophagus projecting beyond the mouth.

The organs of digestion consist of the stomach and intestinal canal. The stomach of insects varies very much according to the nature of the aliment on which they subsist. Sometimes it is single, frequently double, at other times manyfold. The greater number of insects have a single stomach, which is sometimes entirely membranaceous, sometimes muscular, and at other times it is merely the continuation of the œsophagus without any perceptible dilatation. Those insects which have a dilated membranaceous stomach, subsist commonly on the juices of vegetables; such as the bees, which seek the nectar of flowers, the butterflies &c. Their stomachs are almost always dilated, owing to the disengagement of gas from the substances they contain. Those which are furnished with a muscular stomach, such as the bug, the boat-fly, and almost all the hemipterous insects, feed on animal substances. Finally, those which have no dilatation in the œsophagus so as to form an evident stomach, commonly feed on the leaves and roots of vegetables, such as the cock-chaffer and all the beetles. The whole of the alimentary canal in these insects is very long, without any perceptible enlargement. The double stomach is to be found in those coleopterous insects which feed on other live insects, such as the *cicindela*, *carabus*, *attelabus*, &c. all of them are likewise distinguished by six palpæ. The first of their two stomachs is muscular, and is a sort of gizzard, the muscles of which are composed of slender fibres. The second is a long membranaceous canal, which appears villous when examined by the microscope; this villosity at first sight may appear singular, but a little attention to the manner in which nutrition goes on in insects, will suggest an explanation of this peculiarity. When we consider that circulation proceeds very slowly, and that the nutritive fluids must be nearly in a state of stagnation, digestion could not proceed without the assistance of absorbent tubes, which may take up these fluids. We may naturally enough suppose this villosity to be nothing else, but a number of absorbent vessels which take up the nutritive part of the circumambient fluid. Those insects which have many stomachs may be called ruminating, because they

have

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have the power of causing the food to return from the stomach to be chewed over again; such as the grasshopper, cricket, &c.

The mole cricket has a long œsophagus terminating in a round membranaceous stomach, which may perhaps be compared to the first stomach of the ruminating animals of the class *Mammalia*; where the food is accumulated, to be thrown back into the mouth, again to undergo a farther mastication.

A short intestine proceeds from this into a second stomach much less than the former, but muscular and apparently thicker, and furnished with parts which resemble the grinders in the stomach of crabs. They are small laminæ, resembling saws, disposed in five longitudinal rows, each composed of from ten to twelve smaller laminæ, which perform a sort of peristaltic motion by means of the muscular action of the stomach; and it appears pretty evident that the action of those laminæ is exerted on the food contained in the stomach. The other two stomachs are very similar, and placed one opposite to the other at the opening of the intestine which corresponds to the duodenum of the superior animals; they are wrinkled and thicker than the first stomach, but not so thick as the second.

This apparatus is to imbibe some part of the fluid from the aliment.

In the grasshopper the stomachs are similarly arranged. The cricket has to the number of five small and slender stomachs; indeed the two first seem only to be simple dilatations of the œsophagus.

In the cock-roach there is only one stomach, which is very large, and almost entirely membranaceous; at the extremity of which, there is a number of partial enlargements which may be considered as so many stomachs. The stomachs of the larvæ frequently differ from those of their perfect insects; viz. the alimentary canal of the caterpillar differs very much from that of the butterfly; and the intestinal canal of the grub differs widely from that of the beetle.

The œsophagus of the grub of the *scarabæus nasicornis* dilates suddenly, forming a cylindrical stomach which is furnished with three ranges of cæcum, which have their extremities simple and loose. The intestine proceeds in a straight line from the stomach; then having formed a doubling, becomes larger, and puts on the appearance of a colon, four times the length of the stomach; on which is to be perceived two tendinous lines. At the extremity of the colon there is a considerable dilatation; beyond which it becomes slender, and forms the rectum. The intestinal canal of the *scarabæus melolontha*, or cock-chaffer, is almost exactly similar; but nothing analogous to this structure is observable in the perfect insect. The intestines of the *scarabæus melolontha*, and *sc. nasicornis* are very long, very much contorted, and equal throughout their whole length.

The larva of the *hydrophilus* has a very evident stomach, and a very short intestine. In the perfect insect the intestine is long, without any visible enlargement or stomach, which may be accounted for, perhaps, in this way; the larvæ subsist on animal food, while the perfect insects feed on vegetables. The examples we have just given are striking. It may be remarked, that whenever the larvæ and the perfect insect subsist on the same kind of food, the difference in structure is less remarkable; only the intestinal canal is longer in the perfect insect.

The anus or the posterior orifice of the intestinal canal, not only affords a passage for the excrement, but encloses the extremities of the parts of generation. There are neither kidneys, bladder of urine, pancreas, nor any of the conglomerated glands observable in animals of the superior classes, to be found in insects.

Instead of the liver, there is a number of small floating filaments which surround the intestinal canal for almost two-thirds of its length. There is a great quantity of fat in many insects, particularly in those which spend a considerable portion of their lives in a torpid state. It is contained in loose membranes that fill up the intervals between the bronchiæ. This fat in caterpillars is very white, and both in taste and consistence very much resembles that of other animals. The quantity is so considerable in some insects as to equal one-third of the bulk of the body. All the insects which undergo a metamorphosis, are abundantly supplied with this fat; without it, indeed, they seem unable to go through their destined changes; for it has been observed, that those caterpillars which have been fed on by the larvæ of the various species of ichneumon, though they may survive the ravages of these parasitical insects till they are changed into pupæ, commonly die before they become perfect insects.

### *The Respiration of Insects.*

RESPIRATION is the act of inhaling and exhaling the air into, and out of the lungs. Quadrupeds, birds, and most of the amphibia, breathe through the mouth and nostrils. The air when received into the lungs is mixed with the blood, and imparts to it something necessary, and carries off something noxious.

Some authors have asserted that insects have no lungs. But late experiments and observations show, that no species wants them, or at least something similar to them; and in many insects they are larger in proportion to their bodies than in other animals. In most of them they lie at or nearer to the surface of the body, and send out lateral pores or tracheæ. The respiration of insects has attracted the attention of many naturalists, particularly Swammerdam, Malpighi, Reaumur, Lyonnet, Muschenbroeck, Degeer, Bonnet, Vauquelin, &c.

From their observations it may be inferred,

1. That insects do not breathe through the mouth or nostrils.

2. That there are a number of vessels for the reception of air placed along on each side of the body, which are commonly called *spiracula*, which are subdivided into a number of smaller vessels or bronchiæ.

3. That the vessels or tracheæ which proceed from the pores on the sides, are not composed of a simple membrane, but are tubes formed of circular rugæ.

4. That the spiracula are distinguishable, and are covered with a small scaly plate, with an opening in the middle like a button hole, which is furnished with membranes, or threads, to prevent the admission of extraneous bodies.

Reaumur is of opinion that the air enters by the spiracula into the tracheæ and bronchiæ; and is expired through small pores on the skin, without returning by the same way through which it entered. Were

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this the case, the respiration of insects would differ from that of other animals. Degeer seems to entertain the same opinion with Reaumur, from the account he has given of the manner in which caterpillars breathe; but thinks that inspiration and expiration through the spiracula and bronchia take place in the pupa. Lyonnet is not of the same opinion with Degeer, on account of an experiment made on the pupa of the sphinx. He supposes that this pupa lives for a certain time without respiration, and that the two anterior spiracula, which are the largest, and enclose the posterior ones, only serve the purpose of allowing the superabundant moisture to exhale, and to permit the external air to enter in its stead. Some experiments of Muschenbroeck seem to confirm the opinion of Lyonnet with regard to the pupa.

Perhaps nature, with that foresight which is observable in all her works, has taken care to form the pupa so as to require but a small quantity of air, and may have included in its body every thing necessary to enable it to undergo the change of its condition. The pupa of most insects is certainly very torpid, and little capable of receiving external impressions. The experiments of Malpighi and Reaumur have established the fact that insects must respire. Oil applied to the spiracula causes these animals to fall into convulsions, induces a general or partial paralysis, or causes their death.

Vauquelin, the celebrated chemist, has made several experiments on the respiration of the green grashopper. The male of this insect being put into six cubic inches of oxygen gas (the purity of which was ascertained), lived eighteen hours. The oxygen gas was changed into carbonic acid gas; it rendered lime water turbid, but did not extinguish a lighted candle; after the carbonic acid had been absorbed by means of fixed alkali, the combustion of the candle was more vivid than in common air. He found that the insect respired fifty or sixty times in a minute; but when put into oxygen, its respiration became about twelve times more frequent, being interrupted at last almost continually, because it was on the point of undergoing asphyxia. The air in which the insect had died, being washed with alkali, underwent a diminution of five per cent. and the vapour of ammonia could not again revive the insect.

A female insect being put into eighteen cubic inches of common air, lived thirty-six hours; its respiration was not altered as to frequency; the bulk of the air was not diminished at the death of the animal, but it extinguished a candle even after it had been washed in lime water; this is a new proof that oxygen is necessary to the life of insects; and when the atmospheric air contains but little of it, that insects would soon die.

This female grashopper being placed in sulphurated hydrogen gas, was seized with asphyxia instantly, and could be revived by no stimulus. These experiments not only prove that insects respire, and that oxygen is that part of the air which is necessary to their existence, but that carbonic acid or azote is fatal to them. The spiracula are neither of the same form, nor similarly situated in every insect; the larvæ of the common fly have several of these organs placed at the posterior extremity of their bodies; they are most frequently six.

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### *Circulation and Secretion of Insects.*

All the animals of the two first classes have a double circulation; their hearts consist of two distinct auricles and ventricles. The heart in the amphibia has two distinct auricles without any communication; and under these there is the appearance of two ventricles similar in shape to those of the former class; but they may be considered as one cavity; for the ventricle sends out not only the pulmonary artery, but likewise the aorta; for there is a passage in the septum, by which the ventricles communicate freely, allowing the blood to pass from the left into the right one.

The heart of fishes has but one auricle and one ventricle, and one great artery which conveys the blood to the gills. The circulation in insects differs considerably from that of the superior animals. In the lobster, and others of the larger insects, when a piece of the shell is broken, the pulsation of the heart is seen distinctly, and that sometimes for several hours after it has been laid bare. A long delicate vessel runs along the back parallel to the intestines of many insects, particularly caterpillars, in which an alternate contraction and dilatation is perceptible. The heart, or principal artery which performs the function of the heart, seems to be composed of a great number of small hearts, connected together, which transmit the blood from one to another. But when this vessel is injected it becomes continuous, and the small hearts disappear. In the caterpillar the pulsation begins at the posterior part, and proceeds from one segment to another, till it arrive at the head. Reaumur has alleged, that the pulsation of this artery changes its direction in the pupa, and that the blood is propelled from the head towards the tail: he says this may be plainly observed in a pupa newly stripped.

Lyonnet denies the accuracy of Reaumur's observations; and says that he found a species of caterpillar, the pupa of which is very transparent, in which the longitudinal artery was to be seen very distinctly; having examined it carefully, a few days after its change, he ascertained that the motion of the artery had not at all changed its direction, and that it still continued to move from the tail towards the head as in the caterpillar. Further observations can alone determine which of these two opinions is the most correct. One anatomist has lately asserted that the dorsal canal observable in insects, serves the purpose of respiration. Cuvier has proved, that the conglomerate glands which are to be met with in all the animals that have a heart, do not exist in insects; but instead of them, that they are furnished with very long slender vessels which float in the internal cavities of the body, without being even connected into fasciculi; from this circumstance Cuvier is disposed to believe that insects have no heart. It is by means of these fine tubes that the different fluids are secreted, which are peculiar to various kinds of insects. Some insects discharge an acrid and fetid fluid, others discharge an oil of a very pleasant smell.

The bee, the wasp, the sphex, the crysis, have two vessels situated at the bottom of their sting, which contain a very acrid fluid, secreted from the mass of blood, which the animal discharges at pleasure through a perforation in the sting; it is this fluid which causes the pain, inflammation, and swelling, which follow a wound inflicted by these insects.

In the scorpion, there is a fluid of a very malignant nature, which the animal discharges at pleasure through its sting; under certain circumstances, this fluid produces fatal effects. Some of the spiders discharge a fluid, which renders their bite dangerous. The *aranea avicularia*, and the *tarantula*, in particular, are well known; even the common spiders inflict a fatal wound on the insects they entangle in their web. The silk of the common silk-worm and other caterpillars, according to Malpighi, Lyonnet, and others, is a fluid contained in two vessels, which are of a considerable size at the extremity, and taper towards the mouth, and become very slender.

The *carabus* and *dytiscus* contain an acid which reddens the infusion of litmus. The ant contains an acid well known to chemists.

The acrid matter contained in the body of the *lytta vesicatoria*, is used in medicine, and forms the best epispastic we are acquainted with.

### *Generation of Insects.*

INSECTS are the only animals without vertebræ in which the sexes are distinguished. Copulation is performed in them by the introduction of the parts of generation of the male into those of the female.

All insects are either male or female, except in a few of the genera of the order *Hymenoptera* (such as the bee, ant, &c.), where individuals are to be found, which are neither male nor female; and, on that account, called *neuters*. Among the bees, the neuters form the far greater part of the community, and perform the office of labourers. Among the ants, the neuters are very numerous, and constitute the only active members of the society. It has been alleged that these neuters are nothing but females, whose parts have not been developed for want of proper nourishment. Olivier, however, after strict examination, is disposed to think them really different, though he does not adduce facts sufficient to establish his opinion.

The parts which distinguish the male from the female, may be divided into two classes, viz. 1. Those which are not directly connected with generation. 2. Those which are absolutely necessary for the purposes of generation. The circumstances which have no direct communication with generation, which serve to point out the distinction between the sexes, are, 1. The difference of size observable in the male and female. 2. The brightness of the colour in each. 3. The form and number of articulations of the antennæ. 4. The size and form of their wings. 5. The presence or absence of a sting. The male is always smaller than the female. The female ant is nearly six times larger than the male. The female cochineal is from 12 to 15 times the size of the male. The female *termes* is 200 or 300 times the size of the male. The colours of the male are commonly much more brilliant than those of the female; this is particularly the case in lepidopterous insects. In some insects, the colour of the male is totally different from that of the female. The antennæ of the male are commonly of a different form, and larger than those of the female. Frequently the males are furnished with wings, while the females have none; the *lampyris*, *coccus*, and *blatta*, and several moths, afford an example of this. The female bee is furnished with a sting, while the male is destitute of one. The males of some insects are furnished with sharp prominent points, resembling horns, situated either on the head or breast, which are either not perceptible or very faintly marked in the female. The parts essential to generation afford the best distinguishing mark. In most insects they are situated near the extremity of the rectum. By pressing the abdomen near to the anus they may frequently be made to protrude. But the parts of generation are not always situated near the anus. In the spiders they are situated in the feelers. In the *libellula*, the male organ is situated in the breast, while that of the female is placed at the anus.

### *Organs of Generation.*

IN male insects, the organs which serve for the preparation of the semen, bear some resemblance to those organs in the animals which compose the class *Mammalia*. All of them have four organs, two of which may be compared to the testicles, and the other two to the *vesiculæ seminales*. They vary very much in form in different species. During the period the male is usually employed in impregnating the female, these parts are very distinct; after that, they disappear totally. In the larger aquatic insects, (particularly in the *hydrophilus*) besides these four organs already mentioned, there are other two small vesicles, which may be compared to the prostate gland of the superior animals. The *vasa deferentia* in the *hydrophilus* are somewhat reflected, its testicles are very large, and terminate in a very slender folded filament. In the grashopper, these four organs are likewise found, but the *vesiculæ seminales* are of a compound nature; the testicles have a good deal the appearance of those of the *mammalia*.

They are of an oval form, and are fixed to the inside of the back, their convex surface is covered with several tubes of a bright golden colour. After these yellow tubes have been removed, the testicles are easily unfolded; like all the other secretory organs of insects, they seem to be nothing but a collection of convoluted vessels. The *vesiculæ seminales*, which are attached to the testicles, are formed into clusters. In the season of copulation, they increase in bulk so much as nearly to occupy three-fourths of the abdomen; they are full of a limpid fluid, which is the semen.

The *vasa deferentia*, which in most insects are very short, in the *blatta mucronata* are of a considerable length, and form several convolutions before they arrive at the penis.

The *penis*, in insects, is either single or double. Those which have a single penis, have it placed at the posterior extremity of the abdomen; in the *libellula*, however, it is placed at the anterior part: it is membranaceous externally; internally it is composed of a substance analogous to the *corpus cavernosum* of other animals; its form is either cylindrical or conical; it is furnished with two scales, one on each side, which form a sort of wedge; this wedge being introduced into the vagina of the female, and the scales being separated by means of particular muscles, which are situated at their base, open the vagina, and make way for the introduction of the penis.

penis. This singular construction is perhaps owing to the want of a proper erection.

Insects which have a double penis (such as the spider) have this organ placed at the extremity of the feelers of the lower jaw; these feelers are large in the male. During copulation, they are introduced into two vaginæ situated in the anterior part of the abdomen of the female. In these insects, the two small scales are likewise to be found, which serve to open the vagina of the female.

The female is furnished with two *ovaria;* they are long tubular canals, in which the eggs are arranged like a string of beads. The eggs which are situated next the opening into the oviduct, are largest, and they diminish gradually as they recede from it, till they disappear altogether. The tubular canals unite, and terminate in a common canal, which communicates with an oblong cavity, analogous to the uterus. It is in this cavity that the semen of the male is deposited. Malpighi asserts that the fluid penetrates into the oviduct, by means of a canal of communication, and that the eggs are fecundated the instant they pass the mouth of this canal, as they proceed towards the external orifice of the uterus.

In viviparous insects, such as the *hippobosca*, scorpion, &c. the ovaria are different. Sometimes the little animals are arranged in clusters; at other times they compose a spiral cord, the length of which corresponds to the number and size of the fœtus.

Copulation is not performed exactly in the same way by all insects. In most of the species, the male mounts on the back of the female; but the spiders, dragon-flies, and some others, have a mode of performing copulation peculiar to themselves. After copulation, they soon begin to lay their eggs. Some deposit their eggs gradually, one after another; others discharge them all at once, for example, the *ephemera*, the very short duration of whose existence renders this necessary. But the far greater number of insects lay them one by one. There are some which lay a considerable number at the same time. The large blue flesh-fly (*musca carnaria*) when it finds carrion in a proper state for the reception of its eggs, deposits a good number of them at once in the same place; but when it does not find a proper situation in which to deposit its eggs, it can refrain for some time, till it find a proper place and opportunity. There are some insects that do not lay their eggs till a very long time after copulation; bees, wasps, &c. are impregnated before winter, but do not lay their eggs till spring.

### *Eggs of Insects.*

The eggs of insects are of two sorts; the first membranaceous, like the eggs of the tortoise and the other reptiles; the other covered with a shell like those of the birds; their figure varies exceedingly; some are round, some elliptical, some lenticular, some cylindrical, some pyramidal, some flat, some square, but the round and oval are the most common. The eggs of insects seldom increase in size, from the time they have been deposited by the parent till they are hatched. Those of the *tenthredo*, however, and of some others, are observed to increase in bulk.

At first there is nothing to be perceived in the eggs of insects but a watery fluid: and after some little time an obscure point is observable in the centre; which, according to Swammerdam, is not the insect itself, but only its head, which first acquires consistence and colour. And the same author alleges, that insects do not increase in bulk in the egg, but that their parts only acquire shape and consistence. Under the shell of the egg there is a thin and very delicate pellicle, in which the insect is enveloped, (which may be compared to the chorion and amnios which surround the fœtus in quadrupeds. The little insect remains in the egg till the fluids are dissipated, and till its limbs have acquired strength to break the egg, and make its escape. The different species of insects remain enclosed in the egg for very different periods. Some continue enclosed only a few days, others remain for several months. The eggs of many insects remain without being hatched during the whole winter; and the young insects do not come forth from them till the season at which the leaves of the vegetables on which they feed begin to expand. When the insects are ready to break their prison, they commonly attempt to pierce the shell with their teeth, and form a circular hole, through which they put forth first one leg, and then another, till they extricate themselves entirely.

### *Number of Insects.*

Insects are by far the most numerous class of animals. About eleven thousand species have been described by Gmelin in the last edition of the System of Nature. A great many more have been described by other naturalists since the publication of that work, and a very considerable number are to be met with in the cabinets of the curious, which have not as yet been described by any author.

In those parts of the world which we are best acquainted with, we may easily suppose that many species of insects exist which have hitherto escaped notice. The minuteness of some insects makes them easily overlooked; the agility of others renders the catching of them difficult. The retired situations which many of them haunt favour their concealment. In the unexplored parts of America, Africa, and Asia, many hundred species must exist utterly unknown to naturalists. All these circumstances render it very probable that not one half of the insects which exist in the world have hitherto been described.

### *Utility of Insects.*

Insects afford nourishment to a great number of the superior animals; many of the fishes, reptiles, and birds, draw the principal part of their sustenance from that source. The immense swarms of different species of crab which abound in every sea, directly or indirectly form the principal part of the food of the cod, haddock, herring, and a great variety of fishes. The snake, lizard, frog, and many other reptiles, feed both on land and aquatic insects. Gallinaceous fowls, and many of the small birds, &c. feed on insects. Swallows, indeed, feed entirely on winged insects. They afford food likewise to many of the mammalia, &c. to many species of the bat, to the ant-eater, &c. and even to man himself. Many species of crab, viz. lobster, common crab, shrimp, prawn, land-crab, &c. are reckoned delicacies. The larvæ of some coleopterous insects and locusts form part of the food of man.

Insects likewise, by consuming decayed animal and vegetable matter, which if left to undergo the putrefactive process, on the surface of the ground, might taint the atmosphere with pestilential vapours, preserve the air pure for the respiration of man and other animals.

### *Preservation of Insects in Cabinets.*

In collecting insects, both male and female ought if possible to be procured; and the time of the year when they are taken ought to be noted. Specimens with injured wings or antennæ must be rejected.

For collecting insects in their perfect state, a sort of forceps are made use of, which have their extremities covered with gauze. Besides these, the entomologist, in his walks, should be furnished with a pincushion, stored with pins of various sizes, and a tin box lined with cork, of a convenient size for the pocket in which the insects when caught are to be placed; the lepidopterous insects being first carefully killed by squeezing their thorax, lest their fluttering should injure their wings. Coleopterous insects are most expeditiously killed by being immersed in boiling water; and those who prefer this method may carry them home without injury in common pillboxes. Most insects are killed with a few drops of spirit of turpentine; the lepidoptera and hymenoptera may easily be killed by being stuck through with a pin dipt in aquafortis. When the insects are killed they are to be transfixed with pins, their wings, antennæ, and feet spread out and kept displayed. In some of the lepidoptera, two specimens should be preserved; the wings in the one displayed, and in the other placed as much as possible in their natural position.

Insects may likewise be collected by breeding them from their larvæ; and this, when it is convenient, is by far the best method for procuring fine specimens; it is chiefly practised with the lepidopterous kinds. When the caterpillars are taken, they are to be fed on the leaves of the plant or tree on which they were found, and kept in a box with some moist earth at the bottom; they will afterwards turn into a chrysalis, either by going into the earth, by spinning a web and enclosing themselves in it, or by changing into a pupa *obtecta*, according to their kinds. Having continued in this state their appointed time, the perfect insect will come forth, and must then be killed before it has injured its wings by flying.

Lepidopterous insects are likewise to be collected in their pupa state, by seeking for them under the projections of garden walls, pales, and out-houses, summer-houses, &c. or by digging for them in the winter months under the trees they feed on. When thus dug up, they are to be put into a box with moist earth, and kept till they come out.

When the insects are prepared in this manner, they are to be placed in the cabinet, which may consist of boxes or drawers deep enough to hold a long pin, and lined on the bottom with cork, or with wax; the insects of each order in drawers by themselves; and the different genera close together. The generic and trivial name of each insect is to be written on a piece of paper, fixed to the bottom by the same pin which supports the insect. The drawers must be made to shut very close, so as to exclude the dust and minute insects; some cover them with glass. A little camphor in each drawer is likewise useful.

Insects of the aptera order, such as spiders, scolopendræ, juli, &c. are best preserved in some kind of spirits. The onisci and cancri may be preserved like beetles.

## HISTORY OF ENTOMOLOGY.

THOUGH the attention of man must have been attracted by the vegetables and animals with which he found himself surrounded, and by the earth and minerals on which he trod, even at the very earliest periods of human society, yet a very considerable time must have elapsed before any attempts were made at arrangement or classification. Aristotle was the first (as far as we know) who deserved the name of natural historian; his arrangement of animals was the only one followed for many centuries. He divided all animals into viviparous and oviparous; the first contained quadrupeds, the second birds, fishes, and insects. Under insects were comprehended all small animals whose bodies were divided into segments. This definition of insects was followed by all natural historians down to the time of Linnæus.

Theophrastus, the disciple of Aristotle, the only other person among the ancient Greeks who deserves the name of natural historian, bestowed the most of his attention on vegetables and minerals. Pliny has given us an account of all that was known in natural history down to his own times. Though he has mentioned many insects, owing to his want of method little is to be learnt from him respecting entomology. Dioscorides, who was nearly contemporary with Pliny, has confined himself chiefly to natural history connected with medicine. He has given an enumeration of all the natural bodies which entered into the materia medica. On the revival of learning in Europe, writers on natural history seemed to have confined themselves to writing commentaries on the ancients; and nothing was done in entomology till the times of Gesner, who was the greatest naturalist the world had seen from the time of Aristotle, and who was the first who made a collection of the objets of natural history, and formed a museum. He was born in Zurich in 1516, and died in 1565. Aldrovandus lived nearly about the same time with Gesner, and, like him, formed a museum which served for the foundation of the public museum at Bologna, where many specimens may be still seen marked with the venerable hand of the first collector. Gesner formed his zoology on the principles of Aristotle: his history of animals is very voluminous. Aldrovandus made a collection of all that had been written on natural history before his own time, without discriminating truth from fiction. He has given a methodical arrangement of insects in the seventh book of his large work published in 1602. He followed nearly the same arrangement with Gesner. Gesner, in conjunction with some other natural historians, wrote a treatise on insects, which was published by Mouffet,

Mouffet, an English physician. About this time our countryman, the illustrious Harvey, ventured to controvert Aristotle's erroneous opinion with respect to equivocal generation. Though his aphorism, *omnia ex ovo*, at first met with great opposition, it was at last established by his own experiments and those of Rhedi and Malpighi. From this period the writers on entomology have been numerous; we shall content ourselves here with giving little more than an enumeration of the principal works on the subject.

Agricola, in a work entitled *de Animantibus Subterraneis*, published in 1549, has given a methodical arrangement of insects: he divides them into, 1. Creeping insects; 2. Flying insects; and 3. Swimming insects. After giving this arrangement, he proceeds to give an account of each species.

A work entitled *Theatrum Insectorum Thomæ Moufeti opera concinnatum*, Lond. 1634, the joint labour of several of the most eminent natural historians who lived about the middle of the sixteenth century, though not published till 1734, about 30 years after the death of Mouffet, by whose care the work had been abridged, and prepared to meet the public eye, is the next worthy of notice. It is divided into two books; the first treats of winged insects; the second of insects without wings: these two grand divisions are subdivided into several families, characterized by the number and position of the legs. There is but little method displayed in the arrangement of the insects which compose the different families.

Aldrovandus divides insects into *terrestria et aquatica* (land insects, and aquatic insects). The different orders and subdivisions of these two classes, are for the most part determined by the number, nature, and position of their wings and legs. He calls his first order *Favifica*, (those which form combs). As to the rest, according to his own declaration, he follows Aristotle.

Wolfang Frenzius, in his *Historia Animalium sacra*, published in 1612, has divided insects into three classes, viz. 1. *Aeria*, (such as fly); 2. *Aquatica*, (such as inhabit the water); 3. *Terrea et Reptentia*, (such as creep about, or are lodged in the earth). His descriptions are much more accurate than those of any of the authors who preceded him.

John Johnston has borrowed freely from his predecessors, in his *Historia Naturalis Insectorum*, published in 1653. He divides insects into *terrestria* and *aquatica*, (into land and aquatic insects); the land insects he divides into three orders: 1. Such as have wings and legs; 2. Such as have legs without wings; and 3. Such as have neither wings nor legs. These three orders occupy his three first books; his fourth contains aquatic insects.

Walter Charleton follows the system of Aldrovandus in his *Onomasticon Zoicon*, published in 1668.

Jo. Goodart published *Metamorphosis et Historia Naturalis de Insectis*, 8vo. Mediob. 1667.

Likewise in 1675, a work of his appeared, *de Insectis in Methodum reductis, opera Mart. Leister*. Ebor. In this work insects are divided into ten families: The 1st includes butterflies with erect wings; 2d, Butterflies with horizontal wings; 3d, Butterflies with deflected wings; 4th, Libellulæ, (dragon-flies); 5th, Apes, (bees); 6th, Coleopterous insects; 7th, Locusts, and grasshoppers; 8th, Flies corresponding to the order. diptera of Linnæus; 9th, Millepeds; and 10th, Spiders. This work is full of typographical errors and mistakes in natural history.

The discovery of the microscope in 1618, tended greatly to the advancement of entomology, as by means of it the most minute parts of insects could be viewed, and their organization examined. Naturalists were much engaged in making microscopic discoveries, particularly Borel, Rhedi, Swammerdam, Bonanni, Bonomo, Leeuwenhoeck and Joblot.

John Swammerdam, in his *Biblia Naturæ*, published in 1669, has divided insects into four classes.

John Ray published his *Historia Insectorum*. Lond. 1710. This work was properly the joint production of J. Ray and Francis Willoughby. These illustrious friends laboured together with uncommon ardour in the study of nature. Death carried off Willoughby in the prime of life, before he had properly digested what the industry of his early years had collected; and his labours would have been lost to the world, and his name might have sunk in oblivion, but for the friendship of Ray. So close was the intercourse between these two naturalists, and so intimately were their labours blended together, that it is not easy to assign each his due share of merit. Indeed Ray has been so partial to the fame of his departed friend, and has cherished his memory with such affectionate care, that we are in danger of attributing too much to Mr Willoughby, and too little to himself. Though what Dr Derham asserts be not correct, that Mr Willoughby had taken the animal kingdom for his task, and Mr Ray the vegetable one, yet it is generally agreed, that the *Historia Insectorum* is principally to be ascribed to Willoughby. In that work insects are divided into *Transmutabilia et Intransmutabilia*, (those which undergo a metamorphosis, and those which undergo none). These two grand divisions are subdivided into several orders, which are ascertained by the number of their legs, or total want of legs; by the places which they inhabit; by their size; by the configuration of the various parts of the body; by the smell which they diffuse, &c. The *transmutabilia* are divided into four orders. 1. *Vaginipennes*, (those which have their wings covered with a sheath). 2. *Papiliones*, (lepidopterous insects). 3. *Quadripennes*, (those which have four wings); and 4. *Bipennes*, (those which have two). The papiliones, quadripennes, and bipennes are again subdivided into families, the characters of which are taken, either from the appearance and conformation of their larvæ, or from the form, colour, and different properties of the perfect insect.

Eleazar Albin published a natural history of English insects in 1720. He likewise published the Natural History of Spiders in 1736.

Antony Valisnieri, in his work entitled *Esperienze e Osservazioni intorno agli Insetti*, published in 1730, has divided insects into four orders, according to the situation in which they pass their lives.

Mary Sybelle Merian, published in 1730, *Histoire d'Insectes d'Europe et de Surinam*. She likewise published in 1705, *Metamorphosis Insectorum Surinamensium ad vivum picta et descripta*; and in 1717, *Erucarum Ortus*.

George Bernard Rhump published in 1705, and again in 1741, a work entitled *Amboinische Raritatkammer*.

Hans

Hans Sloane, in the years 1707 and 1725, published a Voyage to the Islands of Madeira, Barbadoes, Nevis, Saint Christophers and Jamaica.

Henry Ruisch in 1710 and 1718 published *Theatrum Universale omnium Animalium.*

J. Petiver published in 1715 his *Icones et Nomina Aquatilium Animalium Amboinæ.*

Richard Bradley published in 1721 his Philosophical Account of the Works of Nature.

Linnæus, the most celebrated natural historian the world ever produced, in his first edition of the *Systema Naturæ*, published in 1735, divided insects into four orders, from the number and different appearances of their wings; 1. *Coleoptera; 2. Angioptera; 3. Hemiptera;* and 4. *Aptera.* This was but an imperfect sketch, a first essay. In the subsequent editions of the System of Nature which he published, to the number of twelve, he completed the arrangement of insects, of which we need say nothing here, as we have followed it in preference to all others; and most authors who have written on the subject for more than half a century past, have either followed it closely, or with very slight alterations. His extensive genius embraced all the three kingdoms of nature. In botany and entomology in particular he far excels all who went before him, and as yet remains unrivalled. Writers on entomology became so numerous after Linnæus had published his System of Nature, and established entomology on a solid foundation, that a mere enumeration of their names and titles of their books would occupy more room than we can afford to bestow on the article; we shall therefore only notice a few of the most remarkable.

Charles Degeer, in his *Memoires pour servir à l'Histoire des Insectes*, in 1752, has arranged insects into fourteen orders, distinguished by the different appearances of the various parts which compose their bodies, particularly the elytra, wings, and most remarkable parts of the head. He published again in 1778.

M. de Reaumur published his *Memoires pour servir à l'Histoire des Insectes* at Paris in 1737. No one has paid so much attention to the habits of insects, and to every thing that concerns them, as Reaumur. He ought to be read by every student of entomology.

John Retzius has simplified the arrangement of Degeer, in a small work entitled *Genera et Species Insectorum.* But although in this arrangement he has followed the method of Degeer, the terms he has made use of are principally those of Linnæus. His 14 orders are, 1. Lepidoptera. 2. Alinguia. 3. Neuroptera. 4. Hymenoptera. 5. Siphonata. 6. Dermaptera. 7. Hemiptera. 8. Coleoptera. 9. Hasterata. 10. Proboscidea. 11. Suctoria. 12. Ancenata. 13. Atrachelia. 14. Crustacea.

M. Geoffroy, in his *Histoire Abrègè des Insectes*, published at Paris in 1762, has divided insects into six orders; Coleopteres, Hemipteres, Tetrapteres ailes farineuses, Tetrapteres ailes nues, Dipteres, and Apteres. He determined his families by the number of the articulations of the feet, and his genera by characters drawn from all the parts of the body. He has formed a great number of new genera.

John Antony Scopoli, in his *Entomologia Carniolica*, published in 1762, has followed the arrangement of Linnæus, and only changes the names of some of the orders; *e. g.* Proboscidea, instead of Hemiptera; Aculeata, instead of Hymenoptera; Halterata, instead of Diptera; and Pedestria, instead of Aptera.

J. C. Schæffer published in 1766, *Elementa Entomologica, 135 tabulæ ære excussæ;* he follows in many points the method of Linnæus. He divides insects into seven classes. 1. Coleoptero-macroptera. 2. Coleoptero-microptera. 3. Hemiptera. 4. Hymeno-lepidoptera. 5. Hymeno-gymnoptera. 6. Diptera; and 7. Aptera. His first and second classes correspond with the Coleoptera of Linnæus; the fourth with the Lepidoptera, and the fifth with the Hymenoptera.

John C. Fabricius is the founder of a new system of Entomology, which he published in his *Systema Naturæ* 1775. He discriminates his orders and genera, by the parts of the mouth, (*instrumenta cibaria*). He afterwards published *Species Insectorum, Entomologia Systematica*, and *Mantissa Insectorum.*

The arrangement of Fabricius has acquired great reputation, especially on the continent. It may not therefore be amiss to give a slight view of it. He divides insects into eight classes.

Class I. ELEUTHERATA. Mouth armed with jaws, and four or six feelers. The jaws naked and free.
Class II. ULANATA. The jaws covered with an obtuse helmet.
Class III. SYNISTATA. The jaws united with the lip.
Class IV. AGONATA. The under jaw wanting.
Class V. UNOGATA. Mouth armed with jaws and two feelers; the under jaw generally furnished with a small unguis or nail.
Class VI. GLOSSATA. Mouth furnished with feelers, and a spiral tongue.
Class VII. RHYNGOTA. Mouth furnished with a snout, and an articulated sheath.
Class VIII. ANTLIATA. Mouth furnished with a haustellum and a sheath not articulated.

In a supplement to his *Entomologia Systematica*, he has divided insects into thirteen orders. 1. Eleutherata. 2. Ulonata. 3. Synistata. 4. Piezata. 5. Odorata. 6. Mitosata. 7. Unogata. 8. Polygonata. 9. Kleistagnatha. 10. Exochnata. 11. Glossata. 12. Rhyngota. 13. Anthiata. He has lately published a work entitled *Systema Eleutheratorum*, no more than two volumes of which have as yet made their appearance.

Moses Harris published an Exposition of English Insects, &c. with coloured plates, 1776.

Jo. Christ published *Philosophia Entomologica sistens scientiæ fundamenta*, &c. Hamb. 1778, 8vo.

*Archiv. der Insektengeschichte herausgege bervon.* Joh. Caps. Fuesly. Zurich, 1781.

Fr. Paulla, v. Schrank; *Enumeratio Insectorum Austriæ indigenorum.* Aug. Vindel. 1781.

P. Sim. Pallas; *Icones Insectorum.* Hamb. 1781.

A. W. Knock; *Beytraege zur Insektengeschichte*, 1781.

James Barbut published the *Genera Insectorum* of Linnæus, exemplified by various specimens of English insects drawn from nature. Lond. 1781.

John Nepomuk de Laicharting, has divided insects into ten orders, characterised by the configuration of various parts of the body. He adheres pretty closely to the

the method of Linnæus. His orders are, 1. Scarabæoides. 2. Grylloides. 3. Cimicioides. 4. Papilionoides. 5. Libelluloides. 6. Vespoides. 7. Muscoides. 8. Cancroides. 9. Aranoides, and 10. Oniscoides.

Olivier, in 1780, published *Entomologie, ou Histoire Naturelle des Insectes*, in 3 vols. 4to. Paris. In 1790, in the *Dictionaire des Insectes*, forming a part of the *Encyclopedie Methodique*, he has given an arrangement of insects little different from that of Linnæus. He has added one order which he calls Orthopteres, distinguished by the mode of folding the lower wings, and a part on the head, which he terms *galea*. He has likewise subdivided the order Aptera, into Arachnides and Crustaces. Latreille in 1795, in a work entitled *Precis du Caractere des Genres*, divides insects into two grand divisions, viz. *insectes ailès, et insectes apteres* (winged insects, and insects without wings). These two grand divisions he subdivides into 14 orders. 1. Coleopteres. 2. Orthopteres. 3. Hemipteres. 4. Neuropteres. 5. Lepidopteres. 6. Suceurs. 7. Thysanoures. 8. Parasites. 9. Acephalés. 10. Entomostraces. 11. Crustaces. 12. Myriapodes. Since that he has published a more detailed account of this method in a work entitled *les Genres et les Familles des Insectes.*

Clairville in 1795, in the introduction to his *Entomologie Helvetique*, has given an arrangement of insects, in which he differs from Linnæus almost in nothing, except in the names of his orders, viz. Elytropteres, Dictyopteres, Thlebopteres, Haltipteres, Lepidopteres, Heminopteres, Rophoteires, and Pododuneres.

Link, in his *Magasin sur Thiergeschite*, has divided insects into eleven orders; he follows de Laicharting almost in every thing, even in the names of his orders; he has indeed added an order which he calls Pediculoides.

Cuvier and Dumeril, in their Comparative Anatomy, have very nearly followed the method of Linnæus; they have however divided the order Aptera into two, viz. Gnathaptera and Aptera; they have likewise altered the arrangement of the orders, and have placed those first which contain insects furnished with jaws, viz. Gnathaptera, Neuroptera, Hymenoptera, Coleoptera, and Orthoptera; and have thrown those last which are destitute of jaws, viz. Hemiptera, Lepidoptera, Diptera, and Aptera.

We shall refrain from noticing those authors who have written partial treatises; though there are several works of that kind which the entomologist might peruse with advantage, such as the *Fauna Suecica*, published in 1761 by Linnæus, at Stockholm. *Fauna Germanica*, by Panzer. *La Faune Parisienne de Walknair*. Kirby's *Monographia apum Angliæ*. Latreille's treatise on Ants.

See a more detailed historical account of the writers on this science, in the article ENTOMOLOGY, SUPPLEMENT.

## EXPLANATION OF PLATES.

### PLATE CCIII.

Fig. 1. ANTENNÆ PECTINATÆ, or feathered; as in the *phalæna*, moths.
2. ——— PERFOLIATÆ, or perfoliated; as in the *dermestes* and *dytiscus*.
3. ——— FISSILES, or fissile, divided into laminæ at the extremity, as in the *scarabæi*, beetles.
4. ——— CLAVATÆ, or club-shaped, as in the *papilio*, butterfly.
5. ——— MONILIFORMES, like a necklace of beads; as in the *chrysomela*.
6. ——— SETACEÆ, setaceous, or bristle-shaped; as in many of the *phalænæ*.
7. ——— ARISTATÆ, furnished with a lateral hair, as in the *fly*.
8. 9. *a*, Caput, the head.
*b*, Palpi, or feelers.
*c*, Antennæ, or horns.
*d*, Oculi, the eyes.
*e*, Thorax.
*f*, Scutellum, or escutcheon.
*g*, Pectus, or breast.
*h*, Sternum, or breast-bone.
*i*, Abdomen, and its segments.
*k*, Anus.
*l*, Elytra, or shells.
*m*, Membranous wings.
*n*, Pedes, or feet, which are natatorii.
10. *o*, Femur, or thigh.
*p*, Tibia, or leg.
*q*, Tarsus, or foot.
*r*, Unguis, or claw.
11. *a*, The anterior part of the wing.
*b*, The posterior part.
*c*, The exterior part.
*d*, The interior part.
*e*, The margin.
*f*, The disk or middle.
*g*, Oculus, or eye.
12, 13, 14, 15. Represent the insect in its egg, caterpillar, pupa, and perfect state.

Order I. COLEOPTERA. Fig. 16. *Scarabæus*. Fig. 17. *Ptinus*. Fig. 18. *Buprestis*. Fig. 19. *Carabus*.

Order II. Fig. 20. *Mantis*. Fig. 21. *Fulgora*. Fig. 22. *Notonecta*. Fig. 23. *Cimex*. Fig. 24. *Aphis*. Fig. 25. *Coccus*.

Order III. Fig. 26. *Papilio*. Fig. 27. *Sphinx*. Fig. 28. *Phalæna*.

Order IV. Fig. 29. *Libellula*. Fig. 30. *Hemerobius*. Fig. 31. *Panorpa*.

Order V. Fig. 32. *Tenthredo*. Fig. 33. *Ichneumon*. Fig. 34. *Chrysis*. Fig. 35. *Formica*.

Order VI. Fig. 36. *Oestrus*. Fig. 37. *Tipula*. Fig. 38. *Asilus*.

Order VII. Fig. 39. *Lepisma*. Fig. 40. *Aranea*. Fig. 41. *Scorpio*. Fig. 42. *Cancer*. Fig. 43. *Scolopendra*.

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Fig. 8.

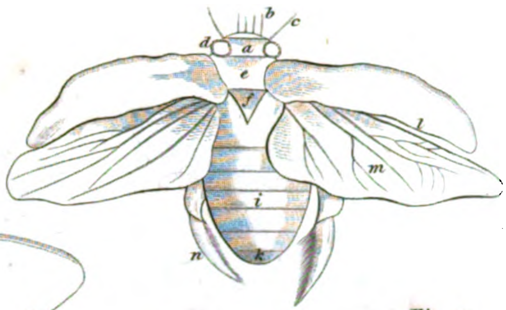


Fig. 9.

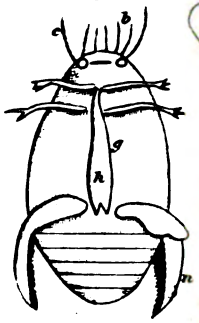


Fig. 11.

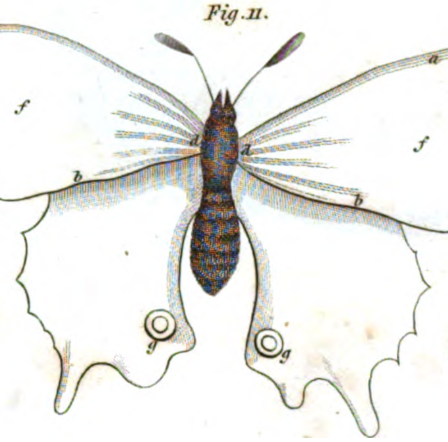


Fig. 10.

Fig. 12.

Fig. 13.

Fig. 15.

Fig. 14.

## ORDER I. COLEOPTERA.

Fig. 16.

SCARABAEUS HERCULES, HERCULES BEETLE.

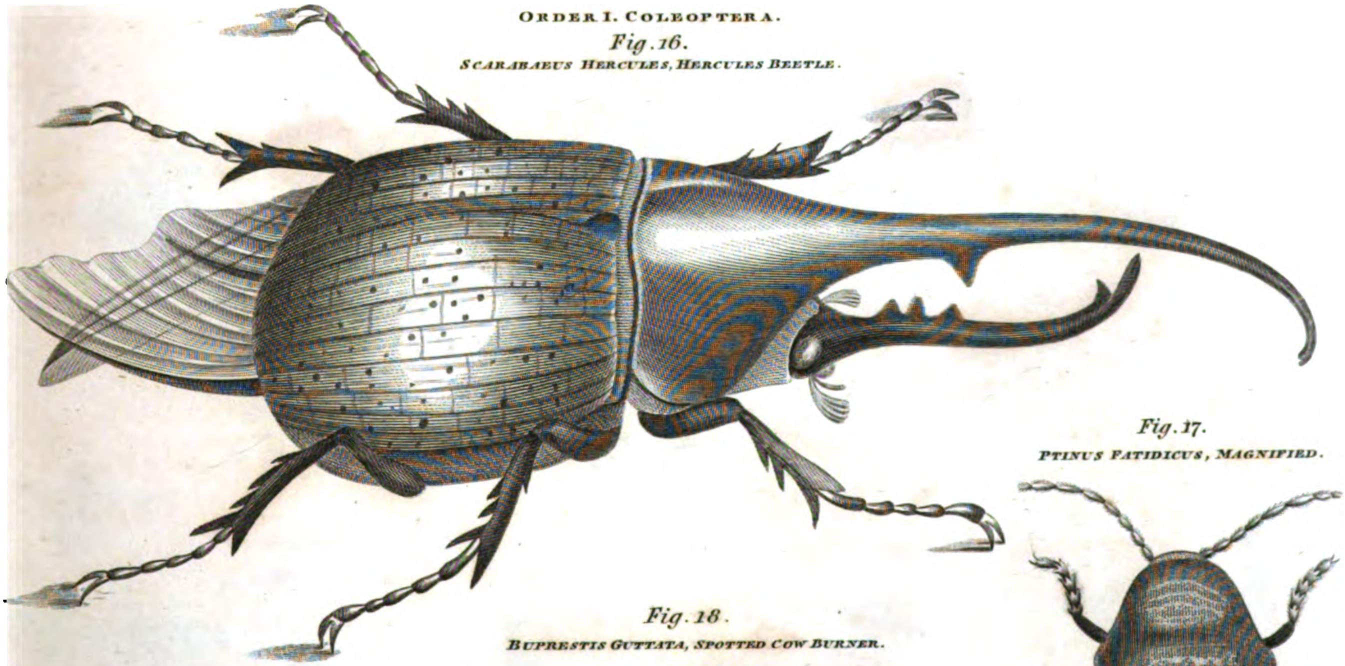


Fig. 17.

PTINUS FATIDICUS, MAGNIFIED.

Fig. 18.

BUPRESTIS GUTTATA, SPOTTED COW BURNER.

Fig. 19.

CARABUS VULGARIS, COMMON CARABUS.

Fig. 19.

CARABUS CORIACEUS, SHAGREEN CARABUS.

PTINUS FATIDICUS, DEATH WATCH.

Fig. 17.

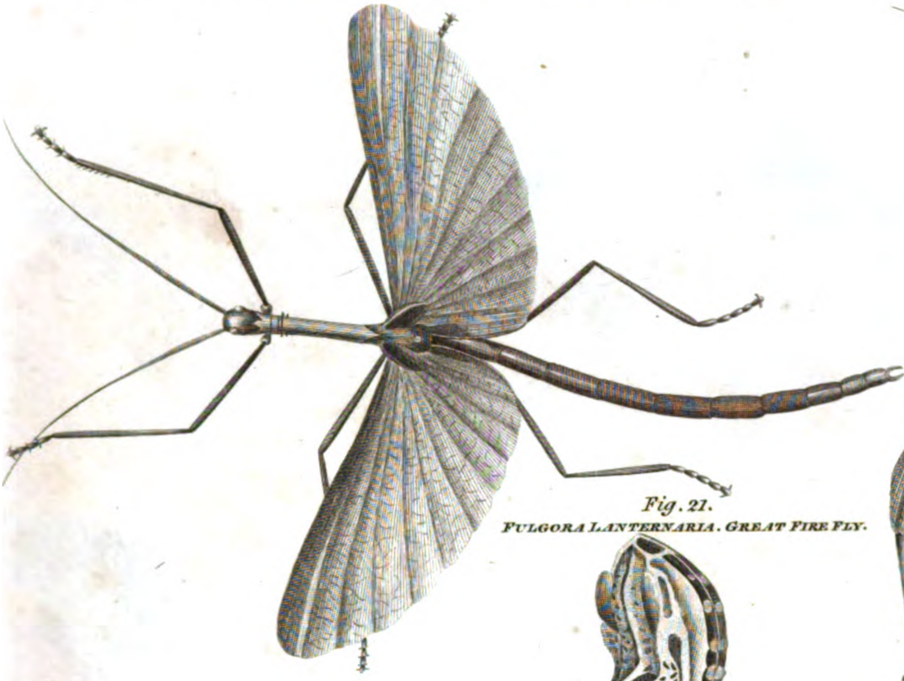
A. Wilson sculp.

# ENTOMOLOGY.

PLATE CCIV.

ORDER II. HEMIPTERA.

Fig. 20. MANTIS BISPINOSA.



MANTIS SICCIFOLIA. the WALKING LEAF.

Fig. 20.

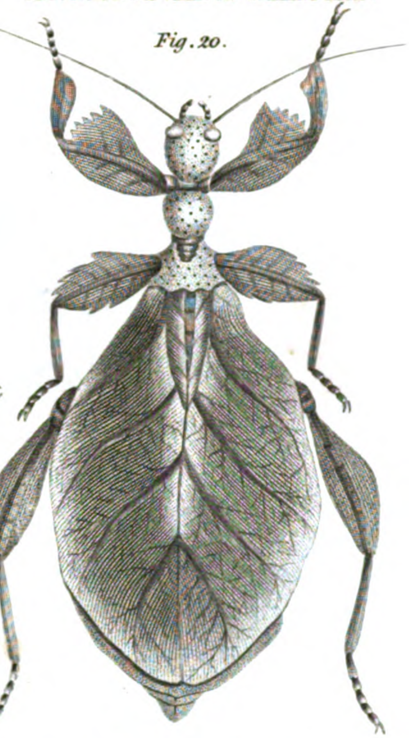


Fig. 21.
FULGORA LANTERNARIA. GREAT FIRE FLY.

Fig. 22.
NOTONECTA BOAT FLY.

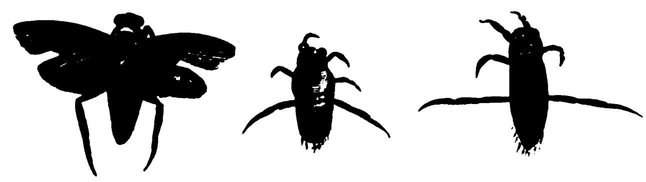


Fig. 24.
APHIS. PLANT LOUSE.

Fig. 25. COCCUS.

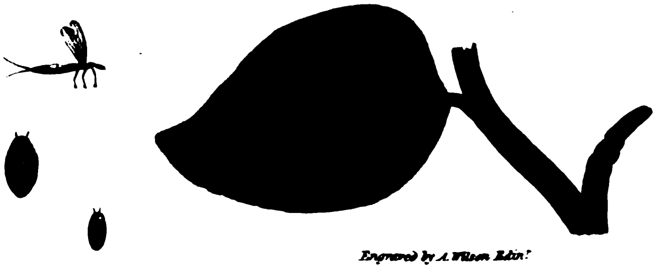
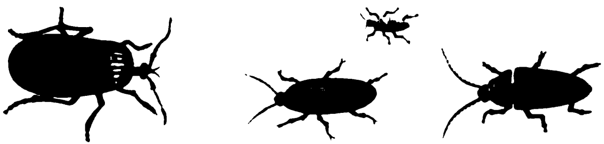


Fig. 23. CIMEX BUG.



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# ENTOMOLOGY. PLATE CCV.

ORDER III. LEPIDOPTERA.

Fig. 26. PAPILIO.

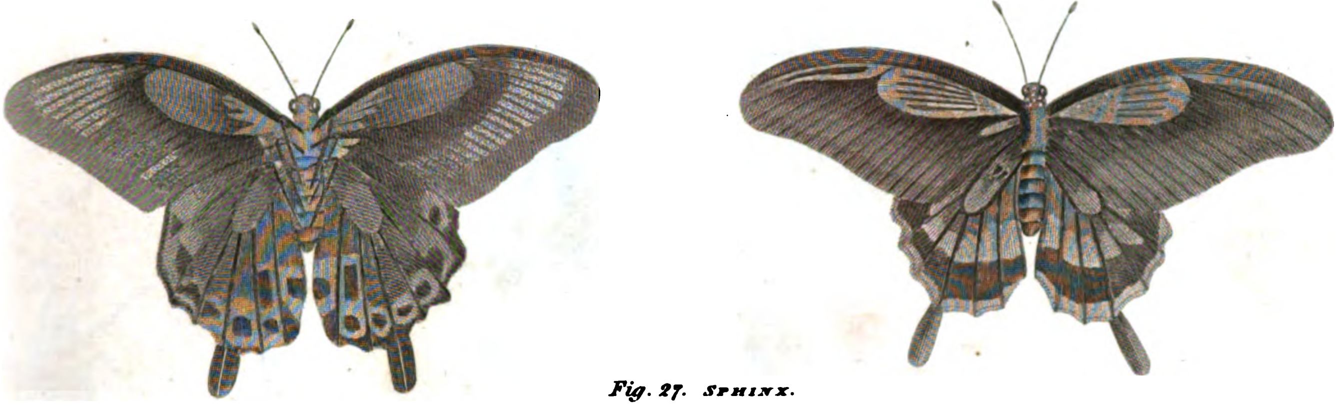

Fig. 27. SPHINX.

Fig. 28. PHALAENA.

ORDER IV. NEUROPTERA.

Fig. 30. HEMEROBIUS.

Fig. 30.

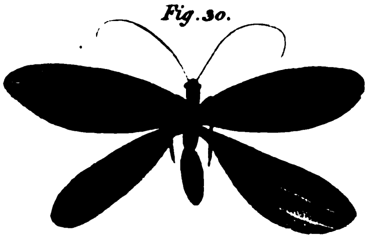

Fig. 29.

LIBELLULA. DRAGON FLY.

Fig. 31. PANORPA.

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# ENTOMOLOGY.

# PLATE CCVI.

## ORDER V. HYMENOPTERA.

Fig. 32. TENTHREDO.

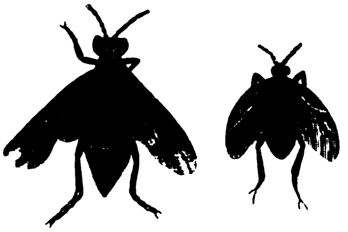


Fig. 33. ICHNEUMON.

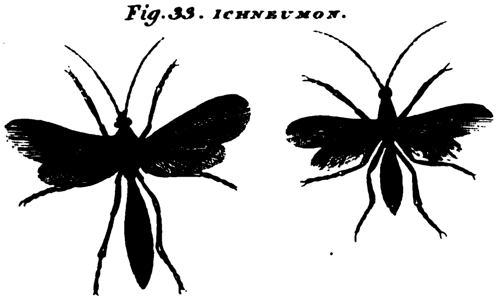
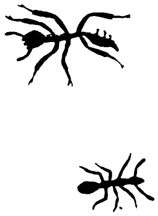


Fig. 34. CHRYSIS.

Fig. 35. FORMICA.



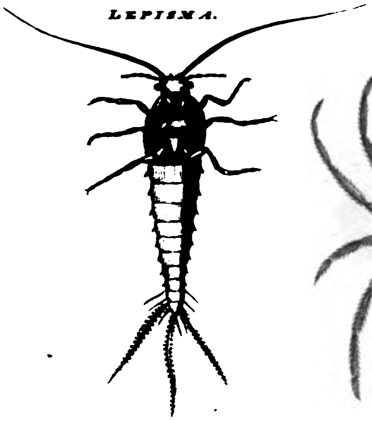
## ORDER VI. DIPTERA.

Fig. 36. OESTRUS.

Fig. 37. TIPULA.

Fig. 38. ASILUS.

Fig. 39. LEPISMA.



## ORDER VII. APTERA.

Fig. 40. ARANEA SPIDER.

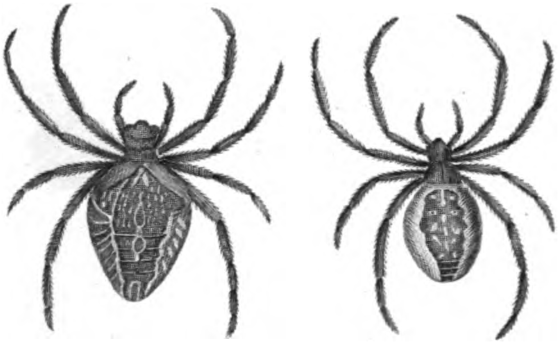
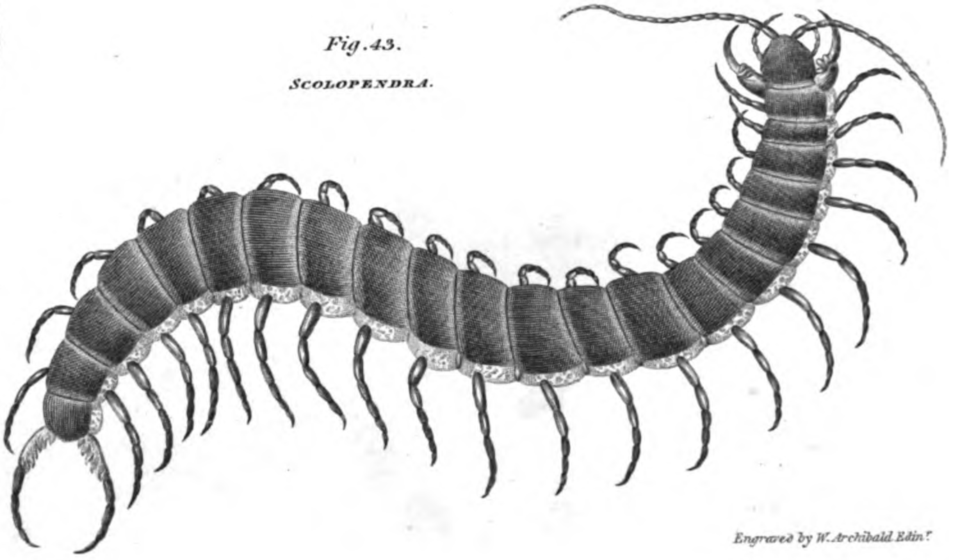


Fig. 42. CANCER.

Fig. 41. SCORPIO.

Fig. 43. SCOLOPENDRA.



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ENTREPAS, in the manege, a broken pace or going, that is neither walk nor trot, but has somewhat of an amble.

This is a pace or gait of such horses as have no reins or back, and go upon their shoulders; or, of such as are spoiled in their limbs.

ENTRING LADDERS, in a ship, are of two sorts; one used by the vessel's sides, in a harbour, or in fair weather, for persons to go in and out of the ship: the other is made of ropes, with small staves for steps; and is hung out of the gallery to enter into the boat, or to come aboard the ship, when the sea runs so high that they durst not bring the boat to the ship's side for fear of staving it.

ENTROCHUS, in *Natural History*, a genus of extraneous fossils, usually of about an inch in length, and made up of a number of round joints, which, when separate and loose, are called *trochitæ:* They are composed of the same kind of plated spar with the fossil shells of the echini, which is usually of a bluish-gray colour, and very bright where fresh broken; they are all striated from the centre to the circumference, and have a cavity in the middle.

The entrochi are found of all sizes, from that of a pin's head to a finger's length, and the thickness of one's middle finger; and are plainly of marine origin, having often sea-shells adhering to them. They are sometimes known by the name of St Cuthbert's beads, and are usually found in limestone.

ENTRY, in *Law*, signifies taking possession of lands or tenements, where a person has a right so to do.

*ENTRY of an Heir*, in *Scots Law*, that form of law by which an heir vests in himself a proper title to his predecessor's estate.

*Bill of ENTRY*, in commerce. See BILL.

In making entries inwards, it is usual for merchants to include all the goods they have on board the same ship in one bill, though sometimes they may happen to be upwards of 20 several kinds: and in case the goods are short entered, additional or post entries are now allowed; though formerly the goods so entered were forfeited. As to bills of entry outwards, or including goods to be exported, upon delivering them, and paying the customs, you will receive a small piece of a parchment called a *cocket*, which testifies your payment thereof, and all duties for such goods.

If several sorts of goods are exported at once, of which some are free, and others pay customs; the exporter must have two cockets, and therefore must make two entries; one for the goods that pay, and the other for the goods that do not pay custom.

Entries of goods, on which a drawback is allowed, must likewise contain the name of the ship in which the goods were imported, the importer's name, and time of entry inwards. The entry being thus made, and an oath taken that the customs for those goods were paid as the law directs, you must carry it to the collector and comptroller, or their deputies; who, after examining their books, will grant warrant, which must be given to the surveyor, searcher, or land-waiter, for them to certify the quantity of goods; after which the certificate must be brought back to the collector and comptroller, or their deputies, and oath made that the said goods are really shipped, and not landed again in any part of Great Britain.

ENVELOPE, in *Fortification*, a work of earth, sometimes in form of a simple parapet, and at others like a small rampart with a parapet: it is raised sometimes on the ditch, and sometimes beyond it.

ENVIRONNE', in *Heraldry*, signifies surrounded with other things: thus, they say, a lion environné with so many bezants. See BEZANTS.

ENUMERATION, an account of several things, in which mention is made of every particular article.

ENUMERATION, in *Rhetoric*, a part of peroration: in which the orator, collecting the scattered heads of what has been delivered throughout the whole, makes a brief and artful relation or recapitulation thereof.

ENVOY, a person deputed to negociate some affair with any foreign prince or state. Those sent from the courts of Britain, France, Spain, &c. to any petty princes or state, such as the princes of Germany, the republics of Venice, Genoa, &c. go in quality of envoys, not ambassadors; and such a character only do those persons bear, who go from any of the principal courts of Europe to another, when the affair they go upon is not very solemn or important. There are envoys ordinary and extraordinary, as well as ambassadors; they are equally under the protection of the law of nations, and enjoy all the privileges of ambassadors; only differing from them in this, that the same ceremonies are not performed to them.

ENVY, in *Ethics*, pain felt, and malignity conceived, at the sight of excellence or happiness in another. See EMULATION.

EON, or ÆON. See ÆON.

EONIANS, in church-history, the followers of Eon, a wild fanatic of the province of Bretagne, in the 12th century, whose brain was disordered. He concluded from the resemblance between *eum*, in the form for exercising malignant spirits, viz. *Per eum, qui venturus est judicare vivos et mortuos*, and his own name Eon, that he was the son of God, and ordained to judge the quick and dead. Eon, however, was solemnly condemned by the council at Rheims, in 1148, at which Pope Eugenius III. presided, and ended his days in a miserable prison. He left behind him a number of followers and adherents, whom persecution and death so weakly and cruelly employed could not persuade to abandon his cause, or to renounce an absurdity which, says Mosheim, one would think could never have gained credit, but in such a place as Bedlam.

EORIA, in *Mythology*, a feast celebrated by the Athenians in honour of Erigonus, who, by way of punishment for their not avenging the death of his father Icarus, engaged the gods to inflict the curse on their daughters, that they should love men who never returned their passion. The feast was instituted by the order of Apollo.

EOSTRE, in *Mythology*, a Saxon goddess to whom they sacrificed in the month of April, called the month of *Eostra;* and thence the name *Easter*, which the Saxons retained after their conversion to Christianity, applying it to the festival celebrated in commemoration of our Saviour's resurrection.

EPACRIS, a genus of plants belonging to the pentandria class. See BOTANY *Index*.

EPACTS, in *Chronology*, the excess of the solar month above the lunar synodical month, and of the solar year above the lunar year of twelve synodical months; or of several solar months above as many synodical months, and several solar years above as many dozen of synodical months.

The epacts, then, are either *annual* or *menstrual.*

Menstrual epacts are the excesses of the civil or kalendar months above the lunar month. Suppose, e. gr. it were new moon on the first day of January; since the lunar month is 29 days 12h. 44′ 3″, and the month of January contains 31 days, the menstrual epact is 1 day 11h. 15′ 57″.

Annual epacts are the excesses of the solar year above the lunar. Hence, as the Julian solar year is 365 days 6h. and the Julian lunar year 354 days 8h. 48′ 38″, the annual epact will be 10 days 21h. 11′ 22″; that is, nearly 11 days. Consequently the epact of 2 years is 22 days; of 3 years, 33 days; or rather 3, since 30 days make an *embolismic* or intercalary month.

Thus the epact of 4 years is 14 days, and so of the rest; and thus every 19th year, the epact becomes 30 or 0; consequently the 20th year the epact is 11 again; and so the cycle of epacts expires with the golden number, or lunar cycle of 19 years, and begins with the same, as in the following table:

| Gold. Numb. | Epacts. | Gold. Numb. | Epacts. | Gold. Numb. | Epacts. |
|---|---|---|---|---|---|
| 1 | XI | 8 | XXVIII | 14 | IV |
| 2 | XXII | 9 | IX | 15 | XV |
| 3 | III | 10 | XX | 16 | XXVI |
| 4 | XIV | 11 | I | 17 | VIII |
| 5 | XXV | 12 | XII | 18 | XIX |
| 6 | VI | 13 | XXIII | 19 | XXX |
| 7 | XVII | | | | |

Again, as the new moons are the same, that is, as they fall on the same day every 19 years, so the difference between the lunar and solar year is the same every 19 years. And because the said difference is always to be added to the lunar year, in order to adjust or make it equal to the solar year; hence the said difference respectively belonging to each year of the moon's cycle is called the *epact of the said year*, that is, the number to be added to the said year, to make it equal to the solar year; the word being formed from the Greek *επαγω*, *induco*, *intercalo.*

Upon this mutual respect between the cycle of the moon and the cycle of the epacts, is founded this rule for finding the Julian epact, belonging to any year of the moon's cycle. Multiply the year given of the moon's cycle into 11: and if the product be less than 30, it is the epact sought; if the product be greater than 30, divide it by 30, and the remainder of the dividend is the epact. For instance, I would know the epact for the year 1712, which is the third year of the moon's cycle. Wherefore 3 is the epact for 1712; for $11\times3=33$, and 33 being divided by 30, there is left 3 of the dividend for the epact. But the difference of the Julian and Gregorian years being equal to the excess of the solar above the lunar year, or 11 days, it happens that the Gregorian epact for one year is the same with the Julian epact for the preceding year.

EPAMINONDAS, a celebrated Theban, the son of Polymnus, and one of the greatest captains of antiquity. He learned philosophy and music under Lysis, a Pythagorean philosopher; and was from his infancy inured to all the exercises of body and mind. He was learned, generous, well-skilled in war, brave, modest, and prudent; and had such a regard for truth, that he would not tell a falsehood even in jest. He served first under the Lacedæmonians; saved the life of Pelopidas their chief, who received in a battle seven or eight wounds; and contracted a strict friendship with that general, which lasted till his death. At his persuasions, Pelopidas delivered the city of Thebes from the yoke of the Spartans, who had rendered themselves masters of Cadmea, which occasioned a bloody war between the two nations. Epaminondas was made general of the Thebans; on which he gained the celebrated battle of Leuctra, in which Cleombrotus, the valiant king of Sparta, was killed. He then ravaged the enemy's country, and caused the city of Messene to be rebuilt and peopled. At length, the command of the army was given to another, because Epaminondas had kept his troops in the field four months longer than he had been ordered by the people; but, instead of retiring in disgust, he now served as a common soldier, and distinguished himself by so many brave actions, that the Thebans, ashamed of having deprived him of the command, restored him to his post, in order to carry the war into Thessaly, where his arms were always victorious. A war breaking out between the Elians and the inhabitants of Mantinea, the Thebans took the part of the former. Epaminondas then resolved to endeavour to surprise Sparta and Mantinea; but not succeeding, he gave the enemy battle, in which he received a mortal wound with a javelin, the bearded iron remaining in the wound. Knowing that it could not be drawn out without occasioning immediate death, he would not suffer it to be touched, but continued to give his orders: and on his being told, that the enemy were entirely defeated, "I have lived long enough (he cried),

cried), since I die without being conquered; and at the same time he plucked the javelin from his wound, and expired, 363, B. C.

EPANALEPSIS. See ORATORY, N° 73.

EPANODOS. *Ibid.* N° 73.

EPANORTHOSIS. *Ibid.* N° 73.

EPARER, in the manege, signifies the flinging of a horse, or his yerking and striking with his hind-legs.

EPAULEMENT, in *Fortification*, a work raised to cover sidewise, is either of earth, gabions, or fascines loaded with earth. The epaulements of the places of arms for the cavalry, at the entrance of the trenches, are generally of fascines mixed with earth.

EPAULETTES, are a kind of shoulder-knots chosen for the soldiers, which are to be of the colour of the facing, with a narrow yellow or white tape round it, and worsted fringe; those for the officers are made of gold or silver lace, with a rich fringe; they are badges of distinction worn on one or both shoulders. Those of the dragoon-guards, horse, and dragoons, are worn on the left shoulder: the light dragoons, and officers of grenadiers, have one on each shoulder: those of the battalion wear one on the right shoulder only, which is to be made of embroidery or lace with a gold or silver fringe. Those of the royal regiment of artillery are to be gold and embroidery, with gold fringe or scarlet cloth, and worn on the right shoulder.

EPENTHESIS, in *Grammar*, the interposition or insertion of a letter or syllable in the middle of a word; as *aliuum*, for *alitum*; *relligio*, for *religio*; *induperator*, for *imporater*, &c.

EPEUS, of the line of Endymion, the inventor of the battering-ram, an engine of great service in sieges to make a breach. He is thought to have built the Trojan horse, and to have founded the city of Metapontum.

EPHA, or EPHAH, in Jewish antiquity, a measure for things dry, equal to 3 pecks and 3 pints.

EPHEBÆUM, in antiquity, the place where the ephebi or youth exercised; or, as some say, where those who designed to exercise met, and agreed what kind of exercise they should contend in, and what should be the victor's reward.

EPHEBI, among the Athenians, a designation given to their young men when they arrived at 18 years of age, at which time they had their names entered in a public register.

EPHEDRA, a genus of plants belonging to the diœcia class, and in the natural method ranking under the 51st order, *Coniferæ*. See BOTANY *Index*.

EPHEMERA, from ἡμέρα, "a day;" a diary fever, or a fever of one day's continuance only. In this case, such a heat as attends an excess of wine, a pulse somewhat full and quick, but soft and regular, a slight headach, a nausea and restlessness, are all the symptoms, and which terminate without any sensible evacuation. If it continue to the third day, it is not a diary fever; and if the constitution is very dry, a hectic is to be dreaded.

EPHEMERA, the *Day-fly*, a genus of insects belonging to the order of neuroptera. See ENTOMOLOGY *Index*.

EPHEMERIDES, in *Astronomy*, tables calculated by astronomers, shewing the present state of the heavens for every day at noon; that is, the places wherein all the planets are found at that time. It is from these tables that the eclipses, conjunctions, and aspects of the planets are determined; horoscopes or celestial schemes, constructed, &c. We have ephemerides of Origan, Kepler, Argoli, Heckerus, Mezzarachis, Wing, De la Hire, Parker, &c. S. Cassini has calculated ephemerides of the sidera medicæa or satellites of Jupiter, which are of good use in determining the longitude.

In England, the Nautical Almanack, or Astronomical Ephemeris, published annually by anticipation, under the direction of the commissioners of longitude, is the most considerable. In France, celestial ephemerides have been published by M. Desplaces every ten years, from 1715 to 1745; they were afterwards continued by the Abbé Caille, with many additions; of which an account may be seen in the History of the Academy of Sciences for 1743. The Academy of Sciences have likewise published annually, from the beginning of the present century, a kind of ephemeris under the title of *Connoissance des Tems*.

EPHESUS, a city of antiquity, much celebrated on account of its temple of Diana, and for being the most famous mart or staple town of Hither Asia. Ephesus was in ancient times the metropolis of all Asia. Stephanus gives it the title of *Epiphanestates*, or *most illustrious*: and Pliny styles it the ornament of Asia. The ancient city stood about 50 miles south of Smyrna, near the mouth of the river Cayster, and the shore of the Icarian sea, which is a bay of the Ægæan; but as it has been so often destroyed and rebuilt, it is no easy matter to determine the precise place. Most of our modern travellers are of opinion, that the ancient city stood more to the south than the present; which they argue from the ruins that still remain. Ephesus was, in ancient times, known by the names of *Alopes*, *Ortygia*, *Morges*, *Smyrna*, *Trachæa*, *Samornion*, and *Ptelo*. It was called *Ephesus*, according to Heraclides, from the Greek word *ephesus*, signifying *permission*; because Hercules (says he) permitted the Amazons to live and build a city in that place. Others tell us, that Ephesus was the name of the Amazon that founded the city; for Pliny, Justin, and Orosius, unanimously affirm that it was built by an Amazon; while others bestow this honour upon Androclus, the son of Codrus king of Athens, who was the chief of the Ionians that settled in Asia. But, in matters of so early a date, it is impossible to come at the truth, and therefore not worth our while to dwell on such fruitless inquiries. What we know for certain is, that the city, which in the Roman times was the metropolis of all Asia, acknowledged Lysimachus for its founder; for that prince, having caused the ancient city to be entirely demolished, rebuilt, at a vast expence, a new one, in a place more convenient, and nearer the temple. Strabo tells us, that, as the inhabitants shewed a great reluctance to quit their ancient habitations, Lysimachus caused all the drains that conveyed the water into the neighbouring fens and the Cayster to be privately stopped up; whereby the city being on the first violent rains in great part laid under water, and many of the inhabitants drowned, they were glad to abandon the ancient and

Ephesus.

retire to the new city. This new Ephesus was greatly damaged by an earthquake in the reign of Tiberius, but by that emperor repaired and adorned with several stately buildings, of which there are now but few ruins to be seen, and scarce any thing worthy of ancient Ephesus. The aqueduct, part of which is still standing, is generally believed to have been the work of the Greek emperors; the pillars which support the arches are of fine marble, and higher or lower as the level of the water required. This aqueduct served to convey water into the city from the spring of Halites, mentioned by Pausanias. The gate, now called by the inhabitants, for what reason we know not, *the Gate of Persecution*, is remarkable for three bas-reliefs on the mould, of an exquisite taste. The port, of which so many medals have been struck, is at present but an open road, and not much frequented. The Cayster was formerly navigable, and afforded a safe place for ships to ride in, but is now almost choked up with sand.

But the chief ornament of Ephesus was the temple of Diana, built at the common charge of all the states in Asia, and for its structure, size, and furniture, accounted among the wonders of the world. This great edifice was situated at the foot of a mountain, and at the head of a marsh; which place they chose, if we believe Pliny, as the least subject to earthquakes. This site doubled the charges; for they were obliged to be at a vast expence in making drains to convey the water that came down the hill into the morass and the Cayster. Philo Byzantius tells, us, that in this work they used such a quantity of stone, as almost exhausted all the quarries in the country; and these drains or vaults are what the present inhabitants take for a labyrinth. To secure the foundations of the conduits or sewers, which were to bear a building of such a prodigious weight, they laid beds of charcoal, says Pliny, well rammed, and upon them others of wool. Two hundred and twenty years, Pliny says 400, were spent in building this wonderful temple by all Asia,. It was 425 feet in length, and 200 in breadth, supported by 127 marble pillars, 70 feet high, of which 27 were most curiously carved, and the rest polished. These pillars were the works of so many kings, and the bas-reliefs of one were done by Scopas, the most famous sculptor of antiquity; the altar was almost wholly the work of Praxiteles. Cheiromocrates, who built the city of Alexandria, and offered to form Mount Athos into a statue of Alexander, was the architect employed on this occasion. The temple enjoyed the privilege of an asylum, which at first extended to a furlong, was afterwards enlarged by Mithridates to a bow-shot, and doubled by Mark Antony, so that it took in part of the city: but Tiberius, to put a stop to the many abuses and disorders that attend privileges of this kind, revoked them all, and declared, that no man guilty of any wicked or dishonest action should escape justice, though he fled to the altar itself.

The priests who officiated in this temple were held in great esteem, and trusted with the care of sacred virgins, or priestesses, but not till they were made eunuchs. They were called *Estiatores* and *Essenæ*, had a particular diet, and were not allowed by their constitutions to go into any private house. They were maintained with the profits accruing from the lake Selinusia, and another that fell into it, which must have been very considerable, since they erected a golden statue to one Artemidorus, who being sent to Rome, recovered them after they had been seized by the farmers of the public revenues. All the Ionians resorted yearly to Ephesus with their wives and children, where they solemnized the festival of Diana with great pomp and magnificence, making on that occasion rich offerings to the goddess, and valuable presents to her priests. The asiarchæ, mentioned by St Luke, were, according to Beza, these priests whose peculiar province it was to regulate the public sports that were annually performed at Ephesus in honour of Diana: they were maintained with the collections made during the sports; for all Asia flocked to see them. The great Diana of the Ephesians, as she was styled by her blind adorers, was, according to Pliny, a small statue of ebony, made by one Canitia, though commonly believed to have been sent down from heaven by Jupiter. This statue was first placed in a niche, which, as we are told, the Amazons caused to be made in the trunk of an elm. Such was the first rise of the veneration that was paid to Diana in this place. In process of time the veneration for the goddess daily increasing among the inhabitants of Asia, a most stately and magnificent temple was built near the place where the elm stood, and the statue of the goddess placed in it. This was the first temple; but not quite so sumptuous as that which we have described, though reckoned, as well as the second, among the wonders of the world. The second, being that above described, was remaining in Pliny's time and in Strabo's; and is supposed to have been destroyed in the reign of Constantine, pursuant to the edict by which that emperor commanded all the temples of the heathens to be thrown down and demolished: the former was burnt the same day that Alexander was born, by one Erostratus, who owned on the rack, that the only thing which had prompted him to destroy so excellent a work, was the desire of transmitting his name to future ages. Whereupon the common council of Asia made a decree, forbidding any one to name him; but this prohibition served only to make his name more memorable, such a remarkable extravagance, or rather madness, being taken notice of by all the historians who have written of those times. Alexander offered to rebuild the temple at his own expence, provided the Ephesians would agree to put his name on the front; but they rejected his offer in such a manner as prevented the resentment of that vain prince, telling him, that "it was not fit one god should build a temple to another." The pillars, and other materials that had been saved out of the flames, were sold, and also the jewels of the Ephesian women, who on that occasion willingly parted with them; and the sum raised from thence served for the carrying on of the work till other contributions came in, which in a short time amounted to an immense treasure. This is the temple which Strabo, Pliny, and other Roman writers speak of. It stood between the city and the port, and was built, or rather finished, as Livy tells us, in the reign of King Servius. Of this wonderful structure there is nothing at present remaining but some ruins, and a few broken pillars.

The Ionians first settled at Ephesus under the conduct of Androclus, who drove out the Carians and Leleges, by whom these places were possessed at his arrival.

rival. The city, whether built by him, as Strabo affirms, or by Crœsus or Ephesus, long before the Ionic migration, as others maintain, became soon the metropolis of Ionia. It was at first governed by Androclus, and his descendants, who assumed the royal title, and exercised the regal authority over the new colony: whence, even in Strabo's time, the posterity of Androclus were styled kings, and allowed to wear a scarlet robe, with a sceptre, and all the ensigns of the royal dignity. In process of time, a new form of government was introduced, and a senate established; but when, or on what occasion, this change happened, we know not. This kind of government continued till the time of Pythagoras, who lived before Cyrus the Great, and was one of the most cruel and inhuman tyrants we read of in history; for having driven out the senate, and taken all the power into his own hands, he filled the city with blood and rapine, not sparing even those who fled to the temple of Diana for shelter. Pythagoras was succeeded by Pindarus, who bore the same sway in the city; but treated the citizens with more humanity. In his time Ephesus being besieged by Crœsus king of Lydia, he advised the inhabitants to devote their city to Diana, and fasten the wall, by a rope, to the pillars of her temple. They followed his advice, and were, from reverence to the goddess, not only treated with great kindness by Crœsus, but restored to their former liberty. Pindarus being obliged to resign his power, retired to Peloponnesus. He was, according to Ælian, grandson to Alyattes king of Lydia, and Croesus's nephew. The other tyrants of Ephesus mentioned in history, are, Athenagoras, Comes, Aristarchus, and Hegesias; of whom the last was expelled by Alexander, who coming to Ephesus, after having defeated the Persians on the banks of the Granicus, bestowed upon Diana all the tributes which the Ephesians had paid to the Persians, and established a democracy in the city. In the war between Mithridates and the Romans, they sided with the former, and, by his directions, massacred all the Romans that resided in their city; for which barbarity they were severely fined, and reduced almost to beggary by Sylla, but afterwards treated kindly, and suffered to live according to their own laws, as is plain from several ancient inscriptions and medals. The Ephesians were much addicted to superstition, sorcery, and curious arts, as the scripture styles them: whence came the proverb "Ephesian letters," signifying all sorts of spells or charms.

In the time of the apostle Paul, Ephesus retained a great deal of its ancient grandeur. But it was a ruinous place, when the emperor Justinian filled Constantinople with its statues, and raised his church of St Sophia upon its columns. Since then it has been almost quite exhausted. Towards the end of the 11th century, a Turkish pirate, named *Tangripermes*, settled there. But the Greek admiral, John Ducas, defeated him in a bloody battle, and pursued the flying Turks up the Mæander. In 1306, it was among the places which suffered from the exactions of the grand duke Roger; and two years after, it surrendered to Sultan Saysan, who, to prevent future insurrection, removed most of the inhabitants to Tyriæum, where they were massacred. Ephesus appears to have subsisted as an inconsiderable place for some time. But now, the Ephesians are only a few Greek peasants, living in extreme wretchedness, dependence, and insensibility; the representatives of an illustrious people, and inhabiting the wreck of their greatness; some, the substructions of the glorious edifices which they raised; some, beneath the vaults of the stadium, once the crowded scene of their diversions; and some, by the abrupt precipice, in the sepulchres which received their ashes.

**EPHETÆ** (from εφιημι, "I send forth"), in antiquity, a sort of magistrates among the Athenians, instituted by King Demophoon, to take cognizance of murder, manslaughter, and chance-medley.

Their number was 100, whereof 50 were Athenians, and 50 Argians: they were not admitted to the post till upwards of 50 years of age. Draco new-modelled it, excluded the Argians out of it, and made it to consist of 51 Athenians, each above 58 years of age: Ubbo Emmius de Rep. Athen. says, he transferred to them part of the jurisdiction of the Areopagites. See Areopagus.

**EPHOD**, in Jewish antiquity, one part of the priestly habit; being a kind of girdle, which, brought from behind the neck over the two shoulders, and hanging down before, was put across the stomach, then carried round the waist, and made use of as a girdle to the tunic.—There were two sorts of ephods, one of plain linen for the priests, and the other embroidered for the high-priest.

**EPHORI**, in Grecian antiquity, magistrates established in ancient Sparta to balance the regal power. The authority of the ephori was very great. They sometimes expelled, and even put to death the kings, and abolished or suspended the power of the other magistrates, calling them to account at pleasure. There were five of them, others say nine. They presided in the public shows and festivals. They were entrusted with the public treasure; made war and peace; and were so absolute, that Aristotle makes their government equal to the prerogative of a monarchy. They were established by Lycurgus, according to the generality of authors: though this is denied by others, who date their origin 130 years after the time of that legislator. Thus Plutarch, in his Life of Cleomenes, ascribes their institution to Theopompus king of Sparta; which is also confirmed by the authority of Aristotle.

**EPHORUS**, an orator and historian of Cumæ in Æolia, about 352 years before Christ. He was disciple to Isocrates, by whose advice he wrote a history which gave an account of all the actions and battles that had happened between the Greeks and barbarians for 750 years. It was greatly esteemed by the ancients; but is now lost.

**EPHRAIM**, in *Ancient Geography*, one of the divisions of Palestine by tribes: Ephraim and the half tribe of Manasseh are blended together by the sacred writer, and it only appears that Ephraim occupied the more southern, and the half tribe of Manasseh the more northern parts, but both seem to have extended from the Jordan to the sea. Ephraim also denotes a kingdom, on the separation of the 10 tribes from the house of David, called also the kingdom of Israel and Samaria.

**EPHRATA**, a small town of Pennsylvania in America, and the principal settlement of the religious sect called *Dunkards* or *Tunkers*. See Tunkers.

**EPHREM** Syrus, an ancient Christian writer, in the fourth century, deacon of Edessa, was born at Nisibe in Syria. He was greatly esteemed by St Basil, St Gregory Nyssen, and other great men. He wrote against the opinions of Sabellius, Arius, Apollonarius, the Manichees, &c. and acquired such reputation by his virtue and his works, that he was called the *doctor and the prophet of the Syrians*. He died in 378. The best editions of his works are, that of Oxford, in 1708, in folio, and that of Rome, from 1732 to 1738, in Syria, Greek, and Latin, 6 vols folio.

**EPHYDOR**, in antiquity, an officer in the Athenian courts of justice, who was to provide the plaintiff and defendant with equal water hour-glasses. When the glass was run out, they were not permitted to speak any farther; and, therefore, we find them very careful not to lose or mispend one drop of their water. Whilst the laws quoted by them were reciting, or if any other business happened to intervene, they gave orders that the glass should be stopped.

**EPIBATÆ**, Επιϐαται, among the Greeks, marines, or soldiers who served on board the ships of war. They were armed in the same manner as the land-forces, only that more of them wore full or heavy armour.

**EPIBATERION**, a poetical composition, in use among the ancient Greeks. When any person of condition and quality returned home after a long absence or journey into another country, he called together his friends and fellow citizens, and made them a speech, or rehearsed them a copy of verses, wherein he returned solemn thanks to the immortal gods for his happy return; and ended with an address by way of compliment to his fellow-citizens.—These verses made what the Greeks call επιϐατηριον, *epibaterium*, of επιϐαινω, "I go abroad." At going away they had another, called *apobaterium*.

**EPIBATERIUM**, a genus of plants belonging to the monœcia class. See Botany *Index*.

**EPIC**, or Heroic, *Poem*, a poem expressed in narration, formed upon a story partly real, and partly feigned; representing, in a sublime style, some signal and fortunate action, distinguished by a variety of great events, to form the morals, and affect the mind with the love of heroic virtue.

We may distinguish three parts of the definition, namely, the matter, the form, and the end. The matter includes the action of the fable, under which are ranged the incidents, episodes, characters, morals, and machinery. The form comprehends the way or manner of the narration, whether by the poet himself, or by any persons introduced, whose discourses are related: to this branch likewise belong the moving of the passions, the descriptions, discourses, sentiments, thoughts, style, and versification; and besides these, the similies, tropes, figures, and, in short, all the ornaments and decorations of the poem. The end is to improve our morals and increase our virtue. See Poetry.

**EPICEDON** (formed of επι, *upon*, and κηδος, *funeral*), in the Greek and Latin poetry, a poem, or poetical composition, on the death of a person.—At the obsequies of any man of figure, there were three kinds of discourses usually made; that rehearsed at his *bustum* or funeral pile, was called *nenia*; that engraven on his tomb, *epitaph*; and that spoken in the ceremony of his funeral, *epicedion*. We have two beautiful epicedions in Virgil, that of Euryalus and that of Pallas.

**EPICEDIUM**, in ancient poetry, a poem rehearsed during the funeral solemnity of persons of distinction.

**EPICHARMUS**, an ancient poet and philosopher, born in Sicily, was a scholar of Pythagoras. He is said to have introduced comedy at Syracuse in the reign of Hiero. Horace commends Plautus for imitating him, in following the chase of the intrigue so closely as not to give the readers or spectators time to trouble themselves with doubts concerning the discovery. He wrote likewise treatises concerning philosophy and medicine; but none of his works have been preserved. He died aged 90, according to Laertius, who has preserved four verses inscribed on his statue.

**EPICHIROTONIA**, among the Athenians. It was ordained by Solon, that once every year the laws should be carefully revised and examined; and if any of them were found unsuitable to the present state of affairs, they should be repealed. This was called επιχειροτονια των νομων, from the manner of giving their suffrages by *holding up their hands*. See a farther account of this custom in Pott. Archæol. Græc. lib. 1. cap. 26. tom. i. p. 242.

**EPICOENE**, in *Grammar*, a term applied to nouns, which, under the same gender and termination, mark indifferently the male and female species. Such in Latin is *aquila*, *vespertilio*, &c. which signify equally a male or female eagle or bat.

Grammarians distinguish between *epicœne* and *common*. A noun is said to be common of two kinds, when it may be joined either with a masculine or a feminine article; and epicœne, when it is always joined to some of the two articles, and yet signifies both genders.

**EPICTETUS**, a celebrated Stoic philosopher, born at Hierapolis in Phrygia, in the first century, was the slave of Epaphroditus, a freedman and one of Nero's guard. Domitian banishing all philosophers from Rome, about the year 94, Epictetus retired to Nicopolis in Epirus, where he died in a very advanced age; and after his death, the earthen lamp he made use of sold for 3000 drachmas. He was a man of great modesty; which was eminent in his own practice, as well as in his recommendation to others: hence he used to say, "That there is no need of adorning a man's house with rich hangings or paintings, since the most graceful furniture is temperance and modesty, which are lasting ornaments, and will never be the worse for wearing." Of all the ancient philosophers, he seems to have made the nearest approaches to the Christian morality, and to have had the most just ideas of God and providence. He always possessed a cool and serene mind, unruffled by passion; and was used to say, that the whole of moral philosophy was included in these words, *support* and *abstain*. One day, his master Epaphroditus strove in a frolic to wrench his leg; when Epictetus said, with a smile, and free from any emotion, "If you go on, you will certainly break my leg: but the former redoubling his effort, and striking it with all his strength, he at last broke the bone; when all the return Epictetus made was, "Did

"Did not I tell you, Sir, that you would break my leg?" No man was more expert at reducing the rigour of the maxims of the Stoics into practice. He conformed himself strictly, both in his discourse and behaviour, to the manners of Socrates and Zeno. He waged continual war with fancy and fortune; and it is an excellence peculiar to himself, that he admitted all the severity of the Stoics without their sourness, and reformed Stoicism as well as professed it; and besides his vindicating the immortality of the soul as strenuously as Socrates or any Stoic of them all, he declared openly against self-murder, the lawfulness of which was maintained by the rest of the sect. Arrian, his disciple, wrote a large account of his life and death, which is lost; and preserved four books of his discourses and his Enchiridion, of which there have been several editions in Greek and Latin; and, in 1758, a translation of them into English was published by the learned and ingenious Miss Carter.

**EPICUREAN PHILOSOPHY**, the doctrine or system of philosophy maintained by Epicurus and his followers.

His philosophy consisted of three parts; canonical, physical, and ethereal. The first was about the canons or rules of judging. The censure which Tully passes upon him for his despising logic, will hold true only with regard to the logic of the Stoics, which he could not approve of, as being too full of nicety and quirk. Epicurus was not acquainted with the analytical method of division and argumentation, nor was he so curious in modes and formation as the Stoics. Soundness and simplicity of sense, assisted with some natural reflections, was all his art. His search after truth proceeded only by the senses; to the evidence of which he gave so great a certainty, that he considered them as an infallible rule of truth, and termed them the *first natural light of mankind.*

In the second part of this philosophy he laid down atoms, space, and gravity, as the first principles of all things: he did not deny the existence of God, but thought it beneath his majesty to concern himself with human affairs: he held him a blessed immortal Being, having no affairs of his own to take care of, and above meddling with those of others.

As to his ethics, he made the supreme good of man to consist in pleasure, and consequently supreme evil in pain. Nature itself, says he, teaches us this truth; and prompts us from our birth to procure whatever gives us pleasure, and avoid what gives us pain. To this end he proposes a remedy against the sharpness of pain: this was to divert the mind from it, by turning our whole attention upon the pleasures we have formerly enjoyed. He held that the wise man must be happy as long as he is wise; the pain, not depriving him of his wisdom, cannot deprive him of his happiness.

There is nothing that has a fairer show of honesty than the moral doctrine of Epicurus. Gassendus pretends, that the pleasure in which this philosopher has fixed the sovereign good, was nothing else but the highest tranquillity of mind, in conjunction with the most perfect health of body: but Tully, Horace, and Plutarch, as well as almost all the fathers of the church, gives us a very different account of it: indeed the nature of this pleasure, in which the chief happiness is supposed to be seated, is a grand problem in the morals of Epicurus. Hence there were two kinds of Epicureans, the rigid and the remiss: the first were those who understood Epicurus's notion of pleasure in the best sense, and placed all their happiness in the pure pleasures of the mind, resulting from the practice of virtue; the loose or remiss Epicureans, taking the words of that philosopher in a gross sense, placed all their happiness in bodily pleasures or debauchery.

**EPICURUS**, the greatest philosopher of his age, was born at Gargettium in Attica, about 340 B. C. in the 109th Olympiad. He settled at Athens in a fine garden he had bought; where he lived with his friends in great tranquillity, and educated a great number of disciples. They lived all in common with their master. The respect which his followers paid to his memory is admirable: his school was never divided, but his doctrine was followed as an oracle. His birth-day was still kept in Pliny's time; the month he was born in was observed as a continual festival; and they placed his picture everywhere. He wrote a great many books, and valued himself upon making no quotations. He raised the atomical system to a great reputation, though he was not the inventor of it, but had only made some change in that of Democritus. As to his doctrine concerning the supreme good or happiness, it was very liable to be misrepresented, and some ill effects proceeded from thence, which discredited his sect. He was charged with perverting the worship of the gods, and inciting men to debauchery; but he did not forget himself on this occasion; he published his opinions to the whole world; he wrote some books of devotion; recommended the veneration of the gods, sobriety, and chastity; and it is certain that he lived in an exemplary manner, and conformably to the rules of philosophical wisdom and frugality. Timocrites, a deserter of his sect, spoke very scandalously of him. Gassendus has given us all he could collect from the ancients concerning the person and doctrine of this philosopher; who died of a suppression of urine, aged 72.

**EPICYCLE**, in the ancient astronomy, a little circle whose centre is in the circumference of a greater circle: or it is a small orb or sphere, which being fixed in the deferent of a planet, is carried along with it; and yet, by its own peculiar motion, carries the planet fastened to it round its proper centre.

It was by means of epicycles that Ptolemy and his followers solved the various phenomena of the planets, but more especially their stations and retrogradations.

**EPICYCLOID**, in *Geometry*, a curve generated by the revolution of the periphery of a circle, along the convex or concave side of the periphery of another circle.

**EPICYEMA**, among *Physicians*, denotes a superfetation; being a false conception or mole happening after the birth of a regular fœtus.

**EPIDAURUM**, EPIDAURUS, or EPITAURUM, in *Ancient Geography*, a town of Dalmatia, on the Adriatic, built the same year, as is said, with Dyrrachium, 430 years after the destruction of Troy: a considerable town formerly, but now reduced to a small village, called *Ragusi Vecchio;* distant six miles from the modern Ragusi. E. Long. 19°. Lat. 42°. 20′.

**EPIDAURUS**, in *Ancient Geography*, a town of

Argolis, in Peloponnesus, on the Saronic bay, to the south of the promontory *Spiræum;* called *sacred*, because of the religious veneration paid to Æsculapius, whose temple stood at the distance of five miles from the town. The Romans, during a pestilence, being advised to convey the god to Rome, sent a ship with a solemn embassy, for his conveyance; but while the Epidaurians were in suspense to part with him, a huge serpent sailed to the ship; and being taken for the god, was carried to Rome in great solemnity. Epidaurus stood in a recess of the bay, fronting the east; and was fortified by nature, being inclosed by high mountains reaching to the sea, and rendering it difficult of access. It had several temples, and in the acropolis or citadel was a remarkable statue of Minerva. The site is now called *Epi-thavro.* The traces are indistinct, and it has probably been long deserted. The harbour of Epidaurus is long. Its periplus or circuit was 15 stadia or near two miles. The entrance is between mountains, and on a small rocky peninsula on the left hand are ruins of a modern fortress. This, it seems, was the point on which a temple of Juno stood. It is frequented by vessels for wood or corn. The grove of Æsculapius was inclosed by mountains, within which all the sacrifices as well of the Epidaurians as of strangers were consumed. One was called Titthion; and on this the god when an infant was said to have been exposed, and to have been suckled by a she-goat. He was a great physician, and his temple was always crowded with sick persons. Beyond it was the dormitory of the suppliants; and near it, a circular edifice called the *Tholus*, built by Polycletus, of white marble, worth seeing. The grove, besides others temples, was adorned with a portico, and a fountain remarkable for its roof and decorations. The bath of Æsculapius was one of the benefactions of Antoninus Pius, while a Roman senator; as was also a house for the reception of pregnant women and dying persons, who before were removed out of the inclosure, to be delivered or to expire in the open air. The remains are heaps of stones, pieces of brick wall, and scattered fragments of marble; besides some churches, or rather piles of rubbish miscalled, being destitute of doors, roofs, or any kind of ornament. The statue of Æsculapius was half as big as that of Jupiter Olympius at Athens. It was made of ivory and gold, and, as the inscription proved, by Thrasymedes son of Arignotus of Paros. He was represented sitting, holding his staff, with one hand on the head of a serpent, and a dog lying by him. Two Argive heroes, Bellerophon combating with the monster Chimæra, and Perseus severing the head of Medusa, were carved on the throne. Many tablets described the cures performed by the deity, yet he had not escaped contumely and robbery. Dionysius deprived him of his golden beard, affirming that it was unseemly in him to appear in that manner when his father Apollo was always seen with his face smooth. Sylla amassed the precious offerings belonging to him and to Apollo and Jupiter at Delphi and Olympia, to pay his army before Athens. The marks in the walls testified that a great number had been plucked down. A few fragments of white marble exquisitely carved occur in the heap of the temple. The inclosure of the temple once abounded in inscriptions. In the second century six marbles remained, on which were written in the Doric dialect the names of men and women who had been patients of the god, with the distemper each had laboured under, and the remedies he had directed. Dr Chandler found only a couple of votive inscriptions, and two pedestals of statues, one of which represented a Roman, and was erected by the city of the Epidaurians. The stadium was near the temple. It was of earth, as most in Greece were. At the upper end are seats of stone, but these were continued along the sides only a few yards. A vaulted passage leading underneath into the area, now choked up, was a private way by which the agonothetæ or presidents with the priests and persons of distinction entered. Two large cisterns or reservoirs remain, made by Antoninus for the reception of rain water. Beyond them is a dry water-course; and in the mountain-side on the right hand are the marble seats of the theatre, overgrown with bushes. The springs and wells by the ruins are now supposed to possess many excellent properties. To these and a good air, Dr Chandler thinks, with the recreations of the theatre and of the stadium, and to the medicinal knowledge and experience of the priests, may be attributed both the recovery of the sick and the reputation of Æsculapius.

Epidaurus, with the surname *Limera*, to distinguish it from the Epidaurus of Argolis; called so, either from its meadows or its commodious harbours (Stephanus, Apollodorus): a town of Laconia, on the Ionian sea, to the south of the Sinus Argolicus, situated where now Molvasia stands, in the Morea. E. Long. 23. 30. Lat. 35. 40.

EPIDEMIA, in Grecian antiquity, festivals kept in honour of Apollo and Diana, at the stated seasons, when those deities, who could not be present everywhere, were supposed to visit different places, in order to receive the vows of their adorers.

EPIDEMIC, among physicians, an epithet of diseases which at certain times are popular, attacking great numbers at or near the same time.

EPIDENDRUM, a genus of plants, belonging to the gynandria class; and in the natural method ranking under the seventh order, *Orchideæ.* See Botany *Index.*—This is the plant which produces the fruit called *vanilla*, and which is used in perfuming chocolate, tobacco, and snuff.

EPIDERMIS, in *Anatomy*, the cuticle or scarf-skin. See Anatomy *Index.* The word is formed of the Greek επι, *on, over;* and δερμα, *skin.*

EPIDICASIA, among the Athenians. Daughters inheriting their parents estate were obliged to marry their nearest relation; which gave occasion to persons of the same family to go to law with one another, each pretending to be more nearly allied to the heiress than the rest. The suit was called επιδικασιας δικη: and the virgin, about whom the relations contested, επιδικος.

EPIDIDYMIS, in *Anatomy*, a little round body, on the back of each testicle; called also *parastata.* See Anatomy *Index.*

EPIGÆA, a genus of plants, belonging to the decandria class; and in the natural method ranking under the 18th order, *Bicornes.* See Botany *Index.*

EPIDOTÆ, certain deities who presided over the growth

growth of children. They were worshipped by the Lacedæmonians, and chiefly invoked by those who were persecuted by the ghosts of the dead, &c.

EPIGASTRIC REGION, a part or subdivision of the abdomen. See ANATOMY *Index*.

EPIGLOTTIS, in *Anatomy*, one of the cartilages of the larynx or windpipe. See ANATOMY *Index*.

EPIGONI, the sons and descendants of the Grecian heroes who were killed in the first Theban war. The war of the Epigoni is famous in ancient history. It was undertaken ten years after the first. The sons of those who had perished in the first war, resolved to avenge the death of their fathers, and marched against Thebes, under the command of Thersander; or, according to others, of Alcmæon the son of Amphiaraus, about 1307 years before Christ. The Argives were assisted by the Corinthians, the people of Messenia, Arcadia, and Megara. The Thebans had engaged all their neighbours in their quarrel, as in one common cause. These two hostile armies met and engaged on the banks of the Glissas. The fight was obstinate and bloody, but victory declared for the Epigoni, and some of the Thebans fled to Illyricum with Leodamas their general, while others retired into Thebes, where they were soon besieged, and forced to surrender. In this war Ægialeus was the only one who was killed, and his father Adrastus was the only one who escaped alive in the first war. This whole war, as Pausanias observes, was written in verse; and Callinus, who quotes some of the verses, ascribes them to Homer, which opinion has been adopted by many writers. "For my part (continues the geographer), I own, that next to the Iliad and Odyssey of Homer, I have never seen a finer poem." The descendants of the veteran Macedonians, who served under Alexander the Great, and who had children by Asiatic women, were also called *Epigoni*, (Justin).

EPIGRAM, in *Poetry*, a short poem in verse, treating only of one thing, and ending with some lively, ingenious, and natural thought or point. The word is formed of *ἐπιγραμμα inscription*, of *ἐπιγραφειν to inscribe* or *write upon*.

Epigrams, then, originally signify inscriptions; and they derive their origin from those inscriptions placed by the ancients on their tombs, statues, temples, triumphal arches, &c. These, at first, were only simple monograms: afterwards, increasing their length, they made them in verse, to be the more easily retained: Herodotus and others have transmitted to us several of them. Such little poems retained the name of epigrams, even after the design of their first institution was varied, and people began to use them for the relation of little facts and accidents, the characterizing of persons, &c. The point or turn is a quality much insisted on by the critics, who require the epigram constantly to close with something poignant and unexpected, to which all the rest of the composition is only preparatory; whilst others, on the contrary, exclude the point, and require the thought to be equally diffused throughout the poem, without laying the whole stress on the close: the former is usually Martial's practice, and the latter that of Catullus.

The Greek epigrams have scarce any thing of the point or briskness of the Latin one: those collected in the Anthology have most of them a remarkable air of ease and simplicity, attended with something just and witty; such as we find in a sensible peasant, or a child that has wit. They have nothing that bites, but something that tickles. Though they want the salt of Martial, yet to a good taste they are not insipid; except a few of them, which are quite flat and spiritless. However, the general faintness and delicacy of the peasantry in them has given occasion for a Greek epigram, or *epigram à la Greque*, to denote, among the French, an epigram void of salt or sharpness.

The epigram admits of great variety of subjects: some are made to praise, and others to satirize; which last are much the easiest, ill-nature serving instead of point and wit. Boileau's epigrams are all satires on one or another; those of Des Reaux are all made in honour of his friends; and those of Mad. Scudery are so many eloges. The epigram being only a single thought, it would be ridiculous to express it in a great number of verses.

EPIGRAPHE, among antiquarians, denotes the inscription of a building, pointing out the time when, the persons by whom, the uses, and the like, for which it was erected.

EPILEPSY, in *Medicine*, the same with what is otherwise called the *falling-sickness*, from the patient's falling suddenly on the ground. See MEDICINE *Index*.

EPILOBIUM, the WILLOW HERB; a genus of plants belonging to the octandria class; and in the natural method ranking under the 17th order, *Calycanthemæ*. See BOTANY *Index*.

EPILOGUE, in *Oratory*, the end or conclusion of a discourse, ordinarily containing a recapitulation of the principal matters delivered.

EPILOGUE, in dramatic poetry, a speech addressed to the audience, after the play is over, by one of the principal actors therein; usually containing some reflections on certain incidents in the play, especially those in the part of the person that speaks it; and having somewhat of pleasantry, intended to compose the passions raised in the course of the representation: A practice which is ridiculed by the *Spectator*; and compared to a merry jigg upon the organ after a good sermon, to wipe away any impressions that might have been made thereby, and send the people away just as they came.

EPIMEDIUM, BARREN-WORT; a genus of plants, belonging to the tetrandria class; and in the natural method ranking under the 24th order, *Corydales*. See BOTANY *Index*.

EPIMENIDES, an ancient poet and philosopher, was born at Gnossus in Crete. Contrary to the custom of his country, he always wore his hair long; which, according to some, was because he was ashamed of being thought a Cretan: and indeed he does not seem to have had a high opinion of his countrymen, if that verse cited by St Paul be, as it is generally believed to be, his; "The Cretans are always liars, evil beasts, slow bellies." Many stories are related of him, too wonderful to merit attention; however, his reputation was so great over all Greece, that he was there esteemed a favourite of the gods. The Athenians being afflicted with the plague, and commanded by the oracle to make a solemn lustration of the city, sent Nicias, the son of Niceratus, with a ship to Crete, to desire Epimenides to come to them. He accepted their invitation, accompanied the messengers to Athens, performed the lustration of the city, and the plague ceased. Here he contracted an acquaintance with Solon, whom he privately instructed in the proper methods for the regulation of the Athenian commonwealth. Having finished his business at Athens, the citizens offered him many valuable presents and high honours, and appointed a ship to carry him back to Crete; but he returned their presents, and would accept of nothing except a little branch of the sacred olive preserved in the citadel; and desired the Athenians to enter into an alliance with the Gnossians. Having obtained this, he returned to Crete; where he died soon after, aged 157 years: or as the Cretans, consistently with their character, pretended, 299. He was a great poet, and wrote 5000 verses on "the genealogy of the gods," 6500 "on the building of the ship Argo and Jason's expedition to Colchis," and 4000 "concerning Minos and Rhadamanthus." He wrote also in prose, "Concerning sacrifices and the commonwealth of Crete." St Jerome likewise mentions his "book of oracles and responses." The Lacedemonians procured his body, and preserved it among them by the advice of an oracle; and Plutarch tells us, that he was reckoned the seventh wise man by those who refused to admit Periander into the number.

**EPIMETHEUS**, a son of Japetus and Clymene, one of the Oceanides, who inconsiderately married Pandora, by whom he had Pyrrha, the wife of Deucalion. He had the curiosity to open the box which Pandora had brought with her, and from thence issued a train of evils, which from that moment have never ceased to afflict the human race. Hope was the only one which remained at the bottom of the box, not having a sufficient time to escape, and it is she alone who comforts men under misfortunes. Epimetheus was changed into a monkey by the gods, and sent into the island Pithecusa.

**EPIPHANIUS**, St, an ancient father of the church, born at Besanducan, a village in Palestine, about the year 332. He founded a monastery near the place of his birth, and presided over it. He was afterwards elected bishop of Salamis; when he sided with Paulinus against Meletius, and ordained in Palestine Paulinian the brother of St Jerome; on which a contest arose between him and John bishop of Jerusalem. He afterwards called a council in the island of Cyprus, in which he procured a prohibition of the reading of Origen's writings; and made use of all his endeavours to prevail on Theophilus bishop of Alexandria to engage St Chrysostom to declare in favour of that decree: but not meeting with success, he went himself to Constantinople, where he would not have any conversation with St Chrysostom; and formed the design of entering the church of the apostles to publish his condemnation of Origen; but being informed of the danger to which he would be exposed, he resolved to return to Cyprus; but died at sea in the year 403. His works were printed in Greek, at Basil, 1544, in folio; and were afterwards translated into Latin, in which language they have been often reprinted. Petavius revised and corrected the Greek text by two manuscripts, and published it together with a new translation at Paris in 1622. This edition was reprinted at Cologne in 1682.

**EPIPHANY**, a Christian festival, otherwise called the *Manifestation of Christ to the Gentiles*, observed on the sixth of January, in honour of the appearance of our Saviour to the three magi or wise men, who came to adore him and bring him presents. The feast of epiphany was not originally a distinct festival; but made a part of that of the nativity of Christ, which being celebrated 12 days, the first and last of which were high or chief days of solemnity, either of these might properly be called *epiphany*, as that word signifies the appearance of Christ in the world.

The word in the original Greek, επιφανια, signifies *appearance* or *apparition;* and was applied, as some critics will have it, to this feast, on account of the star which appeared to the magi.—St Jerome and St Chrysostom take the epiphany for the day of our Saviour's baptism, when he was declared to men by the voice, *Hic est filius meus dilectus, in quo mihi complacui:* "This is my beloved Son, in whom I am well pleased." And accordingly it is still observed by the Cophtæ and Ethiopians in that view. Others contend, that the feast of Christmas, or the nativity of our Saviour, was held in divers churches on this day; which had the denomination *epiphany* or *appearance*, by reason of our Saviour's first appearance on earth at that time. And it must be allowed, that the word is used among the ancient Greek fathers, not for the appearance of the star to the magi, but for that of our Saviour to the world: In which sense St Paul uses the word *epiphania* in his second epistle to Timothy, i. 10.

**EPIPHONEMA.** See Oratory, N° 96.

**EPIPHORA**, in *Medicine*, a preternatural defluxion of the eyes, when they continually discharge a sharp serous humour, which excoriates the cheeks. See Medicine *Index*.

**EPIPHYSIS**, in *Anatomy*. See Anatomy *Index*.

**EPIPLOCELE**, in *Medicine*, is a kind of hernia or rupture, in which the omentum subsides into the scrotum.

**EPIPLOOMPHALON**, in *Medicine*, an hernia umbilicalis, proceeding from the omentum falling into the region of the umbilicus or navel.

**EPIPLOON.** See Omentum, Anatomy *Index*.

**EPIRUS**, a district of ancient Greece, bounded on the east by Etolia, on the west by the Adriatic, on the north by Thessaly and Macedon, and on the south by the Ionian sea. This country was anciently governed by its own princes, in which state it made a very considerable figure. The country, according to Josephus, was first peopled by Dodanim the son of Javan and grandson of Japhet. The people were very warlike; but they continued in their savage state long after their neighbours were civilized; whence the islanders used to threaten their offenders with transportation to Epirus. Their horses were in great request among the ancients, as well as the dogs produced in one of the divisions called *Molossus;* and hence these dogs were called by the Romans *Molossi*.

The history of Epirus commences with the reign of Pyrrhus the son of Achilles by Deidamia the daughter of Lycomedes king of Scyros. He is said to have behaved with great bravery at the siege of Troy; but it would appear that he behaved with no less barbarity. After the city was taken, he is said to have killed old King Priam with his own hand; to have thrown Astyanax the son of of Hector and Andromache headlong from a high tower; and sacrificed Polyxena the daughter of Priam on the tomb of his father. He carried Andromache with him into Epirus, where he settled by the advice of the famous soothsayer Helenus, one of Priam's sons, who had served during the Trojan war both under his father and himself. The only remarkable period of the history of Epirus is the reign of Pyrrhus II. who made war upon the Romans. He was invited into Italy by the Tarentines; and embarked about 280 B. C. After having escaped many dangers by sea, he landed in that country, and with great difficulty gained a victory over the Romans; but he was afterwards utterly defeated by them †, and obliged to return into his own country. To retrieve his honour, he then undertook an expedition against Macedon; where he overthrew Antigonus, and at last made himself master of the whole kingdom. He then formed a design of subduing all the other Grecian states; but met with such an obstinate resistance at Lacedæmon, that he was obliged to drop the enterprise; and was soon after killed at the siege of Argos by a woman, who from the wall threw a tile upon his head. Deidamia, the grand-daughter of Pyrrhus, was the last that sat on the throne of Epirus. She is said to have been murdered after a short reign; upon which the Epirots formed themselves into a republic.

Under the new form of government Epirus never made any considerable figure, but seems rather to have been dependent on the kingdom of Macedon. The Romans having conquered Philip king of that country, restored the Epirots to their ancient liberty; but they, forgetful of this favour, soon after took up arms in favour of Perseus. As a punishment for this ingratitude, the Romans gave orders to Paulus Emilius, after the reduction of Macedon, to plunder the cities of Epirus, and level them with the ground. This was punctually executed throughout the whole country on the same day and at the same hour. The booty was sold, and each foot-soldier had 200 denarii, that is, six pounds nine shillings and two pence, and each of the horse the double of the sum. An hundred and fifty thousand men were made slaves, and sold to the best bidder for the benefit of the republic. Nor did the vengeance of Rome stop here; all the cities of Epirus, to the number of 70, were dismantled, and the chief men of the country carried to Rome, where they were tried, and most of them condemned to perpetual imprisonment. After this terrible blow, Epirus never recovered its ancient splendour. Upon the dissolution of the Achæan league, it was made part of the province of Macedon; but when Macedon became a diocese, Epirus was made a province of itself, called the province of *Old Epirus*, to distinguish it from *New Epirus*, another province lying to the east of it. On the division of the empire, it fell to the emperors of the east, and continued under them till the taking of Constantinople by the Latins, when Michael Angelus, a prince nearly related to the Greek emperor, seized on Etolia and Epirus, of which he declared himself despot or prince; and was succeeded by his brother Theodorus, who took several towns from the Latins, and so far enlarged his dominions, that, disdaining the title of *despot*, he assumed that of *emperor*, and was crowned by Demetrius archbishop of Bulgaria. Charles, the last prince of this family, dying without lawful issue, bequeathed Epirus and Acarnania to his natural sons, who were driven out by Amurath the second. Great part of Epirus was afterwards held by the noble family of the Castriots; who, though they were masters of all Albania, yet styled themselves princes of Epirus. Upon the death of the famous George Castriot, surnamed *Scanderbeg*, Epirus fell to the Venetians, who were soon dispossessed of it by the Turks; in whose hands it still continues, being now known by the name of *Albania*, which comprehends the Albania of the ancients, all Epirus, and that part of Dalmatia which is subject to the Turks.

1 Commencement of the episcopal controversy.

EPISCOPACY, that form of church-government, in which diocesan bishops are established as distinct from and superior to priests or presbyters. We have already observed, that it is a long time since the ministers of religion have been distinguished into different orders, and that it has been much controverted whether the distinction be of divine or human right; whether it was settled in the apostolic age or afterwards (See BISHOP). This controversy commenced soon after the Reformation; and has been agitated with great warmth between the *Episcopalians* on the one side, and the *Presbyterians* and *Independents* on the other. Among the Protestant churches *abroad*, those which were reformed by *Luther* and his associates were in general *episcopal*; whilst such as follow the doctrines of *Calvin* have for the most part thrown off the order of bishops as one of the corruptions of popery. In *England*, however, the controversy has been considered as of greater importance than on the *Continent*; for it has there been strenuously maintained by one party, that the *episcopal order* is essential to the constitution of the church; and by others, that it is a pernicious encroachment on the rights of men, for which there is no authority in scripture. Though the question has for some time lain almost dormant, and though we have no desire to revive it; yet as a work of this kind might perhaps be deemed defective, did it contain no account whatever of a controversy which has employed some of the ablest writers of the past and present centuries, we shall give a fair though short view of the chief arguments by which the advocates of each contending party have endeavoured to support their own cause, leaving our readers to judge for themselves where the truth lies. See INDEPENDENTS and PRESBYTERIANS.

2 The Independent scheme.

The *Independent* maintains, that under the gospel dispensation there is nothing which bears the smallest resemblance to an exclusive priesthood; that Christ and his apostles constituted no permanent order of ministers in the church; but that any man who has a firm belief in revelation, a principle of sincere and unaffected piety, a capacity for leading devotion and communicating instruction, and a serious inclination to engage in the important employment of promoting the everlasting salvation of mankind; is to all intents and purposes a regular minister of the New Testament, especially if he have an invitation to the pastoral office from some particular society of Christians.

3 Episcopal arguments against it.

Against this scheme, which supposes the rights of Christians all equal and common, and acknowledges no authority in the church except what may be derived from the election of her members, the Protestant Episcopalian reasons in the following manner. He admits, as an undoubted truth, that our blessed Lord gave to

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† See Rome.

none of his immediate followers authority or jurisdiction of such a nature as could interfere with the rights of the civil magistrate, for all such authority was disclaimed by himself: "My kingdom (said he to Pilate) is not of this world:" and to a certain person who asked him to decide a question of property between him and his brother, he replied, "Man, who made me a judge or a divider over you?" But when it is considered, that Christ came into this world to "turn men from darkness to light, and from the power of Satan to the living God; that he gave himself for us, that he might redeem us from all iniquity, and purify to himself a peculiar people zealous of *good works*; that of these works many are such as unregenerate humanity has no inclination to perform, and that the doctrines which he revealed are such as human reason could never have discovered: the advocate for episcopacy thinks it was extremely expedient, if not absolutely necessary, that, when he ascended into heaven, he should establish upon earth some authority to illustrate the revelation which he had given, and to enforce obedience to the laws which he had enacted. There is nothing, continues he, more strictly required of Christians, than that they live together in unity, professing the same faith, joining in the same worship, and practising the same virtues.

4
Christians linked together in one society called the *church*, the *kingdom of heaven*, and the *kingdom of God*.

But as men have very different passions, prejudices, and pursuits, such unity would be impossible, were they not linked together in *one society* under the government of persons authorised to watch over the purity of the faith, to prescribe the forms of public worship, and to explain the nature, and inculcate the necessity of the several virtues. The society of Christians, in respect of its unity and organization, is compared to the human body: for "as we have many members in one body, and all members have not the same office; so we being many are one body in Christ, and every one members one of another," (Rom. xii. 4, 5.). It is called the *church*, the *kingdom of heaven*, and *the kingdom of God*; and its affairs, like those of every other kingdom, are administered by proper officers in subordination to the ONE Lord, who, "when he ascended up on high, and led captivity captive, gave some apostles, and some prophets, and some pastors and teachers, for the perfecting of the saints, for the work of the ministry, for the edifying of the body of Christ:" (Ephes. iv. 8.—13.). That those various orders of ministers were vested with real authority in the church might be inferred from principles of reason as well as from the dictates of revelation. A society without some sort of government, government without laws, or laws without an executive power, is a direct absurdity.

5
The church governed by proper officers.

Where there are laws, some must govern, and others be governed; some must command, and others obey; some must direct, and others submit to direction. This is the voice of *nature*; it is likewise the language of *scripture*. "Obey them (says the inspired author of the epistle to the Hebrews) who have the rule over you, and submit yourselves; for they watch for your souls as they that must give account." A text which shows that the authority of the ministers of religion was distinct from that of the civil magistrate, whose duty is to watch, *not for the souls*, but for the *lives* and *properties*, of his subjects.

6
All Christians required to be members of the church.

Of the society thus constituted, it was not, as of a philosophical sect, left to every man's *choice* whether or not he would become a member. All who embrace the faith of the Redeemer of the world are required to be *baptized*, under the pain of forfeiting the benefits of redemption; but one great purpose for which baptism was instituted, is to be the rite of initiation into the church of Christ; for by one spirit are we all baptized into one body, whether we be Jews or Gentiles, whether we be bond or free," (1 Cor. xii. 13.). Of baptism, whatever be the importance, it is evident, that to receive it, is not, like the practice of justice, or the veneration of the Supreme Being, a duty resulting from the relations of man to his Creator and fellow-creatures; that its whole efficacy, which in scripture is said to be nothing less than the remission of sins, is derived from *positive institution*; and therefore, that the *external rite* can be of no avail, but when it is administered in the *manner prescribed*, and by a person *authorised* to administer it.

7
All Christians not authorised to administer the sacraments.

That *all* Christians are not vested with this authority, as one of the common privileges of the faith, appears from the commission which our Saviour after his resurrection gave to his apostles. At that period, we are assured that the number of his followers was not less than *five hundred*; yet we find, that to the *eleven disciples* only did "he come and speak, saying, All power is given unto me in heaven and in earth; go ye, therefore, and teach all nations, baptizing them in the name of the Father, and of the Son, and of the Holy Ghost."

Of the 500 disciples there is surely no reason to believe that there were not *many* well qualified to instruct either a Jew or a Gentile in the doctrines of the gospel; and it is certain, that *any one* of them could have washed his convert with water in the name of the Holy Trinity as well as St Peter or St John; but such an unauthorised washing would not have been Christian baptism, nor of equal validity with it, any more than the opinion of a lawyer at the bar is the judgment of a court of justice, or of equal obligation. It is the commission of the sovereign which gives force to the judgement of the court; it is the commission of Christ which gives validity to baptism. The same reasoning is applicable to the Lord's supper, which, if it be not administered by those who have authority for such administration, cannot be deemed a sacrament of Christ's institution.

These two rites are the external badges of our profession. By the *one*, we are incorporated into that society of which our Redeemer is the head and sovereign: in the celebration of the *other*, we have a right to join, whilst of that society we continue members. But if by an open and scandalous disregard of the precepts of the gospel, we should prove ourselves unworthy of its privileges, the same persons who are authorised to admit us into the church, are likewise vested with authority to cast us out of it: for to them were given "the keys of the kingdom of heaven (or the church), with assurance, that whatsoever they should bind on earth, should be bound in heaven; and whatsoever they should loose on earth, should be loosed in heaven," (Mat. xviii. 18.). As baptism is to be administered so long as there shall be persons to be enlisted under the banners of Christ, and the Lord's Supper to be celebrated so long as it shall be the duty of soldiers to adhere to the standard of their leader and their head; and as it is likewise to be feared that there will never come a time

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when all Christians shall "walk worthy of the vocation wherewith they are called;" it follows, that this *power of keys*, which was originally given to the apostles, must continue in the church through all ages, even unto the end of the world. But as we have seen, that it was not at first intrusted to *all* the disciples in common, as one of the privileges inseparable from their profession, and as no body of men can possibly *transfer* an authority of which they themselves were *never possessed;* it is certain, that even now it cannot, by the election of one class of Christians, be delegated to another, but must, by some mode of succession, be derived from the apostles, who were sent by Christ as he was sent by his Father. To argue from the origin of *civil* to that of *ecclesiastical* government, although not very uncommon, the Episcopalian deems extremely fallacious. Of the various nations of the world, many of the sovereigns may indeed derive their authority from the suffrages of their subjects; because in a state of nature every man has an inherent right to defend his life, liberty, and property; and what he possessed in his own person, he may for the good of society transfer to another: but no man is by *nature*, or can *make himself*, a member of the Christian church; and therefore authority to govern that society can be derived only from him by whom it was founded, and who died that he might "gather together in one all the children of God."

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Against such reasoning as this it hath been urged, that to make institutions, which like baptism and the Lord's supper are generally necessary to the salvation of *all* Christians, depend for their efficacy upon the authority or commission of a *particular order*, appears inconsistent with the wisdom and goodness of God; as by such an economy an intolerable domination would be established over the souls of men, and the purpose for which the Saviour of the world died might be in some degree defeated by the caprice of an ignorant and arbitrary priesthood. The objection is certainly plausible; but the Episcopalian affirms, that either it has no weight, or militates with equal force against the wisdom of Providence in the government of this world.—In every thing, he observes, relating to their temporal and to their spiritual interests, mankind are all subjected to mutual dependence. The rich depend upon the poor, and the poor upon the rich. An infant neglected from the birth would barely cry and cease to live; nor is it easily to be conceived, that in the more rigid climates of the earth a full-grown man could provide even the necessaries of mere animal life. Of religion, it is certain that in such a state nothing could be known; for there is not the smallest reason to imagine that any individual of the human race—an *Aristotle*, a *Bacon*, or a *Newton*, had he been left alone from his infancy, without culture and without education,—could ever, by the native vigour of his own mind, have discovered the existence of a God, or that such speculations as lead to that discovery would have employed any portion of his time or his thoughts. Even in civilized society it would be impossible, in the present age, for any man, without the assistance of others, to understand the very first principles of our common Christianity; for the scriptures, which alone contain those principles, are written in languages which are now nowhere vernacular. In the fidelity of translators, therefore, every illiterate disciple of Jesus *must* confide, for the truth of those doctrines which constitute the foundation of all his hopes; and as no man ever pretended that the Christian *sacraments* are more necessary to salvation than the Christian *faith*, the Episcopalian sees no impropriety or inconsistency in making those persons receive baptism and the Lord's supper by the ministration of others, who by such ministration must of necessity receive the truths of the gospel.

11
A permanent order of ministers constituted by Christ.

By such arguments as these does the Episcopalian endeavour to prove that Christ constituted some *permanent order of ministers* in the church, to whom in the externals of religion the great body of Christians are commanded to pay obedience; and thus far the Presbyterian agrees with him; but here their agreement ends. They hand in hand attack the Independent with the same weapons, and then proceed to attack each other. The *one* maintains, that originally the officers of the Christian church were all *presbyters* or *elders* of *one order*, and vested with *equal powers;* whilst the *other* holds, that Christ and his apostles appointed *divers orders* of ministers in the church; that of these orders the highest alone was empowered to ordain others; and that therefore obedience, as to those who watch for our souls, can be due only to such as are *episcopally ordained.*

12
The Presbyterian plea.

In behalf of the Presbyterian plea it is urged, that the titles of *bishop* and *presbyter*, being in the New Testament indifferently given to the same persons, cannot be the titles of distinct ecclesiastical officers; which appears still more evident from the ordination of *Timothy*, who, although he was the first *bishop* of Ephesus, received his episcopal character by the imposition of the hands of the *presbytery.*—That one and the same man is, in the New Testament, styled sometimes a *bishop* and sometimes a *presbyter*, cannot be denied; but although every apostolic bishop was therefore undoubtedly a presbyter, it does not of course follow, says the Episcopalian, that every presbyter was likewise a *bishop.* In the *Old* Testament, Aaron and his sons are without any discrimination of order frequently styled *priests;* and in the *New*, both St Peter and St John call themselves *presbyters*, as St Paul, upon one occasion, styles himself a *deacon*—διακονος (Eph. iii. 7.): yet no man ever supposed those apostles to have been such ecclesiastical officers as modern presbyters and deacons; and it is universally known, that in the Jewish priesthood there were different orders, and that Aaron was of an order superior to his sons. This being the case, the presbyters, by the laying on of whose hands Timothy was made a bishop, *may have been* of the same order with St Peter and St John; and if so, it follows that his ordination was *Episcopal.* At all events, we are certain, continues the advocate for Episcopacy, that it was not, in the modern sense of the word, *Presbyterian;* for the gift, which in the first epistle is said to have been "given by prophecy *with* the laying on of the hands of the presbytery," is in the second said to have been "in him *by* the putting on of the hands of St Paul." And here it is worthy of observation, that the preposition used in the former case is μετα, which signifies *concurrence* rather than instrumentality; but *that* in the latter is δια, which, as every Greek scholar knows, is prefixed to the *instrumental cause* by which any thing is effected: so that whatever may have been the order of the pres-

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13
Episcopal arguments against it.

byters who *concurred*, St Paul appears to have been the *sole* ordainer. But by the confession of all parties, St Paul was a bishop in the highest sense in which that word is ever used; and the powers of the episcopate not being parcelled out among various partners, of whom each possesses only a share, the imposition of his hands was sufficient for every purpose which could have been effected by the hands of the whole college of apostles.

It appears, therefore, that from the promiscuous use of the titles *bishop* and *presbyter*, and from the *ordination of Timothy*, nothing can with certainty be concluded on either side of this celebrated question. But if, instead of resting on mere *words*, which when taken alone and without regard to the context, are almost all of ambiguous signification, we attend to some important *facts* recorded in the New Testament, the Episcopalian thinks we shall in them discover sufficient evidence that the government of the primitive church was prelatical.

14
Three orders of Christian ministers during our Saviour's stay upon earth; and likewise after his ascension into heaven.

During our Saviour's stay upon earth, it is undeniable that he had under him two distinct orders of ministers—the twelve, and the seventy; and after his ascension, immediately before which he had enlarged the powers of the *eleven*, we read of *apostles*, *presbyters*, and *deacons*, in the church. That the presbyters were superior to the deacons, and the apostles superior to both, is universally acknowledged; but it has been said, that in Scripture we find no intimation that the apostolic order was designed for continuance. A Quaker says the same thing of water-baptism; and the Episcopalian observes, that it would be difficult to point out by what passage of Scripture, or what mode of reasoning, those who upon this plea reject the apostolic order of Christian ministers, could overthrow the principles upon which the disciples of *George Fox* reject the use of that rite which our Saviour instituted for the initiation of mankind into his church. They were the *eleven* alone to whom Christ said, "Go ye therefore and teach all nations, baptising them in the name of the Father, and of the Son, and of the Holy Ghost:" and therefore, although we frequently find presbyters and deacons administering the sacrament of baptism, we must conclude, that as a *judge* administers justice by authority derived from his *sovereign*, so those *inferior officers* of the church administered baptism by authority derived from the *apostles*. Indeed, had they pretended to act by any other authority, it is not easily to be conceived how *their* baptism could have been the baptism instituted by Christ; for it was not with the *external washing* by whomsoever performed, but with the *eleven* and their successors, that he promised to be "always, even unto the end of the world."

15
The apostolic or highest order designed to be permanent.

That the *eleven* did not consider this promise, or the commission with which it was given, as terminating with their lives, is evident from their admitting others into their own order; for which they had competent authority, as having been sent by Christ as he was sent by his father. When St Paul, to magnify his office and procure to it from the Galatians due reverence, styles himself, "an apostle not of men, neither by man, but by Jesus Christ and God the Father," he must have known some who derived their apostolic mission *by man*; otherwise he could with no propriety have claimed particular respect, as he evidently does, from what was in his own apostleship no particular distinction. At that very early period, therefore, there must have been in the church *secondary* apostles, if they may be so called, upon whom, by imposition of hands, or by some other significant ceremony, the eleven had conferred that authority which was given to them by their Divine Master. Such were *Matthias* and *Barnabas*; such likewise were *Timothy*, *Titus*, and the *angels* of the seven churches in Asia, with many others whose names and offices are mentioned in the New Testament.

16
Matthias, Barnabas, Timothy, Titus, and the angels of the seven churches in Asia, bishops.

That *Matthias* and *Barnabas* were of the apostolic order, has never been controverted; and that *Timothy* and *Titus* were superior to modern presbyters, is evident from the offices assigned them. Timothy was, by St Paul, empowered to *preside* over the presbyters of Ephesus, to receive accusations against them, to *exhort*, to *charge*, and even to *rebuke* them; and Titus was, by the same apostle, left in Crete for the express purpose of setting things in order, and ordaining *presbyters* in *every* city. To *exhort*, to *charge*, and with authority to *rebuke* one's equal, is certainly incongruous; and therefore the Episcopalian thinks the powers conferred on Timothy altogether inconsistent with that parity of order and of office for which his antagonists so strenuously plead. Even the commission given to Titus appears in his eyes by much too extensive for a Presbyterian minister, who, after having ordained in *one* city, could not have proceeded to ordain in *another* without the consent and assistance of his brother and fellow-labourer. With respect to the *angels* of the Asiatic churches, he observes, that in the Old Testament the title of *angel* is sometimes given to the *Jewish high-priest*, and particularly by the prophet Malachi, who calls him "the *messenger* (αγγελος) of the Lord of Hosts;" and that the *angels* of the churches mentioned by St John, were *Christian high-priests*, or *bishops* presiding over more than one congregation, as it is affirmed by all the ancient writers, cannot, he thinks, be denied by any man who will take the trouble to compare Scripture with Scripture. We read (Acts xix. 10. and 20.), that "in the space of two years *all they* who dwelt in Asia heard from St Paul the word of the Lord Jesus, both Jews and Greeks; and that there the word of God *grew mightily* and *prevailed*:" but with what truth or propriety could this have been said, if at the time of St John's writing the Apocalypse, which was 30 years after St Paul's death, all the Christians of Proconsular Asia were comprised in *seven congregations*, which assembled, each with its proper pastor, to perform, in *one place*, the duties of public worship? In a word, the advocate for Episcopacy insists, that no man, who reads without prejudice the acts of the apostles, the epistles of St Paul, and the Apocalypse of St John, can seriously believe that *Timothy*, *Titus*, *Epaphroditus*, *Sosthenes*, and *Silvanus*, with the *angels* of the seven churches in Asia, were *mere presbyters*, or that the government of the church was, in those days, by a college of elders.

When from the inspired penmen of the New Testament he proceeds to examine the succeeding writers of the Christian church, the Episcopalian finds such multiplied and concurring evidence of the apostolic institution of episcopacy, as he thinks it impossible to resist without

without denying the truth of all ancient history, and even shaking the pillars of revelation itself; for "in the noble army of martyrs," the witnesses of the episcopal government of the church are earlier, and by far more numerous, than those who testify that the *gospel* of *St Matthew* was written by that apostle, or that the book of the *Apocalypse* is canonical Scripture. The authority of the *fathers* indeed is at present very low; but should they be allowed to be as fanciful divines and as bad critics as their worst enemies are pleased to represent them, this would detract nothing from their evidence when they bear witness to the constitution of the church in their own times; for of their *integrity* there can be no doubt: and what the Episcopalian wants of them is only their testimony to matters of fact which fell under the cognizance of their own senses, and about which therefore they could not be deceived. It is here indeed chiefly that he triumphs over his antagonists. In the second and third centuries there was no general council, nor any Christian sovereign.

17
he divine
ght of E-
scopacy.

A prelacy therefore, he urges, could not have been *universally* introduced, during that period, either by a concert among the clergy, or by the authority of the civil magistrate. Yet that even *then* there was no church under heaven, of which the government was not episcopal, has been confessed by some of the most learned writers among the Presbyterians themselves; whence he concludes that episcopacy is of divine institution.

The candid Episcopalian, however, allows, that in the apostolic age there may have been some churches which at first had only bishops and deacons to perform the offices of religion; for when the number of disciples in any place was so small that they could all meet in one assembly, there was no necessity for any other order of ministers: but it appears that, from the very *beginning*, *bishops*, *presbyters*, and *deacons*, were settled in all the *larger* cities of the Roman empire; and it was in those days an allowed maxim, that without a *bishop* there could be *no church*. The better to understand the original state and institution of episcopacy, it is necessary to observe, that the empire, which contained almost all the known part of the Christian world, was by Augustus Cæsar divided into provinces, subjected each to the authority of one chief magistrate, who was commonly a *prætor* or *proconsul*, and who resided in the metropolis or chief city of the province. A province comprehended the cities of a whole region; and in the age of the apostles, each city was under the immediate government of certain magistrates within its own body, known by the name of *βουλη* or *senatus*, *ordo* and *curia*, "the states and court of the city." Those magistrates were subordinate to the *prætor* or *proconsul*: but among them there was *one* superior to the rest, called sometimes *dictator* and sometimes *defensor civitatis*, whose jurisdiction extended not only over the city itself, but likewise over all the adjacent territory. That territory was denominated *προαστιον*, or the suburbs, and often reached to the distance of 10 or 12 miles round the city, and sometimes much farther, containing within it many villages and small towns under the government of the city magistrates.

8
origin
eses.

From some passages in the New Testament, and from the concurring evidence of the earliest writers of the church, it appears to have been the purpose of the apostles to settle a bishop in *every* city where there was a civil magistracy: but as they could not be personally present in all places at once, it was natural for them to *enter* upon the great work of converting the nations by *first* preaching the gospel in that city of each province which was the ordinary residence of the governor; because to it there must have been the greatest resort of people, who would carry the glad tidings with them into the country when they returned. Accordingly, having dispersed themselves over the empire, and made numbers of proselytes in the principal cities, they fixed in each, where they saw it necessary, a *bishop*, with a college of *presbyters* and *deacons*; and gave to those bishops, who were at first called *apostles*, a commission, as the *other* cities of the province should be converted, to fix in them bishops also.

In some of the smaller cities, it is extremely probable that a bishop and a deacon were for a short time the only ecclesiastical officers, till the number of Christians increased so much as to make it impossible for them all to assemble in one house for the purposes of public worship. The bishop then ordained *presbyters* to officiate in those congregations where he himself could not be present, and to assist him in other parts of his pastoral office; but in all their ministrations the presbyters were subordinate to him, who was the chief pastor within the city, who composed the prayers which were offered up in public, and to whom all the other ministers of religion were accountable for their conduct. So long as the number of the faithful was confined within the *walls* of the city, it appears that the bishop with his presbyters and deacons lived together as in a college; that divine service was every Lord's day, or oftener, performed in what was afterwards called the cathedral or mother-church, by the bishop himself, assisted by some of his clergy; and that the congregations which met in other churches, having no *fixed* pastors, were supplied by such presbyters as the bishop chose to send to them from his own church. Whilst matters continued in this state, the clergy had no other revenues than what arose from the voluntary oblations of the people; which were indeed so large as not only to support them with decency, but likewise to answer other ends of charity and munificence. They were commonly divided into four equal parts; of which one was allotted to the bishop, a second to the inferior clergy, a third to the poor, and a fourth to keep the churches in repair; and it was considered as a part of the bishop's duty to take care that the offerings should be faithfully applied to these purposes.

19
The origin
of parishes.

When converts increased in number, and churches were built in the suburbs, each of these churches had a fixed pastor similar to a parish-priest among us; but still those pastors, as well as the city-clergy, ministered in subordination to the bishop, whose authority extended as far as the civil authority of the Roman magistrate, within which district or diocese it was supreme over all orders of Christians. This every man knows who is acquainted with ecclesiastical history; for the bishop alone could ordain *priests* and *deacons*, administer the rite of *confirmation*, *absolve penitents* who were under church censure, and *exclude from communion* heretics and notorious offenders; and from his sentence there lay no appeal but to a synod of comprovincial bishops.

Such synods were in each province convened by the bishop

bishop of the chief city; for the apostles having been careful to place in those cities men of the most eminent gifts and abilities, the other bishops of the provinces applied to them for advice upon every emergency, and paid a particular deference to them upon every occasion. So that though all bishops were of equal authority as *bishops*, yet when they met to consecrate a new bishop, or to deliberate upon the affairs of the church, they yielded a precedency to the bishop of the metropolis, who called them together, and who sat as *president* or *moderator* of the synod. Hence the origin of metropolitans or *archbishops;* whose authority was so considerable, that though there is not a doubt but the *election* of bishops was anciently placed in the clergy and people of the vacant diocese, yet the bishop *elect* could not be *consecrated* without the consent of the archbishop of the province.

20 The origin of metropolitans.

In consequence of the extensive powers with which the primitive bishops were vested, they are commonly styled in the writings of those times *presidents, provosts*, or *inspectors* of the church, *chief priests, princes of the clergy*, and even *princes of the people;* but their authority was wholly spiritual. Those prelates, imitating the example of their Divine Master when on earth, neither possessed nor assumed to themselves any jurisdiction over the *properties* or *civil rights* of men. In consequence of St Paul's having reprimanded the Corinthians for going to law before the *unbelievers*, they were indeed often chosen as *arbiters* of such civil disputes as arose between individuals under their episcopal government; but on these occasions they could not act unless the submission was *voluntarily* made by *both* the contending parties, and *then* their decision was final. When the empire became Christian, this privilege was confirmed to them by law*;* for any *civil* cause depending before a court of justice could be withdrawn, and by the mutual consent of parties be submitted to the arbitration of the bishop, whose award, which in former times could be enforced only by the terror of church-censures, was then enforced by the secular magistrate. In *criminal* causes, where the trial might be for life or death, they were prohibited both by the canons of the church and by the laws of the state from acting as judges; and therefore they never suffered such causes to come before them, except when it was necessary that the person accused, if found guilty, should be excluded from the communion of the faithful. But they had so many civil causes flowing in upon them, that they were soon obliged to devolve part of that care upon other persons, in whose knowledge, prudence, and integrity, they could fully confide: and as the persons employed to act in the bishop's stead were often *laymen*, it has been conjectured that they gave rise to the office of *lay-chancellor* in the church, and to all that train of spiritual judges and spiritual courts against which such numbers are disposed to clamour.

21 The probable origin of spiritual courts.

22 Bishops had no civil rank till after the subversion of the Roman empire and the conversion of the Gothic nations.

Be this as it may, it is certain that, through the piety and munificence of the Christian emperors, the bishops enjoyed large revenues and many valuable privileges; but it does not appear that they had any rank or authority, as *barons* or *temporal princes*, till the Gothic nations, which subverted the Roman empire, had embraced the Christian faith. As Christianity incapacitated the leaders of those tribes from officiating as chief priests at the religious rites which were usually celebrated at the opening of their public assemblies, the bishops came naturally to discharge that duty on such occasions, when they must have shared in the rank by sharing in the functions of the chief. The situation in which they thus appeared at the opening of all political conventions, would enable them to join with much effect in the deliberations which ensued; and their superior knowledge, their sacred character, and their influence with the people, would soon acquire them power equal to their rank. They must therefore have been well entitled to demand admission into that council which was formed by the king and the lay-chiefs at the national assemblies: and as they balanced the authority of those chiefs, we cannot doubt that the king would be disposed to give the utmost effect to their claim. Accordingly, we find the dignified clergy, who received large grants of land to be held on the same tenures with the lands of the lay-magistrates, presiding along with those magistrates in the provincial assemblies of every degree in all the Gothic nations, and enjoying every advantage in point of rank and authority in their national diets. Hence the bishop of Rome, and several bishops in Germany, have, like the dukes and marquises of that empire, been for a long time sovereign princes; and hence too the bishops of England and Ireland have always sat, and have an equal right with the lay-peers to sit, in the upper house of parliament. It is however obvious, that, so far as episcopacy is of *apostolical* institution, those peers and princes possess not the *original* character in any higher degree than the bishops in America, who are barely tolerated, or than those in Scotland who do not enjoy that privilege; and that confirmation administered, or holy orders conferred, by a persecuted prelate, must be as effectual to the purposes of religion, as if given by a German prince or an English peer.

In this short view of episcopacy, it has been our endeavour to do justice to the subject, without suffering ourselves to be influenced by partiality or prejudice. As we are not ourselves episcopalians, we have advanced nothing of our own; but have selected from English writers, who have at different times undertaken to defend the *divine right* of episcopacy, such facts and arguments as to us appear to be of the most importance, or to have the greatest weight, without remarking upon them, or offering any answer. The reasoning employed to prove that the order of bishops was instituted by the apostles, is taken from a work prepared for the press by Dr Berkeley prebendary of Canterbury, and son of the celebrated bishop of Cloyne. For the rest of the detail we are indebted chiefly to Bingham's *Origines Ecclesiasticæ;* a performance in great estimation with those English divines who are commonly known by the appellation of *high churchmen*. As editors of a work of this kind, it is not *our* business to be of *any party*, or to support, in opposition to all others, a *particular* church, though that church should be our own: We shall therefore treat *independency* and *presbytery* as we have treated *episcopacy*, by employing some able writer of each society to plead his own cause. Meanwhile, we shall conclude this article with a few reflections, which, though they come from the pen of an obscure author, deserve to be engraved deep in the memory of every controvertist of every communion.

23 Moderation in controversy recommended. "On complicated questions (says a late apologist for the episcopal church in Scotland), men will always differ in opinion; but conscious each of the weakness of his own understanding, and sensible of the bias which the strongest minds are apt to receive from thinking long in the same tract, they ought to differ with charity and meekness. Since unhappily there are still so many subjects of debate among those who name the name of Christ; it is doubtless every man's duty, after divesting himself as much as possible of prejudice, to investigate those subjects with accuracy, and to adhere to that side of each disputed question which, after such investigation, appears to him to be the truth: but he transgresses the favourite precept of his divine master, when he casts injurious reflections, or denounces anathemas, upon those who, with equal sincerity, may view the matter in a different light; and by his want of charity does more harm to the religion of the *Prince of Peace*, than he possibly could do good, were he able to convert all mankind to his own orthodox opinions."

24 Episcopal church of Scotland. The following is a short history of the episcopal church of Scotland, extracted from a more detailed account by a member of that church.

The real tenets of the Scotch episcopalians, or members of what was at one period the established church of Scotland, he observes, appear to be imperfectly understood. About the time of the reformation from popery, the want of order and decency in the worship of the reformed church was abolished in the reign of James VI. by the establishment of episcopacy on very liberal principles. This mode of worship obtained the sanction of the most respectable part of the nation, and continued to flourish under the auspices of government, till it was overthrown by the sticklers for the *national covenant*. Its restoration was effected in the year 1662, and twenty-seven years afterwards it was again abolished by the advocates of the prince of Orange.

It may be proper to observe, that the Scotch episcopal church had no public liturgy during her legal establishment. It is indeed true, that the English book of common prayer was used by the first reformers, and there is reason to believe that John Knox himself was by no means inimical to set forms of prayer nor to clerical subordination; but his successor, Andrew Melvil, a man much inferior to him in point of erudition, introduced an equality among the clergy, and excited the odium of the people against the liturgy to such a degree, that an attempt to modify the prayer book for the use of the church of Scotland, was productive of the solemn league and covenant, and the subsequent ruin of the unfortunate Charles.

During the reign of William III. the episcopalians were treated with some degree of severity, because they could not transfer that allegiance to him which they had sworn to King James. It is said that they were prohibited from officiating on the sabbath day, except "in their own hired houses, where they received such friends as chose to come in unto them." In this manner was their worship conducted, praying either extempore, or from premeditation, till the accession of Queen Anne, when the English liturgy was introduced by degrees into Scotland, under the sanction of an act of parliament, passed on the 3d of March 1712, "to prevent the disturbing of those of the episcopal communion in that part of Great Britain called Scotland, in the exercise of their religious worship, and in the use of the liturgy of the church of England." But as their attachment to the house of Stuart was well known, they were, at the rebellion in 1715, laid under some restraints, yet neither severe in their nature, nor of any long continuance, since in 1720 their places of worship were as numerous as before, and frequented by numbers both of rank and respectability, many of whom held places under government.

In England, Dr Sancroft, archbishop of Canterbury, with five other bishops, were deprived of their sees for refusing their allegiance to King William, which occasioned a schism in the church, as they were extremely popular. Different opinions were entertained respecting the nature and design of the Lord's Supper, and the controversy infected the episcopalians of Scotland. The introduction of prayers into public worship in behalf of departed friends, was at least a very impolitic step at such a critical period, when every thing savouring of popery was held in the utmost abhorrence. On the death of Dr Rose, the proscribed bishop of Edinburgh, the diocesan form of church government was opposed by such of the presbyters as had been raised to the episcopal dignity, and it was proposed to govern the whole church by a college of bishops. This plan, for the adoption of which no precedent could be found in the annals of history, was successfully opposed by many of the most enlightened bishops, and it was of consequence abandoned.

The Scotch episcopalians, it is well known, were always charged with an undue attachment to the Stuart family, which was even considered as their most distinguishing tenet; yet there is some reason to believe that the public opinion of this matter was rather exaggerated. They have invariably maintained that the Almighty, and not the people, is the ruler of princes, which fairly places them beyond the imputation of a republican or levelling spirit. The several restraints laid on Scotch episcopalians from time to time, with a view to eradicate their attachment to the Stuart family, were happily removed in the year 1792, and they enjoyed a free toleration like the rest of dissenters. It was about this time that the clergy of this church, with a very few exceptions, took the oaths of abjuration and allegiance.

It is well known, it is added by the same writer, from whose account the above is taken, that in Scotland there are chapels quite distinct from the Scotch episcopal church, where clergymen who have been ordained either in England or Ireland, make use of the liturgy of the church of England; but as each of these is strictly and properly independent of the rest, and under the guardianship of no bishop whatever, those who attend them have, in every sense of the word, a much better claim to the appellation of *congregationalists* than to that of *episcopalians*.

**EPISCOPAL**, something belonging to BISHOPS.

**EPISCOPALIANS**, in church history, an appellation given to those who prefer the episcopal government and discipline to all others. See EPISCOPACY.

By the test act, none but episcopalians, or members of the church of England, are qualified to enjoy any office civil or military.

**EPISCOPIUS**, SIMON, one of the most learned men of the 17th century, and the chief supporter of the Arminian sect, was born at Amsterdam in 1583. In 1612, he was chosen divinity professor at Leyden, in the room of Gomarus, who resigned; and the functions of his office, with his private studies, were light burdens to him, compared with the difficulties he sustained on account of the Arminian controversy: which, though it began in the universities, soon flew to the pulpits, from whence it spread and inflamed the people. The states of Holland having invited Episcopius to take his place at the synod of Dort, he went thither accompanied by some remonstrant ministers; but the synod would not allow them to sit as judges, nor to appear in any other capacity than as persons summoned before them: they submitted, were deposed from their functions, and banished the territories of the commonwealth. Episcopius and his persecuted brethren retired to Antwerp; but the times growing more favourable, he returned to Holland in 1626, and was made minister of the church of the Remonstrants at Rotterdam: in 1634, he was chosen rector of the college founded by the sect at Amsterdam, where he spent the remaider of his days. He died in 1643 of the same disorder which had killed his wife before, a retention of urine; having lost his sight some weeks previous to his end. The learned have bestowed great eulogiums on Episcopius; but he did not always write with that moderation which might have been wished. His works make two volumes in folio, of which the second consists of posthumous publications.

EPISCOPUS, the same with bishop. See BISHOP and EPISCOPACY.

EPISODE, in *Poetry*, a separate incident, story, or action, which a poet invents, and connects with his principal action, that his work may abound with a greater diversity of events; though in a more limited sense, all the particular incidents whereof the action or narration is compounded are called *episodes*. See POETRY.

EPISPASTIC, in *Medicine*, a topical remedy, which being applied to the external parts of the body, attracts the humours to that part.

EPISTATES, in the Athenian government, was the president of the proedri. See PROEDRI.

EPISTEMONARCH, in the ancient Greek church, an officer of great dignity, who had the care of every thing relating to faith, in the quality of censor. His office answered very nearly to that of master of the sacred palace at Rome.

EPISTLE, denotes the same with a missive letter; but is now chiefly used in speaking of ancient writings, as the epistles of St Paul, epistles of Cicero, epistles of Pliny, &c.

*EPISTLES and Gospels*, in the liturgy of the church of England, are select portions of scripture, taken out of the writings of the evangelists and apostles, and appointed to be read, in the communion service, on Sundays and holidays. They are thought to have been selected by St Jerome, and by him put into the lectionary. It is certain they were very anciently appropriated to the days whereon we now read them, since they are not only of general use throughout the western church, but are also commented upon in the homilies of several ancient fathers, which are said to have been preached upon those very days to which these portions of scripture are now affixed.

The epistles and gospels are placed in an admirable order and method, and bear a special relation to the several days whereon they are read. The year is distinguished into two parts; the first being designed to commemorate Christ's living among us, the other to instruct us to live after his example. The former takes in the whole time from Advent to Trinity-Sunday; the latter, all the Sundays from Trinity to Advent. During the first of these seasons, the epistles and gospels are calculated to raise in us a grateful sense of what our Saviour did and suffered for us, and set before our eyes his nativity, circumcision, and manifestation to the Gentiles; his doctrines and miracles; his baptism, fasting, and temptation; his agony and bloody sweat; his cross and passion; his death, burial, resurrection, and ascension; and his mission of the Holy Ghost. During the second season of the year, the epistles and gospels tend to instruct us in the true paths of Christianity. See COLLECTS.

EPISTOLARY, something belonging to an epistle. See EPISTLE.

*EPISTOLARY Compositions.* See LETTER; and the article POETRY.

EPISTROPHE. See ORATORY.

EPISTYLE, in the ancient architecture, a term used by the Greeks for what we call *architrave*, viz. a massive piece of stone or wood, laid immediately over the capital of a column.

EPITAPH (from επι, *upon*, and ταφος *sepulchre*,) a monumental inscription, in honour or memory of a person deceased. It has been disputed whether the ancient Jews inscribed epitaphs on the monuments of the dead; but be this as it will, epitaphs, it is certain, of very ancient date, are found among them.—The Athenians, by way of epitaph, put only the name of the dead, with the epithet χρηστος, signifying "good," or ἡρως, "hero," and the word χαιρε, signifying their good wishes: the name of the deceased's father and his tribe were frequently added.—The Lacedæmonians allowed epitaphs to none but those who had died in battle. The Romans inscribed their epitaphs to the *manes*, *diis manibus*; and frequently introduced the dead by way of prosopopœia, speaking to the living; of which we have a fine instance, worthy the Augustan age, wherein the dead wife thus bespeaks her surviving husband:

*Immatura peri; sed tu, felicior, annos*
*Vive tuos, conjux optime, vive meos.*

The epitaphs of the present day are generally crammed with fulsome compliments which were never merited, characters which human nature in its best state could scarce lay claim to, and expressions of respect which were never paid in the life-time of the deceased. Hence the proverb with great propriety took its rise, "He lies like an epitaph."

EPITAPH, is also applied to certain eloges, either in prose or in verse, composed without any intent to be engraven on tombs; as, that of Alexander,

*Sufficit huic tumulus, cui non sufficeret orbis.*

and that of Newton,

*Isaacum Newton,*
*Quem immortalem*
*Testantur Tempus, Natura, Cœlum;*
*Mortalem,*
*Hoc Marmor*
*Fatetur.*

EPITASIS, in ancient poetry, the second part or division of a dramatic poem, wherein the plot, entered upon in the first part or *protasis*, was carried on, heightened, and worked up, till it arrived at its state or height, called *catastasis*.

Epitasis, in *Medicine*, the increase of a disease or beginning of a paroxysm, particularly in a fever.

EPITHALAMIUM, in *Poetry*, a nuptial song or composition in praise of the bride and bridegroom, praying for their prosperity, for a happy offspring, &c.

Epithalamia were sung among the Jews, at the door of the bride, by her friends and companions, the evening before the marriage. Psalm xlv. is an epithalamium. Among the Greeks the epithalamium was sung as soon as the married couple were gone to bed, and attended with shouts and stamping of the feet to drown the cries of the bride. They returned in the morning, and with the same song, a little altered, saluted them again. The evening song was called επιθαλαμια κοιμητικα, the morning salute was called επιθαλαμια εγερτικα. This was the practice amongst the Romans also, but their epithalamia were often obscene.

EPITHEM, in *Pharmacy*, a kind of fomentation, or remedy of a spirituous or aromatic kind, applied externally to the regions of the heart, liver, &c. to strengthen and comfort the same, or to correct some intemperature thereof.

EPITHET, in *Poetry* and *Rhetoric*, an adjective expressing some quality of a substantive to which it is joined; or such an adjective as is annexed to substantives by way of ornament and illustration, not to make up an essential part of the description. Nothing, says Aristotle, tires the reader more than too great a redundancy of epithets, or epithets placed improperly; and yet nothing is so essential in poetry as a proper use of them. The writings of the best poets are full of them.

EPITOME, in literary history, the same with Abridgement.

EPITRITUS, in prosody, a foot consisting of three long syllables and one short. Of these, grammarians reckon four kinds: the first consisting of an iambus and spondee, as sălūtāntēs; the second, of a trocheus and spondee, as cōncĭtātī; the third of a spondee and an iambus, as cōmmūnĭcāns; and the fourth, of a spondee and trocheus, as īncāntārĕ. See the articles Spondeus, Trocheus, &c.

EPITROPE. See Oratory, N° 83.

EPITROPUS, a kind of judge, or rather an arbitrator, which the Greek Christians, under the dominion of the Turks, elect in the several cities, to terminate the differences that arise among them, and avoid carrying them before the Turkish magistrates. See Arbitrator.

Anciently the Greeks used the term επιτροπος, in the same sense as the Latins did *procurator*, viz. for a commissioner or intendant. Thus the commissioners of provisions in the Persian army are called by Herodotus and Xenophon *epitropi*. In the New Testament, επιτροπος denotes the steward of a household, rendered in the vulgate *procurator*.

EPIZEUXIS. See Oratory, N° 68.

EPOCHA, in *Chronology*, a term or fixed point of time whence the succeeding years are numbered or counted. See Æra.

EPODE, in lyric poetry, the third or last part of the ode, the ancient ode being divided into strophe, antistrophe, and epode. See Ode, &c.

The epode was sung by the priests, standing still before the altar, after all the turns and returns of the strophe and antistrophe, and was not confined to any precise number or kind of verses.

The epode is now a general name for all kinds of little verses that follow one or more great ones, of what kind soever they be, and in this sense a pentameter is an epode after an hexameter. And as every little verse, which, being put after another, closes the period, is called *epode*; hence the sixth book of Horace's odes is intitled *liber epodon*, "book of epodes," because the verses are all alternately long and short, and the short ones generally, though not always, close the sense of the long one.

EPOPOEIA, in *Poetry*, the history, action, or fable, which makes the subject of an epic poem. The word is derived from the Greek επος, *carmen*, "verse," and ποιεω, *facio*, "I make."

In the common use of the word, however, *epopœia* is the same with *epos*, or epic poem itself. See the article Poetry.

EPOPS, or Hoopoe. See Upupa, Ornithology *Index*.

EPSOM, a town of Surry, about 16 miles southwest from London, long famous for its mineral waters. These were discovered in 1618; and though not in such repute as formerly, yet they are not impaired in virtue, and the salt made from them is famous all over Europe, for gently cleansing and cooling the body. The hall, galleries, and other public apartments, are now run to decay; and there remains only one house on the spot, which is inhabited by a countryman and his wife, who carry the waters in bottles to the adjacent places, and supply the demands of dealers in London. On the neighbouring downs are annually horse-races; but the inns, shops, and bowling-greens are not near so much frequented as formerly. The market is on Friday; fair, July 25. The town is about one mile and a half in semicircle, from the church to the palace at Durdans, which was burnt down some years since, but has been rebuilt. It was once inhabited by the late king's father. In Hudson's Lane here was Epsom Court, an ancient Saxon seat, long since converted into a farm. Here are so many fields, meadows, orchards, gardens, and the like, that a stranger would imagine that the town was built in a wood. The population in 1811 was 2515.

Epsom water is easily imitated by art; i. e. by only dissolving half an ounce of Epsom salt in a quart of pure water, made somewhat brisk or quick by adding a little sulphuric acid and potash, so as to let the alkali prevail.

EPULARES, in antiquity, an epithet given to those who were admitted to the sacred *epulæ* or entertainments,

tainments, it being unlawful for any to be present at them who were not pure and chaste.

**EPULO**, in antiquity, the name of a minister of sacrifice among the Romans.

The pontifices, not being able to attend all the sacrifices performed at Rome to so many gods as were adored by that people, appointed three ministers, whom they called *epulones*, because they conferred on them the care and management of the *epula*, feasts in the solemn games and festivals. To them belonged the ordering and serving the sacred banquet, offered on such occasions to Jupiter, &c. They wore a gown bordered with purple like the pontifices. Their number was at length augmented from three to seven, and afterwards by Cæsar to ten. Their first establishment was in the year of Rome 558, under the consulate of L. Furius Purpureo and M. Claudius Marcellus.

**EPULUM**, in antiquity, a holy feast prepared for the gods in times of public danger. The feast was sumptuous, and the gods were formally invited and attended; for the statues were brought on rich beds furnished with soft pillows, called *pulvinaria.* Thus accommodated, their godships were placed on their couches at the most honourable part of the table. The care of the *epula* belonged to the *epulones*, and the gods were plentifully served with the richest dainties, as if they were able to eat; but the *epulones* performed that function for them, and doubtless were competent proxies! No wonder that Pliny solicited Trajan to be admitted of their order.

Epulum is also used to signify any solemn feast; so we meet with *epulum ferale*, "a funeral entertainment."

**EQUABLE**, an appellation given to such motions as always continue the same in degree of velocity, without being either accelerated or retarded.

**EQUAL**, a term of relation between two or more things of the same magnitude, quantity, or quality.

Mathematicians speak of *equal* lines, angles, figures, circles, ratios, solids.

**EQUALITY**, that agreement between two or more things, whereby they are denominated equal.

**EQUANIMITY**, in *Ethics*, denotes that even and calm frame of mind and temper, under good or bad fortune, whereby a man appears to be neither puffed up nor overjoyed with prosperity, nor dispirited, soured, or rendered uneasy by adversity.

**EQUATIONS**, in *Algebra*. See Algebra.

*Equation of Time*, in *Astronomy* and *Chronology*, the reduction of the apparent time or motion of the sun, to equable, mean, or true time. See Astronomy *Index*.

**EQUATOR**, or Æquator, in *Astronomy* and *Geography*, a great circle of the sphere, equally distant from the two poles of the world, or having the same poles with those of the world. It is called the *equator*, because when the sun is in it the days and nights are *equal;* whence also it is called the *equinoctial;* and when drawn on maps and planispheres, the *equinoctial line*, or simply the *line*. Every point of the equator is a quadrant's distance from the poles of the world; whence it follows, that the equator divides the sphere into two hemispheres, in one of which is the northern, and in the other the southern pole.

**EQUATORIAL** Instrument. See Astronomy *Index*.

**EQUERY**, or Ecury, a grand stable or lodge for horses, furnished with all the conveniences thereof; as stalls, manger, rack, &c. The word is formed from the French *escurie*, which signifies the same thing. Some again derive *escurie* from the Latin *scuria*, which not only denotes a place for beasts to be put up in, but also a grange or barn. But a more probable derivation is from *equile*, "a stable for horses," of *equus*, "horse." Some hold that the word *stable*, in propriety, relates only to bullocks, cows, sheep, hogs, &c. and *equery*, to horses, mules, &c.

A *simple equery* is that provided for one row of horses; a *double equery* that provided for two, with a passage in the middle, or two passages; the horses being placed head to head, as in the little equery at Versailles.

Under equery are sometimes also comprehended the lodgings and apartments of the equerries, grooms, pages, &c.

Equery (*escuyer*), is also an officer who has the care and management of the horses of a king or prince.

**EQUERIES**, or Equerries, popularly called *Querries*, are particularly used among us for officers of the king's stables, under the master of the horse, seven in number, who, when his majesty goes abroad, ride in the leading coach, are in waiting one at a time monthly, and have a table with the gentlemen ushers during the time, and a salary of 300l. a-year each. They used to ride on horseback by the coach side when the king travelled; but that being more expensive to them than necessary to the sovereign, it has been discontinued.

*Equeries of the Crown Stable* have that appellation, as being employed in managing and breaking the saddle-horses, and preparing them for the king's riding. These are two in number; the first having an annual salary of 256l. and the second 200l. whereof one is, or always should be, in close waiting at court; and when his majesty rides, holds the stirrup, while the master of the horse, or one of the equeries in his absence, assists in mounting him: and when his majesty rides, they usually attend him.

**EQUES**, in antiquity. See *Equestrian Order* and Equites.

*Eques Auratus*, is used to signify a knight-bachelor, called *auratus*, q. d. *gilt*, because anciently none but knights might gild or beautify their armour or other habiliments of war with gold. In law this term is not used, but instead of it *miles*, and sometime *chevalier*.

**EQUESTRIA**, among the Romans, a place in the theatre where the equites or knights sat.

**EQUESTRIAN** (*equestris*), a term chiefly used in the phrase *equestrian statue*, which signifies a statue representing a person mounted on horseback. The word is formed of the Latin *eques*, "knight, horseman," of *equus*, "horse."

*Equestrian Games*, among the Romans, horse-races, of which there were five kinds, the *prodromus* or *plain horse-race*, the *chariot-race*, the *decursory-race* about funeral piles, the *ludi sevirales*, and the *ludi neptunales*.

*Equestrian Order*, among the Romans, signified their

their knights or equites; as also their troopers or horsemen in the field; the first of which orders stood in contradistinction to the senators; as the last did to the foot military, or infantry. Each of these distinctions was introduced into the state by Romulus.

**EQUIANGULAR**, in *Geometry*, an epithet given to figures whose angles are all equal: such are a square, an equilateral triangle, &c.

**EQUIDISTANT**, an apellation given to things placed at equal distances from some fixed point or place to which they are referred.

**EQUILATERAL**, in general, something that hath equal sides; as an equilateral triangle.

**EQUILIBRIUM**, in *Mechanics*, is when the two ends of a lever or balance hang so exactly even and level, that neither doth ascend or descend, but both keep in a position parallel to the horizon; which is occasioned by their being both charged with an equal weight.

**EQUIMULTIPLES**, in *Arithmetic* and *Geometry*, are numbers or quantities multiplied by one and the same number or quantity. Hence, equimultiples are always in the same ratio to each other as the simple quantities before multiplication, thus, if 6 and 8 are multiplied by 4, the equimultiples 24 and 32 will be to each other as 6 to 8.

**EQUINOCTIAL**, or ÆQUINOCTIAL, in *Astronomy*, a great and immoveable circle of the sphere, under which the equator moves in its diurnal motion.

The equinoctial or equinoctial line is ordinarily confounded with the equator; but there is a difference; the equator being moveable, and the equinoctial immoveable; and the equator being drawn about the convex surface of the sphere, but the equinoctial on the concave surface of the magnus orbis.

Whenever the sun in his progress through the ecliptic comes to this circle, it makes equal days and nights all round the globe; as then rising due east and setting due west, which he never does at any other time of the year. And hence the denomination from *æquus* and *nox*, "night;" *quia æquat diem nocti.*

The equinoctial then is the circle which the sun describes, or appears to describe, at the time of the equinoxes; that is, when the length of the day is everywhere equal to that of night, which happens twice a-year. See EQUINOX.

EQUINOCTIAL, in *Geography*. See EQUATOR.

The shadows of those who live under this circle are cast to the southward of them for one half of the year, and to the northward of them during the other half; and twice in a year, viz. at the equinoxes, the sun at noon casts no shadow, being in their zenith.

From this circle is the declination or latitude of places accounted in the degrees of the meridian.

*EQUINOCTIAL Points*, are the two points wherein the equator and ecliptic intersect each other: the one being in the first point of Aries, is called the *vernal point* or *equinox;* and the other in the first point of Libra, the *autumnal point* or *equinox.*

*EQUINOCTIAL Dial*, is that whose plane lies parallel to the equinoctial. See DIAL.

**EQUINOX**, or ÆQUINOX, in *Astronomy*, the time when the sun enters one of the equinoctial points.

The equinoxes happen when the sun is in the equinoctial circle; when of consequence the days are equal to the night throughout the world, which is the case twice a-year, viz. about the 20th of March and the 23d of September, the first of which is the vernal and the second the autumnal equinox.

It is found by observation, that the equinoctial points, and all the other points of the ecliptic, are continually moving backwards, or *in antecedentia*, that is, westward. This retrograde motion of the equinoctial points, is that famous and difficult phenomenon called the *precession of the equinoxes.* See ASTRONOMY *Index.*

**EQUIPAGE**, in the military art, denotes all sorts of utensils, artillery, &c. necessary for commencing and prosecuting with ease and success any military operations. Camp and field equipage consists of tents, kitchen-furniture, saddle-horses, baggage-waggons, bat-horses, &c.

To **EQUIP**, in naval language, a term borrowed from the French marine, and frequently applied to the business of fitting a ship for sea, or arming her for war.

**EQUIPOLLENCE**, in *Logic*, is when there is an equivalence between any two or more terms or propositions; i. e. when they signify one and the same thing, though they express it differently. Such propositions, &c. are said to be *equipollent.*

**EQUIRIA**, in antiquity, a festival instituted by Romulus, and celebrated on the 27th of February, in honour of Mars, at which there were horse-races.

**EQUISETUM**, HORSE-TAIL; a genus of plants belonging to the cryptogamia class; and in the natural method ranking under the 51st order, *Coniferæ.* See BOTANY *Index.*

**EQUITES**, amongst the Romans, were persons of the second degree of nobility, immediately succeeding the senators in point of rank. The *equites* or knights were required to be possessed of 400 *sestertia* before they could be admitted into that order; and when the knights were so reduced as to fall short of the prescribed revenue, they were expunged out of the equestrian list. The equestrian revenue just mentioned amounted to about 10,000 crowns.

Part of the ceremony whereby the honour of knighthood was conferred amongst the Romans was the giving of a horse; for every *eques* or knight had a horse kept at the public charge: he received also the stipend of a horseman to serve in the wars, and wore a ring which was given him by the state. The *equites* composed a large body of men, and constituted the Roman cavalry; for there was always a sufficient number of them in the city, and nothing but a review was requisite to fit them for service.

The knights at last grew too powerful, were a balance for the senate and people, neglected the exercises of war, and betook themselves to civil employments. The *equites* were liable to be punished by the censors, and to suffer degradation. They were degraded by taking from them the horse which was kept for each of them at the public charge; this was called *equum adimere.*

**EQUITY**, in a general sense, the virtue of treating all other men according to reason and justice, or as we would be gladly treated ourselves when we understand aright what is our due. See JUSTICE.

EQUITY, in jurisprudence, is defined a correction or qualification of the law, generally made in that part wherein it faileth or is too severe. It likewise signifies

the

the extension of the words of the law to cases unexpressed, yet having the same reason; so that where one thing is enacted by statute, all other things are enacted that are of the same degree. For example, the statute of *Glouc.* gives action of waste against him that holds lands for life or years; and by the equity thereof, a man shall have action of waste against a tenant that holds but for one year, or one half-year, which is without the words of the act, but within the meaning of it; and the words that enact the one, by *equity* enact the other. So that equity is of two kinds. The one abridges and takes from the letter of the law; the other enlarges and adds to it: and statutes may be construed according to equity, especially where they give remedy for wrong, or are for expedition of justice. Equity seems to be the interposing *law of reason*, exercised by the lord chancellor in extraordinary matters to do equal justice; and by supplying the defects of the law, gives remedy in all cases. See CHANCERY.

EQUITY, in *Mythology*, sometimes confounded with *Justice*, a goddess among the Greeks and Romans, represented with a sword in one hand and a balance in the other.

**EQUIVALENT**, is understood of something that is equal in value, force, or effect, to another.

Equivalence is of various kinds; in propositions, in terms, and in things.

*EQUIVALENT Propositions.* See EQUIPOLLENCE.

*EQUIVALENT Terms*, are where several words that differ in sound have yet one and the same signification; as *everybody was there*, and *nobody was absent*, *nihil non*, and *omne*.

*EQUIVALENT Things*, are either *moral*, *physical*, or *statical*. *Moral*, as when we say that the commanding or advising a murder is a guilt equivalent to that of the murderer. *Physical*, as when a man who has the strength of two men is said to be equivalent to two men. *Statical*, whereby a less weight becomes of equal force with a greater, by having its distance from the centre increased.

**EQUIVOCAL** TERMS or WORDS, among logicians, are those which have a doubtful or double meaning.

According to Mr Locke, the doubtfulness or uncertainty of words has its cause more in the ideas themselves, than in any incapacity of the words to signify them; and might be avoided, would people always use the same term to denote the same idea or collection of ideas: but, adds he, it is hard to find a discourse on any subject where this is the case; a practice which can only be imputed to folly or great dishonesty; since a man, in making up his accounts, might with as much fairness use the numerical characters sometimes for one sometimes for another collection of units.

*EQUIVOCAL Generation*, the production of animals without the intercourse between the sexes, by the influence of the sun or stars, &c.

This kind of generation is now quite exploded by the learned.

**EQUIVOCATION**, the using a term or expression that has a double signification. Equivocations are expedients to save telling the truth, and yet without telling a falsity. The fathers are great patrons of equivocations and mental reservations, holding that the use of such shifts and ambiguities is in many cases allowable.

**EQUULEUS**, or ECCULEUS, in antiquity, a kind of rack used for extorting a confession; at first chiefly practised on slaves, but afterwards made use of against the Christians.

The equuleus was made of wood, having holes at certain distances, with a screw by which the criminal was stretched to the third, sometimes to the fourth or fifth holes, his arms and legs being fastened on the equuleus with cords; and thus was hoisted aloft, and extended in such a manner, that all his bones were dislocated. In this state red-hot plates were applied to his body, and he was goaded in the sides with an instrument called an *ungula*.

EQUULEUS, EQUICULUS, and *EQUUS Minor*, the horse's head, in *Astronomy*, a constellation of the northern hemisphere, whose stars in Ptolemy's catalogue are four, in Tycho's four, in Hevelius's six, and in Mr Flamstead's ten.

**EQUUS**, a genus of quadrupeds belonging to the class mammalia, and order of belluæ. See MAMMALIA *Index*. And for the diseases of the horse, see FARRIERY *Index*.

**ERA**, in *Chronology*. See ÆRA.

**ERANARCHA**, a public officer among the ancient Greeks, whose business was to preside over and direct the alms and provisions made for the poor. Cornelius Nepos, in his life of Epaminondas, describes his office thus: When any person was reduced to poverty, taken captive, or had a daughter to marry, which he could not effect for want of money, &c. the eranarcha called an assembly of friends and neighbours, and taxed each according to his means and estate, to contribute towards his relief.

**ERANTHEMUM**, a genus of plants belonging to the diandria class. See BOTANY *Index*.

**ERASISTRATUS**, a celebrated physician, grandson to the philosopher Aristotle. He discovered by the motion of the pulse the love which Antiochus had conceived for his mother-in-law Stratonice, and was rewarded with 100 talents for the cure by the father of Antiochus. He was a great enemy to bleeding and violent physic.

**ERASMUS**, DESIDERIUS, born at Rotterdam in 1467. He lost his father and mother at 14 years of age; and was committed to the care of certain guardians, who would force him to be an ecclesiastic, which he refused for a long time. However, he was obliged to assume the religious habit among the canons regular in the monastery of Stein near Tergou; but afterwards obtained a dispensation from his vows. He was the most learned man of the age in which he lived; and contributed, by his example and his writings, to the restoration of learning in the several countries in which he occasionally resided, viz. Italy, Switzerland, Holland, France, and England: with the last, he was most satisfied; and found the greatest encouragement from Henry VIII. Sir Thomas More, and all the learned Englishmen of those days. He published a great many books; and died at Basil in 1536. He was buried honourably, and his memory is still held in veneration. He had, however, many enemies; and as he did not embrace the reformation, and yet censured many things in popery, he hath been treated injuriously both by the Catholics and Protestants. The works of Erasmus in 10 vols folio were published at Leyden in in 1706, in a very handsome manner, under the care of M. le Clerc. Dr Jortin published his life in one vol. 4to, 1758.

ERASTIANS, a religious sect or faction which arose in England during the time of the civil wars in 1647, thus called from their leader Thomas Erastus, whose distinguishing doctrine it was, that the church had no right to discipline, that is, no regular power to excommunicate, exclude, censure, absolve, decree, or the like.

ERATO (from ερω, *I love*), in *Mythology*, the name of one of the nine muses, who presided over love-poetry. To this muse some have ascribed the invention of the lyre and lute; and she is represented with a garland of myrtles and roses, holding a lyre in one hand and a bow in the other, and at her side a Cupid with his torch. There is also a Nereid of the same name.

ERATOSTHENES, a Cyrenæan philosopher, historian, and poet; called for his learning *Plato Minor*. He was keeper of the famous library at Alexandria; and was greatly in favour with Ptolemy Euergetes, by whose order he wrote a history of the Theban kings of Egypt, which succession was entirely omitted by Manetho. He thus fixed the Egyptian chronology, and his authority is by many preferred to that of Manetho. He wrote many other things, a catalogue of which is to be seen in Fabricius, Vossius, &c. but his only piece now remaining entire is a description and fabulous account of the stars. He starved himself in old age through grief for the dimness of his sight, about the 10th or 12th year of Ptolemy Epiphanes, 194 B. C.

ERATOSTRATUS, an Ephesian who burnt the famous temple of Diana the same night that Alexander the Great was born. This burning, as some writers have observed, was not prevented or seen by the goddess of the place, who was then present at the labour of Olympias, and at the birth of the conqueror of Persia. Eratostratus did this villany merely to eternize his name by so uncommon an action.

EREBUS Ερεϐος, (from ערב, *night*), in *Mythology*, a term denoting darkness. According to Hesiod, Erebus was the son of Chaos and the night, and the father of the day. This was also the name of part of the *inferi* among the ancients; they had a peculiar expiation for those who were detained in Erebus.

Erebus was properly the gloomy region, and distinguished both from Tartarus the place of torment, and Elysium the region of bliss: according to the account given of it by Virgil, it forms the third grand division of the invisible world beyond the Styx, and comprehends several particular districts, as the *limbus infantum*, or the receptacle for infants; the *limbus* for those who have destroyed themselves; the fields of mourning, full of dark groves and woods, inhabited by those who died for love; and beyond these, an open champaign country for departed warriors.

ERECTION, in a general sense, the art of raising or elevating any thing; as the erection of a perpendicular, &c. It is also used in a figurative sense; as the erection of a bishopric, marquisate, &c.

Erection is particularly used by medical writers for the state of the penis when swelled and distended by the action of the muscles called *erectores*. See Anatomy *Index*.

There is also an erection of the clitoris, which is performed by muscles for that purpose.

EREMIT. See Hermit.

ERETRIA, in *Ancient Geography*, a town of Eubœa, situated on the Euripus, in the south-west of the island. A very ancient city, and the largest of the island, after Chalcis. After being demolished by the Persians, it was restored on an adjoining spot, according to Strabo, who mentions a school of Eretrian philosophers there. The Abantes of Homer were of Eubœa.

ERFORT, a town of Germany, in the circle of Upper Saxony, the capital of Thuringia, and subject to the elector of Mentz. It is defended by good ramparts; and has a castle on an eminence, which commands the town. Its inhabitants are almost all Lutherans, but its principal churches belong to the Catholics. There are several handsome structures, both public and private; but the houses in general are but indifferently built. E. Long. 11. 14. N. Lat. 50. 49.

ERGASTULUM, among the Romans, was a prison, work-house, or house of correction, where slaves by the private authority of their masters were confined and kept for their offences to hard labour. The Greeks had a place of confinement of this sort called Σωφρονιστηριον.

ERGOT, in *Farriery*, is a stub, like a piece of soft horn, about the bigness of a chesnut, placed behind and below the pastern joint, and commonly hid under the tuft of the fetlock. See Farriery *Index*.

ERICA, Heath, a genus of plants belonging to the octandria class, and in the natural method ranking under the 28th order, *Bicornes*. See Botany *Index*.

ERIDANUS, in *Ancient Geography*, a river of Attica, falling into the Ilissus.—Another Eridanus, the more ancient name of the Padus, an appellation ascribed by Pliny to the Greeks; followed in this by Virgil. It rises in Mount Vesulus, in the Alpes Cottiæ, and dividing the Cisalpine Gaul into the Cispadana and Transpadana, and swelled on each hand with no inconsiderable rivers from the other Alps and the Apennines, falls by seven mouths into the Adriatic. Famous in mythology, from the story of Phaëton; whose sisters, the Heliades, were here changed into poplars, according to Ovid.

Eridanus, in *Astronomy*, a constellation of the southern hemisphere, in form of a river.—The stars in the constellation Eridanus, in Ptolemy's catalogue, are 34; in Tycho's, 19; and in the British catalogue, 84.

ERIE, a vast lake to the westward of Pennsylvania, in North America, situated between 80° and 87° W. Long. and between 41° and 42° N. Lat.

ERIGENA, or Scotus, John, a famous scholastic divine, born about the beginning of the ninth century; but where, is a matter of dispute among authors. Bale and Pits say he was born at St David's in Wales; Dempster, Mackenzie, and Henry, that he was born at Ayr in Scotland; which they infer from his names *Erigena* and *Scotus*, by the latter of which he was generally distinguished by his cotemporary writers. But Du Pin and Sir James Ware assert that he was by birth an Irishman; Ireland being in those days called *Scotia*, and by the natives *Erin*. They agree, however, in relating that he travelled to Athens, where he acquired a competent knowledge of the Greek and other oriental languages; and that he afterwards resided many years in the court of Charles the Bald, king of France, who, on account of his singular abilities, treated him as his intimate friend and companion. He slept frequently in the royal apartment; and was constantly admitted to the king's table. "We may judge (says a modern historian) of the freedom which he used with Charles, by the following repartee. As the king and Scotus were sitting one day at table, opposite to each other, after dinner, drinking a cheerful glass, the philosopher having said something that was not quite agreeable to the rules of French politeness, the king in a merry humour asked him, Pray what is between a *Scot* and a *sot*? To which he answered, "Nothing but the table." See *Henry's History of Great Britain*, vol. i. p. 344, who quotes this story from *Hovedeni Annal. ad ann.* 86. Quer. What language were they talking when this *bon mot* was uttered?

During his residence with Charles, he wrote several books of scholastic divinity; which, though absurd enough, were at that time not sufficiently so to secure him from the reputation of heterodoxy; and on that account the pope commanded Charles the Bold to send him to Rome; but the king had too great a reward for his companion to trust him with his Holiness. One of the chief controversies in which Scotus was engaged, and with which the pope was much offended, was concerning the real presence and blood of Christ in the wafer. His opinion of this weighty matter is expressed in these few words: "What we receive corporally is not the body of our Lord; but that which feeds the soul, and is only perceived by faith." He was also engaged in two other controversies of equal importance, but of a somewhat less delicate nature. The first was, Whether any part of the eucharist be evacuated by stool? and the second, Whether Christ was born of the Virgin Mary *aperta vulva*? Paschasius was of opinion, that this could not be without some injury to her perpetual virginity; and therefore believed that Christ came into the world *per vulvam clausam*, as he came into the place where his disciples were assembled, through the door, and not through the wall, without opening the door. Concerning the first of these delicate questions, Scotus with several others declared, that part of the eucharist was certainly evacuated by stool; for which they were honoured with the appellation of *Stercorists*. And as to the second question, he said, that the *vulva clausa* was a dangerous opinion: for it would thence follow, that he was not born, but issued; *non est nasci, sed erumpi*. See Mackenzie, vol. i. p. 55.

Whether this John Scotus returned to England, or ended his days in France, is a matter of doubt. Some of our historians tell us, that he left France in the year 864; and that, after residing about three years in Oxford, he retired to the abbey of Malmsbury, where his scholars stabbed him with their pen knives. There is no foundation for this story. Probably he died about the year 874; but whether in France or England, is uncertain, and of little importance. Some have related, that he was invited to England by King Alfred: but in this they confounded him with John, abbot of Etheling, who was assassinated in 895; and to this mistake the various accounts concerning this author are to be attributed. Regardless of his history, he appears from his writings to have been a man of parts, and, in point of learning, superior to any of his cotemporaries. He wrote, 1. *De divisione naturæ*, lib. v. 2. *De prædestinatione Dei*. 3. *Excerpta de differentiis & societatibus Græci Latinique verbi*. 4. *De corpore et sanguine Domini*. 5. *Ambigua S. Maximi, seu scholia ejus in difficiles locos S. Gregorii Nazianzeni, Latinè versa*. 6. *Opera S. Dionysii quatuor in Latinam linguam conversa*. All published. 7. *De visione Dei*, and several other works, in manuscript, preserved in different libraries.

ERIGERON, FLEA-BANE, a genus of plants, belonging to the syngenesia class; and in the natural method ranking under the 49th order, *Compositæ*. See BOTANY *Index*.

ERIGONE, in fabulous history, daughter to Icarius, died of grief for her father's death, was translated into heaven, and makes the sign Virgo.

ERINACEUS, or HEDGE-HOG, a genus of quadrupeds belonging to the order of *feræ*, in the class mammalia. See MAMMALIA *Index*.

ERINGO. See ERYNGIUM, BOTANY *Index*.

ERINUS, a genus of plants belonging to the didynamia class; and in the natural method ranking under the 40th order, *Personatæ*. See BOTANY *Index*.

ERIOCAULON, a genus of plants belonging to the triandria class; and in the natural method ranking with the sixth order, *Ensatæ*. See BOTANY *Index*.

ERIOCEPHALUS, a genus of plants, belonging to the syngenesia class; and in the natural method ranking under the 49th order, *Compositæ*. See BOTANY *Index*.

ERIOPHORUM, a genus of plants, belonging to the triandria class; and in the natural method ranking under the third order, *Calamariæ*. See BOTANY *Index*.

ERITHALIS, a genus of plants, belonging to the pentandria class; and in the natural method ranking with those of which the order is doubtful. See BOTANY *Index*.

ERIVAN, a city of Persia, in Asia, and capital of Persian Armenia. It is a large, dirty, ill-looking place, in which are no handsome buildings, the houses being very mean, and raised with earth or mud; but it is full of gardens and vineyards. It is situated in a plain which is surrounded on all sides with mountains. Two rivers pass near it, the Zengui to the north-west, and the Queur Boulac to the south-west. The fortress may pass for a town of itself; it is of an oval form, and is four miles in circumference, containing about 800 houses. It is inhabited by none but the native Persians. The Armenians have shops in it, where they work and trade in the day time, but at night return to their habitations in the city. The fortress is surrounded with three walls, made with bricks dried in the sun, which have battlements, and are flanked with towers, and defended with ramparts. On the north-east there is a dreadful precipice, above 200 yards in depth, at the bottom of which the river runs. The garrison usually consisted of 2000 men; but how many there are since the revolution is hard to say. The palace of the governor of the province is within the fortress. The city is about a cannon's shot distant from the fortress, and the space between is full of houses and markets. E. Long. 44. 50. N. Lat. 40. 20.

**ERIPHYLE**, in fabulous history, a sister of Adrastus king of Argus, who married Amphiaraus. She was daughter of Talaus and Lisimache. When her husband concealed himself that he might not accompany the Argives in their expedition against Thebes, where he knew he was to perish, Eriphyle suffered herself to be bribed by Polynices with a golden necklace which had been formerly given to Hermione by the goddess Venus, and she discovered where Amphiaraus was. This treachery of Eriphyle compelled him to go to the war; but before he departed, he charged his son Alcmæon to murder his mother as soon as he was informed of his death. Amphiaraus perished in the expedition; and his death was no sooner known than his last injunctions were obeyed, and Eriphyle was murdered by the hands of her son.

**ERIS**, the goddess of discord among the Greeks. She is the same as the *Discordia* of the Latins.

**ERISICHTHON**, in fabulous history, a Thessalian, son of Triops, who derided Ceres and cut down her groves. This impiety irritated the goddess, who afflicted him with continual hunger. He squandered all his possessions to gratify the cravings of his appetite, and at last he devoured his own limbs for want of food. Some say that his daughter had the power of transforming herself into whatever animal she pleased, and that she made use of that artifice to maintain her father, who sold her, after which she assumed another shape, and became again his property.

**ERMIN.** See MUSTELA, MAMMALIA *Index*.

ERMIN, or *Ermine*, in *Heraldry*, denotes a white field or fur, powdered or interspersed with black spots, called *powdering*. It is supposed to represent the skin of an animal of the same denomination. There is however no animal whose skin naturally corresponds to the herald's ermin.

The animal is milk white; and so far is it from having spots, that tradition reports, that it will rather die or be taken than sully its whiteness. Whence its symbolical use.

But white skins having for many ages been used for the lining of the robes of magistrates and great men; the furriers at length, to add to their beauty, used to sew bits of the black tails of those creatures upon the white skins, to render them the more conspicuous. Which alteration was introduced into armoury.

The sable spots in ermin are not of any determinate number, but they may be more or less at the pleasure of the painter or furrier.

ERMIN, an order of knights, instituted in 1450 by Francis I. duke of Bretagne, and formerly subsisting in France. The collar of this order was of gold, composed of ears of corn in saltier; at the end of which hung the ermin, with this inscription, *à ma vie*. But the order expired when the dukedom of Bretagne was annexed to the crown of France.

ERMINES, in *Heraldry*, the reverse of ermine, i. e. white spots on a black field.

**ERMINITES**, in *Heraldry*, should signify little ermines, but it is otherwise; for it signifies a white field powdered with black, only that every such spot hath a little red hair on each. Erminites also signify a yellow field powdered with black, which the French express much better by *or semée d'ermine de sable*.

**ERMINOIS**, in *Heraldry*, signifies the field or, and the spots black.

**ERNESTI**, JOHN AUGUSTUS, a late eminent German scholar. See SUPPLEMENT.

**EROORO.** See ALCEDO, ORNITHOLOGY *Index*.

**EROS**, (of ερως, "love"), in *Mythology*, one of two chiefs over all the other Cupids, being the cause of love. See ANTEROS.

**EROTIA**, a festival in honour of Eros the god of love. It was celebrated by the Thespians every fifth year with sports and games, when musicians and others contended. If any quarrels or seditions had arisen among the people, it was then usual to offer sacrifices and prayers to the god, that he would totally remove them.

**EROTIC** (derived from ερως, "love;" whence ερωτικος), is applied to any thing which has a relation to the passion of love. In medicine we find the phrase *delirium eroticum* used for a kind of melancholy contracted through excess of love.

**EROSION**, among physicians, denotes much the same with CORROSION, only in a stronger degree.

**EROTESIS.** See ORATORY, N° 94.

**ERPENIUS**, THOMAS, in Dutch THOMAS of ERPE, a celebrated professor of the Arabic language, was born at Gorcum in Holland in 1584, and educated at Leyden. He applied himself to the oriental languages at the persuasion of Joseph Scaliger; and afterwards travelled into England, France, Italy, and Germany, and everywhere obtained the esteem of the learned. On his return to Holland, he was made professor of Arabic in the university of Leyden, and died there in 1624. He published a great many excellent works, which spread his reputation through the whole learned world. It is said, that the king of Morocco admired so greatly the letters of Erpenius wrote to him in Arabic in the name of the United Provinces, that he could not cease reading them, and showing them to those who spoke that language naturally.

# ERPETOLOGY.

## INTRODUCTION.

THE animals of which we propose, under the general title *Erpetology*, to give the classification and natural history, belong to the class *Amphibia*, and the order *Reptilia*, in the Linnæan arrangement. The animals included under this class have obtained the denomination of amphibious, from the supposed circumstance that they are equally capable of living both on land and in the water. But in this view, the application of the term is inaccurate, for there are few, or perhaps no animals belonging to this class which can always exist, or even perform the functions of life for any considerable length of time, in the water. Many of them, however, possess this faculty to a certain degree, and therefore, the name has been extended to all which are distinguished by the same peculiarity of external form, and a similar structure of external organs.

Some naturalists have denominated this order of animals *oviparous quadrupeds*. This denomination is undoubtedly sufficiently characteristic; for although some species are viviparous, and in this circumstance, as well as being furnished with four feet, exhibit some resemblance with the higher order of quadrupeds, the striking difference which is discovered by the anatomist and the physiologist, affords unequivocal and decided marks of distinction. From the structure, habits, and general economy of this order of animals, we derive characters which are sufficiently distinctive between it and the class of birds, to which the term *oviparous* is strictly applicable. This denomination, therefore, which is also employed by the Count de la Cepede, is sufficiently characteristic of the class of animals which are included under it.

The word *reptile*, by which this order of animals has been distinguished by Linnæus, seems not to be liable to much objection. All the individuals of which it is composed have short legs, and these are placed at a great distance from each other, and so weak, that they are unable to support the weight of the body. The gray lizard, for instance, which is one of the most active of the tribe, is obliged to support itself on its belly, as soon as its progressive motion is greatly diminished; so that it employs its limbs rather for the purpose of crawling than that of walking. And indeed all the animals of the order, from the peculiar structure and disposition of their limbs, when their motions are slow, must drag the body along on the belly, other modifications of their locomotive powers depending only on the great length and relation of the instruments of motion. In this view, therefore, the Linnæan name of the order is not improperly applied to almost all the individuals which it comprehends.

The term *erpetology*, which we have given to this treatise upon the order *reptilia*, was formerly employed by the Swedish naturalist Klein, in a more extensive sense. Under this title he included the order *serpentes*, as well as that of *reptilia*, thus comprehending the whole class of *amphibia*. Here we have adopted it in a more limited acceptation, and confined its meaning to the last order, pursuing the plan of M. Bonnaterre, in his arrangement of the same order of animals in the Encyclopedie Methodique.

Linnæus has adopted as a mark of distinction of this order of animals, the peculiar structure of the heart, which in the language of the anatomist is said to be *unilocular*, or furnished only with one ventricle or cavity. This doctrine has been admitted by eminent anatomists, as well as by some of the greatest physiologists, such as Boerhaave, Haller, and some others; and called in question only when some exceptions have occurred, of animals belonging to this tribe, which have exhibited somewhat of a different structure. One instance of this is quoted in the heart of an Indian inland ortoise, which was examined by the French academicians of the 17th century, and in which they discovered three ventricles instead of one. But other physiologists are of opinion, that the heart of this order of animal is really furnished with two ventricles, having an immediate communication between them; they mus therefore be considered as having a double heart.

The lungs of the order of *reptilia*, are, in their appearance and structure, widely different from those of other animals. They are in general composed of two large bladders, or membranaceous bags, which, in the different species, are divided into a greater or smaller number of *cancelli*, or subdivisions; among which are distributed the pulmonary blood-vessels. These bear but a small proportion to the vesicular part through which the ramifications are carried; in this respect differing greatly from the lungs of the higher order of quadrupeds, or *mammalia*, in which the proportion of the blood-vessels is so much greater than that of the air-cells, that the lungs have more of a fleshy than of a membranaceous appearance. In this order of animals, therefore, in which the blood is cold, the vesicular system far overbalances the vascular; but in the class *mammalia*, which are warm-blooded animals, the vascular system prevails over the vesicular.

Of all the animals which occupy the surface of the earth, and which the Almighty creator has dispersed throughout his works, to fill up the void space, and to produce motion, the tribe of reptiles seems at first sight to have been least the objects of beneficence and wisdom. In their structure, habits, and modes of life, when compared with other orders of animals, they exhibit marks of degradation and neglect. The body in general presents only a rude inactive mass; their senses are extremely obtuse; their instincts are limited to the grossest sensations, and the extent of their enjoyments reaches only to the gratifications of appetite. On the boundaries of land and water, in those vast morasses, which are remarkable only for immense depositions of mud, few or scarcely any possess the graces or elegance of other terrestrial animals; like the latter they enjoy not the pleasure of associating together for amusement or defence; or of indulging in sportive tricks on the land or in the air. On the contrary, they crawl on the earth, on the margin of extensive lakes, surrounded with unwholesome vapours; or they live in the cavities of the rocks, or in the midst of barren deserts, undisturbed by other animals, and far retired from the habitations of man. Some delight in exposing themselves to the rays of the sun; while others retire during the day to shady, moist, and sequestered places, proceeding from their retreats only during the night, as it were to conceal their deformity, and to spare man those feelings of fear, disgust, and horror, with which their presence inspires him. But as the study of every part of the long chain of beings is worthy of our attentive consideration and regard, these animals, in the eyes of the careful observer of nature, are far from being wanting in exciting his interest and curiosity. He cannot fail to be highly gratified with contemplating the resources which they derive from the peculiar structure of their external form, as well as from the nature of their functions. Their manners, their habits, and the relations which they bear to beings of a higher order, on the one hand, and the distance to which they are removed from brute matter on the other, are objects worthy of the contemplation of the naturalist. This study, properly directed and applied, unveils to our eyes the beneficent design

design and riches of creation, and raises our admiration to the wonderful and extensive variety of animated beings.

The uses of some of the animals belonging to this class, as valuable articles of food in those regions where they abound, or as furnishing the tables of the luxurious in other countries with a rich delicacy; the peculiarities of external form, and of internal structure, as well as of several of their functions, such as circulation and respiration; their great length of life; the reproductive power of some, and the long abstinence which others can undergo, give additional interest and importance to the natural history of these animals.

In the following treatise, we propose to lay before our readers a brief but comprehensive view of the natural history of this order of animals; and for the sake of perspicuity we shall treat this subject under two general heads. We shall first consider the classification and natural history of the order *reptilia*; and secondly, we shall give a short sketch of their anatomy, with the principal facts connected with their physiology. These will form the subjects of the two following chapters.

## CHAP. I. OF THE CLASSIFICATION AND NATURAL HISTORY OF REPTILES.

IN the Linnæan arrangement, the order *reptilia* is divided into four genera. Other naturalists have adopted a different arrangement. De la Cepede, in his history of oviparous quadrupeds, has divided this order into two great classes. The first class includes those animals which are furnished with a tail, and the second comprehends those which have no tail. The following table exhibits a view of the classification of this eminent naturalist.

- Class I. Animals furnished with a tail.
    - Genus 1. *Tortoises*, having the body covered with a bony shield.
        - Division 1. The fingers very unequal, and lengthened out in the form of fins.
        - Division 2. The fingers very short, and almost equal.
    - Genus 2. *Lizard*: the body having no bony covering.
        - Division 1. The tail flattened; five fingers on the fore feet.
        - Division 2. The tail round; five fingers on each foot, and elevated scales on the back.
        - Division 3. The tail round; five fingers on the fore feet; scaly bands under the belly.
        - Division 4. The tail round; five fingers on the fore feet, without scaly bands under the belly.
        - Division 5. The fingers furnished underneath with large scales, covering each other, like the slates on the roof of a house.
        - Division 6. Three fingers on the fore and the hind feet.
        - Division 7. Membranes in the form of wings.
        - Division 8. Three or four fingers on the fore feet; four or five fingers on the hind feet.
- Class II. Animals which have no tail.
    - Genus 1. *Frogs*: the head and the body lengthened out, and the one or the other angular.
    - Genus 2. *Tree-frogs*: the body long, with soft viscid tubercles under the toes.
    - Genus 3. *Toads*: the body thick and round.
    - Appendix. Biped reptiles.
        - Division 1. Two fore feet.
        - Division 2. Two hind feet.

Of this arrangement it may be observed, that, although it exhibits much minuteness and ingenuity, the distinctive characters upon which some parts of it are founded, are not always constant and fixed; for it has been found that these characters vary in the different individuals in which they have been observed. This variety, it has been conjectured, arises from the difference of age, and peculiarities in their food and modes of life.

M. Bonnaterre has adopted a different arrangement. He has also divided the whole order of reptiles into two classes, as will appear from the following table.

- Class I. Reptiles which have no tail.
    - Genus 1. *Frog*.
    - Genus 2. *Tree Frog*.
    - Genus 3. *Toad*.
- Class II. Reptiles which are furnished with a tail.
    - Genus 1. *Tortoise*.
    - Genus 2. *Chamelion*.
    - Genus 3. *Crocodile*.
    - Genus 4. *Lizard*.
    - Genus 5. *Flying dragon*.
    - Genus 6. *Salamander*.
    - Genus 7. *Chalcis*.

This arrangement is undoubtedly, in many cases, convenient and proper; yet, as there seems to be in others an unnecessary multiplication of genera, we shall still adhere to the Linnæan classification, which, though more simple, will in general be found not to be much less accurate; and the objects which it comprehends not being very numerous, it is sufficiently distinct. Linnæus divided this order into four genera. The following are the characters of the genera, of which we give a translation, for the accommodation of the English reader.

## GENERIC CHARACTERS.

Genus. I. Testudo. Corpus caudatum; lorica ossea aut coriacea supernè et infernè, vel squamis supernè obtectum. Oris mandibula superior inferiorem pyxidum instar claudens.

Genus I. Tortoise. Body having a tail; covered above and beneath with a bony or coriaceous shell, or scales above. The upper jaw closing over the lower like the lid of a box.

| | |
|---|---|
| Genus II. **Rana.** Corpus tetrapodum, nudum, et plurimum ecaudatum: pedibus posterioribus longioribus. | Genus II. **Frog.** Body four-footed, naked, generally without tail; the hinder feet longest; *and without any integument but the skin.* |
| Genus III. **Draco.** Corpus tetrapodum, caudatum, alatum: alis propriis. | Genus III. **Flying Dragon.** Body four-footed, furnished with a tail, and on each side with an expansile wing-like skin. |
| Genus IV. **Lacerta.** Corpus tetrapodum, elongatum, caudatum, nudum: pedibus æqualibus. | Genus IV. **Lizard.** Body four-footed, elongated, furnished with a tail, without any additional integument: legs equal. |

## I. TESTUDO, or TORTOISE.

FROM the great similarity which prevails among several species, and the variety in size, colour, and other circumstances, according to the different periods of their age, considerable difficulties have arisen in discriminating them with precision. The observations of later naturalists have shown, that the specific characters of Linnæus are not sufficient for the purpose of accurate distinction; nor have the descriptions of the Count de la Cepede been more useful in furnishing proper characteristic marks. One set of characters, which have been usually employed for this purpose, it has been observed by Mr Schoepff, ought not to be trusted. They are derived from the number of claws on the feet of marine tortoises, or turtles. These, however, are found to vary so much, that they are not to be considered as affording uniform and constant characters of distinction. As a proof of this observation, if different individuals of the common green turtle (*testudo midas*), be compared together, it will appear that some have only a single claw on each foot; while others are furnished with two, and sometimes three; sometimes with two on the fore feet, and with one on the hind feet. Similar variations have also been observed in the number of claws of land tortoises, and particularly in those of the common tortoise, (*testudo græca*); in some individuals of which the fore feet have four, and in others five claws. Avoiding, therefore, these uncertain and varying characters, the shape, pattern, colours of the shell, and form of the head, Dr Shaw observes, furnish the most accurate marks of distinction.

Some of the species belonging to this genus are natives of the ocean; some are confined to the land, or to fresh water. This affords a natural division into land and sea tortoises. In following out this division, we shall treat of them in two sections, including under the first those that frequent fresh waters.

### SECT. I. *Land and Fresh-water Tortoises.*

1. **TESTUDO GRÆCA.** Lin. *Common Land Tortoise.*

*Specif. Char.*—The shell is hemispherical, and of a black and yellow colour, and having a bunch behind; the pieces of which the disk is composed are convex, and the sides are obtuse.

Description. The length of the common tortoise is about six inches, and rarely exceeds eight: when full grown, it is about forty-eight ounces weight. The shell is composed of thirteen middle pieces, and about twenty-five marginal ones; is of an oval form, and very convex above. The middle pieces, or those which constitute the disk of the shield, are mostly of a square form, somewhat oblong; their colour is blackish or dark brown, each having a broad yellow band running along one side, which is continued half way along the upper part. The colours vary in different individuals, and the shape of the pieces is also subject to occasional variations. The sulci or furrows which appear on the surface of young animals are obliterated as they grow old. The belly part of the shell is of a pale yellow colour; the head is rather small, the upper part covered with irregular tough scales, and the neck with smaller pieces, which admit of the motion of the head; the eye is small and black, and the mouth does not extend beyond the eyes. The legs are short; and the feet, which are moderately broad, are covered with strong ovate scales. The feet have usually four stout claws, but their number is found to vary in different circumstances. The tail is rather shorter than the legs, is covered with small scales, and terminates in a naked, horny, pointed tip.

Native country. The land tortoise is a native of almost all the countries round the Mediterranean; but it has been supposed to be more frequent in Greece, from whence it has derived its specific name. It is also found in the islands of the Archipelago, in Corsica, Sardinia, and in many parts of Africa. From the account of the Danish naturalist Forskal, it is employed in Greece for the purpose of food. "The inhabitants," he says, "often swallow the blood recent, and eat the eggs boiled, which are about the size of those of a pigeon, four or five in number, and of a white colour. In September the animal hides itself under ground, and again emerges in February; laying its eggs in June, in a small hole, which it scratches in some sunny spot, out of which, after the first rains of September, the young are hatched, which are about the size of a walnut. The males of this species are said to fight often, butting at each other with such force, as to be heard at a considerable distance."

The land tortoise, when it is kept in gardens in Italy and Germany, is commonly observed to conceal itself in October, and to reappear in April. The period of retirement in England is about the end of October, and the time of its appearance is about the middle of April; but it ought to be added, that these periods vary in different countries, and according to the temperature of the season.

Grea The land tortoise lives to a very great age. In several instances which seem to be well authenticated, it has considerably exceeded the extraordinary period of an hundred years. One instance, which is perhaps not the least remarkable, is recorded of a tortoise which was introduced into the archbishop's garden at Lambeth,

beth, about the year 1633, and lived till the year 1753; the shell of which is still preserved in the library of the palace at Lambeth. Another remarkable circumstance respecting this individual is, that it was of a larger size than usual. The shell measured 10 inches in length, and six and a half in breadth.

Very tenacious of life.

None of this order of animals is more tenacious of life than the tortoise. The experiments of Redi afford a remarkable proof of this fact. In the beginning of November he made a large opening in the skull of a land tortoise, extracted the whole of the brain, washed out the cavity, that no part might remain; and having left the hole open, let the animal go. It walked off seemingly uninjured, excepting that it closed its eyes, which never afterwards opened. At the end of three days, during which time the hole of the skull began to close, the wound was covered with a complete skin; and thus without brain it walked about as usual, and lived for six months. The same naturalist cut off the head of another tortoise, which lived for the space of twenty-three days afterwards.

Abstinence.

This animal is not less remarkable for its abstinence. Blasius kept an individual of this species for ten months, during which time it tasted no kind of food whatever. It died about the end of that time, but this was ascribed to the severity of the season, rather than to the want of food; for the intestines being examined, they were found full of excrement of the natural colour.

Mr White, in his Natural History of Selborne, has given so full and distinct an account of the natural history of the land tortoise, founded on facts drawn from his own observation, that we shall lay it before our readers in his own words.

White's account of one.

"A land tortoise (says he), which has been kept for thirty years in a little walled court belonging to the house where I now am visiting, retires under ground about the middle of November, and comes forth again about the middle of April. When it first appears in the spring it discovers very little inclination towards food; but in the height of summer grows voracious: and then as the summer declines, its appetite declines; so that for the last six weeks in autumn, it hardly eats at all. Milky plants, such as lettuces, dandelions, sowthistles, are its favourite dish. In a neighbouring village one was kept, till by tradition it was supposed to be an hundred years old. An instance of vast longevity in such a poor reptile! 135.

"On the 1st of November, I remarked that it began first to dig the ground in order to the forming its hybernaculum, which it had fixed on just beside a great tuft of hepaticas. It scrapes out the ground with its fore-feet, and throws it up over its back with its hind; but the motion of its legs is ridiculously slow, little exceeding the hour-hand of a clock; and suitable to the composure of an animal said to be a whole month in performing one feat of copulation. Nothing can be more assiduous than this creature night and day in scooping the earth, and forcing its great body into the cavity; but, as the noons of that season proved unusually warm and sunny, it was continually interrupted, and called forth by the heat in the middle of the day; and though I continued there till the thirteenth of November, yet the work remained unfinished. Harsher weather, and frosty mornings, would have quickened its operations. No part of its behaviour ever struck me more than the extreme timidity it always expresses with regard to rain; for though it has a shell that would secure it against the wheel of a loaded cart, yet does it discover as much solicitude about rain as a lady dressed in all her best attire, shuffling away on the first sprinklings, and running its head up in a corner. If attended to, it becomes an excellent weather-glass; for as sure as it walks elate, and as it were on tiptoe, feeding with great earnestness in a morning, so sure will it rain before night. It is totally a diurnal animal, and never pretends to stir after it becomes dark. The tortoise, like other reptiles, has an arbitrary stomach as well as lungs; and can refrain from eating as well as breathing for a great part of the year. When first awakened it eats nothing; nor again in the autumn before it retires: through the height of the summer it feeds voraciously, devouring all the food that comes in its way. I was much taken with its sagacity in discerning those that do it kind offices: for, as soon as the good old lady comes in sight who has waited on it for more than thirty years, it hobbles towards its benefactress with awkward alacrity; but remains inattentive to strangers. Thus not only "*the ox knoweth his owner, and the ass his master's crib,*" but the most abject reptile, and torpid of beings, distinguishes the hand that feeds it, and is touched with the feelings of gratitude! *Ibid.* p. 158.

"The old Sussex tortoise, (he adds), that I have mentioned so often, is become my property. I dug it out of its winter dormitory in March last, when it was enough awakened to express its resentment by hissing; and packing it in a box with earth, carried it eighty miles in post-chaises. The rattle and hurry of the journey so perfectly roused it, that when I turned it out on a border, it walked twice down to the bottom of my garden; however, in the evening, the weather being cold, it buried itself in the loose mould, and continues still concealed.

"As it will be under my eye, I shall now have an opportunity of enlarging my observations on its mode of life and propensities; and perceive already that, towards the time of coming forth, it opens a breathing place in the ground near its head, requiring, I conclude, a freer respiration as it becomes more alive. This creature not only goes under the earth from the middle of November to the middle of April, but sleeps great part of the summer; for it goes to bed in the longest days at four in the afternoon, and often does not stir in the morning till late. Besides, it retires to rest for every shower; and does not move at all in wet days.

"When one reflects on the state of this strange being, it is a matter of wonder to find that Providence should bestow such a profusion of days, such a seeming waste of longevity, on a reptile that appears to relish it so little as to squander more than two-thirds of its existence in a joyless stupor, and be lost to all sensation for months together in the profoundest of slumbers.

"While I was writing, a moist and warm afternoon, with the thermometer at 50, brought forth troops of shell-snails; and at the same juncture, the tortoise heaved up the mould, and put out its head; and the next morning came forth, as it were raised from the dead, and walked about till four in the afternoon. This was a curious coincidence! a very amusing occurrence! to see such a similarity of feeling between the two *φερέοικοι!* for so the Greeks called both the shell-snail and the tortoise. Ibid p 261.

"Because we call this creature an abject reptile, we are too apt to undervalue his abilities, and depreciate his powers of instinct. Yet he is, as Mr Pope says of his lord,

> ——"Much too wise to walk into a well:"

and has so much discernment as not to fall down a haha; but to stop and withdraw from the brink with the readiest precaution.

"Though he loves warm weather, he avoids the hot sun; because his thick shell, when once heated, would, as the poet says of solid armour, "scald with safety." He therefore spends the more sultry hours under the umbrella of a large cabbage-leaf, or amidst the waving forests of an asparagus-bed.

"But as he avoids heat in the summer, so, in the decline of the year, he improves the faint autumnal beams, by getting within the reflection of a fruit-wall: and, though he has not read that planes inclining to the horizon receive a greater share of warmth, he inclines his shell, by tilting it against the wall, to collect and admit every feeble ray.

"Pitiable seems the condition of this poor embarrassed reptile: to be cased in a suit of ponderous armour, which he cannot lay aside; to be imprisoned, as it were, within his own shell, must preclude, we should suppose, all activity and disposition for enterprise. Yet there is a season of the year (usually the beginning of June) when his exertions are remarkable. He then walks on tiptoe, and is stirring by five in the morning; and, traversing the garden, examines every wicket and interstice in the fences, through which he will escape if possible: and often has eluded the care of the gardener, and wandered to some distant field. The motives that impel him to undertake these rambles seem to be of the amorous kind: his fancy then becomes intent
Ibid p. 427. on sexual attachments, which transport him beyond his usual gravity, and induce him to forget for a time his ordinary solemn deportment."

### 2. TESTUDO MARGINATA, *Marginated Tortoise.*

*Specif. Char.*—The shell is blackish-brown, variegated with yellow, oblong, and gibbose, widened and depressed on the hinder part.

The length of this species is nearly fourteen inches, the breadth about ten, measuring the curvature of the shell. The head, which is flat and triangular above, is nearly two inches long, above an inch broad, and one inch deep. The eyes are furnished with a nictitating membrane; but the lower eyelid only is moveable. The mandibles are strong, notched, and internally beset with protuberances which have been sometimes mistaken for teeth. The external orifices of the ears are covered with the common skin. The tail is very short. The fore legs are about three inches and a half long; the hind legs are about two and a half long. The skin is grainy, and covered with brown coloured, unequal, hard scales, extending over the head, legs, and tail. Some of these scales on the ends of the feet are large, hard, and pointed; so that at first sight they might be taken for claws. The feet are thick, and so covered with the investing membrane, that the toes are only distinguished.

The disk of the shell is composed of thirteen pieces, which are striated on the margin. The border consists of twenty-four pieces; all of which, especially the posterior ones, are proportionally larger than in the other species. From the position of the latter, the circumference of the upper shell appears toothed. The upper shell is very convex, being more than four inches deep: in consequence of this form, when the animal is placed on its back, it can recover its former situation.

The colour of this species is generally dark, or blackish-bay. The convex part of the pieces which compose the disk are irregularly varied with yellow. The pieces are also variegated with the same colour. This prevails chiefly on the posterior divisions, and these are distinctly striated or furrowed. The width or dilatation of these divisions, being greater than in other species, constitutes the principal characteristic mark of the present. The colour of the under shell is pale yellow; each division is marked on its upper joining with a transverse blackish band, which runs into a pair of pointed or triangular processes, extending nearly to the inferior division. Another specific difference between this and the common tortoise is, that in the former the outline of the shell, seen from above, is proportionally longer, and has a slight sinking or contraction on each side.

It is supposed that this species is a native of America, but this seems not to be certainly determined; and little, or scarcely any thing, is known of its natural history.

### 3. TESTUDO GEOMETRICA, *Geometrical Tortoise.*

*Specif. Char.*—The shell is black and ovate; the scutella elevated, and radiated with yellow.

The number of pieces of which the disk is composed, is subject to variation. Instead of thirteen, fourteen pieces have been observed in different specimens. These pieces are very prominent, striated distinctly with numerous lines on their sides, and terminated above by a yellowish coloured, flat, hexagonal, roughened space; from which proceed, in a radiated direction, some well defined yellow streaks towards the edge; in this forming on the black ground colour, something like geometrical figures. The marginal pieces are commonly 24, but sometimes 26. They also are streaked with yellow. As in other species, the brightness of the colour is subject to variation, but their regular distribution is never entirely obliterated.

This species, it is said, is a native of Asia, Africa, and also of America; but this seems not to be fully ascertained, which is rather surprising, as its shell is oftener met with in Europe than that of any other species. Thunberg says that it is a native of the Cape of Good Hope, where it frequents shrubby places. It is said also that it is found on the coast of the Pine islands, between the continent of America and Cuba, where they frequent moist and marshy places in the forests. They are very easily taken, and are sought after as food. It is usual for the natives to put a mark on the shield, and then allow them to go about in the woods, finding them again almost as readily as any domesticated animal, when they transport them to Cuba. This species

cies is supposed to be the *terrapin* of Dampier, who gives the above account, and represents it as beautifully variegated.

### 4. Testudo Radiata, *Radiated Tortoise.*

*Specif. Char.*—Shell ovate, black; scutella flattish, and radiated with yellow.

This species has sometimes been confounded with the preceding; it often however exceeds a foot in length, and its outline is nearly smooth. The size of the geometrical tortoise is less, its outline is very much tuberculated, and the pieces of which it is composed rise greatly towards their centres.

According to Grew, it is a native of Madagascar; and its characters correspond nearly with one described by Browne in his history of Jamaica, so that it must also be considered as a native of that island. Grew has given a very particular description of it.

### 5. Testudo Indica, *Indian Tortoise.*

*Specif. Char.*—Shell brown, reflected above the neck; the three upper scutella are marked with a tubercle.

This is a very large species, which was first described by Perrault in the history of animals published by the Royal Academy of France. It measured from the tip of the nose to the tail four feet and a half; the height or convexity was about fourteen inches; the shell itself was in length three feet, and two in breadth; the colour was of a dull brown. The pieces composing the shield were large and dissimilar, of which the three anterior were marked in the middle with a round knob or tubercle, about half an inch wide. The skin of the head, feet, and neck, was wrinkled and granulated; the fore legs were nine inches long, the feet undivided, with five blunt claws; the hind legs were eleven inches long, with four toes, each armed with a claw; the tail six inches thick at the base, fourteen inches in length, and terminating in a horny bent process. This species is a native of the coast of Coromandel.

*Var.* 1. A variety of this species brought from the Cape of Good Hope, is described by Vosmaer: it was about 2½ feet long, 1½ foot broad, one foot high, with thirteen pieces in the disk, and twenty-five in the margin. In this, the three tubercles on the anterior pieces of the shield are wanting.

*Var.* 2. Another variety of this species, of a very large size, has been brought from the South sea islands. The shell, which is of a dull uniform brown, with a smooth surface, is of an ovate oblong form, widening at the bottom, and contracting considerably on each side of the neck. It is at least three feet and a half long; the divisions are all even, but the whole surface of the shell is marked with regular elevations and depressions.

### 6. Testudo Rugosa, *Wrinkled Tortoise.*

*Specif. Char.*—Shell black, wrinkled, mottled, and variegated with yellow; the middle dorsal piece subpanduriform.

This species, of which a specimen is preserved in the Leverian museum, is described by Dr Shaw †. The colour is dark brown, or black, thickly mottled with small confluent spots of pale yellow, which are largest on the sides of the shell. The form of the shell is long and oval, dilated or widened behind; the depth or convexity is very considerable. The three middle divisions of the row of scutella on the back are somewhat panduriform, or fiddle-shaped. The upper piece resembles the outline of a pitcher; the lowest approaches to a hexagonal form. The number of the side pieces is four, of the usual form; that of the marginal pieces is twenty-five, the upper one very small. A carina or ridge runs down the dorsal row; the upper surface of the shell is strongly wrinkled. The under shell is smooth, and of a yellowish white colour, mottled with black. The length of the shell is nine and a half inches; width in the middle five inches. Its native country is unknown.

*Var.* A variety of this species is also described, consisting chiefly in the colours of the shell, and owing, it is supposed, to a sexual difference.

### 7. Testudo Europæa, *Speckled Tortoise.*

*Specif. Char.*—Shell oval, flattish, smooth, dark brown, marked with numerous yellowish specks and streaks. *Testudo orbicularis*, Lin.

This species is from four to five inches long; the colour is blackish or olive brown; the shell flattish, but slightly convex, marked with numerous, oblong, yellow specks, disposed in a radiated form on each division of the shell. The skin of the neck and breast is similarly spotted. The disk consists of thirteen, and the margin of twenty-five pieces. The under shell is of a whitish yellow, tinged with brown at the joints. The head is ovate, somewhat convex above, flattish on the sides and beneath. The skin of the neck is wrinkled and loose. The legs are short, and covered with scales. The feet are webbed, the fore feet having five toes, the hind only four. The claws are sharp pointed and crooked; the tail is nearly half the length of the body, and is thin and compressed.

This species is a native of Italy, Sardinia, France, Hungary, and Prussia, as well as other parts of Europe. It inhabits lakes and muddy waters, feeding on small fish, insects, snails, and aquatic plants. The flesh is esteemed and employed as food, and in some places brought to market for sale. It is sometimes kept in ponds for the purpose, and fed with lettuce leaves, bread, &c. It may be kept in a cellar, and fed with oats scattered on the floor, which it eats as soon as they begin to germinate. In the beginning of spring it deposits its eggs in sandy places, exposed to the sun; and it has been said, that these are not hatched till the spring following. The growth of this animal is extremely slow, and it varies somewhat in colour, according to the climate where it is found.

### 8. Testudo Lutaria, *Mud Tortoise.*

*Specif. Char.*—The shell is flattish, and the tail is half the length of the body.

The length of this species does not exceed seven or eight inches from the tip of the nose to the end of the tail. The breadth is about three or four inches. The disk is composed of 13 pieces, which are striated and slight-

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† *Gen. Zool.* vol. iii. p. 28.

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ly punctated in the centre. A longitudinal ridge runs along the middle range. The margin consists of 23 pieces slightly striated on the edges. The shell is blackish, as well as the skin; the feet are webbed, and have five toes before and four behind.

This species is a native of many parts of Europe; it is also found in different parts of Asia, as in India and Japan. It is very common in France, particularly in Languedoc, and in different parts of Provence. It is said that such numbers were found one time in a lake half a league wide, in the plain of Durance, that the neighbouring peasantry were supported by them for more than three months.

This species always lays its eggs on land, digging a hollow in the ground, and covering the eggs with earth. When the young are first hatched, they are only about half an inch in diameter. The motions of this species are quicker than those of the land tortoise. It continues to grow for a long time, and lives for upwards of 24 years. It has been found useful in gardens, by destroying small snails, and other animals which are destructive to vegetables; but it ought to be observed, that it is disposed to attack and destroy the fish in fish-ponds.

### 9. TESTUDO CARINATA, *Carinated Tortoise.*

*Specif. Char.*—Feet digitated; shell gibbose; four first dorsal scutella carinated; sternum entire.

The shell of this species does not exceed three inches in length. The form is broad, and somewhat orbicular; the colour is brown, and each scutellum is marked with a pale zone of confluent spots, which surround the centre part, the edges of each being surrounded with three or four distinctly marked furrows. Marginal pieces 25 in number, including the uppermost, which is very small. Its native country is unknown.

### 10. TESTUDO CAROLINA, Lin. TESTUDO CLAUSA, Shaw. *Close Tortoise.*

*Specif. Char.*—Shell blackish, irregularly spotted with yellow; dorsal carina obtuse; under shell bivalve, completely inclosing the upper shell.

This species is thus described by Edwards. "The head is furnished with a hard or shelly covering of a dark brown colour on the top; on the sides and throat it is yellow, with small black or dusky spots: its nostrils are near together, a little above the end of the beak: the eyes are of a yellowish colour: the neck is covered with a loose skin of a dark purplish flesh colour, which partly covers the head when it is not fully extended: the hinder legs and parts about the vent are covered with a skin of the same dull flesh colour as the neck: the fore-legs and feet are covered with yellow hard scales: it hath five toes on each foot forwards, and four on each of the hinder feet, all armed with pretty strong claws: the shell above rises pretty much, and is round, divided into separate scales of the horny substance called tortoise shell: each scale is engraven, as it were, with rings round its extremities, which lessen inwards to its centre: the shell above is of a dusky brown colour, with yellowish spots of various forms: underneath it is flattish, and of a yellow colour, with black clouds and spots: it has only the rudiment of a tail, on which the vent is placed: the lower shell is divided across the middle of the belly, and joined to the upper shell by a tough though flexible skin, by which means it can, when it draws in its head and legs, close up its shell as firmly as an oyster." From this peculiarity in its structure, this species has derived its name; and this proves so strong a defence to the little animal, that it seems not only not to receive any injury, from having a weight of five or six hundred pounds laid upon it, but to walk under the load without any inconvenience.

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The length of this species seldom exceeds four or five inches. It is a native of North America, and is chiefly found in marshy situations; but it also sometimes appears in dry and warm places. It lives both on vegetables and animals. Of the latter beetles, mice, and sometimes serpents, are its prey. These it seizes, draws them into its shell, and crushes them to death. It is much in request on account of its eggs, which are esteemed a great delicacy. They are about the size of a pigeon's egg.

### 11. TESTUDO SULCATA, *Sulcated Tortoise.*

*Specif. Char.*—Shell brown, ovate; scutella furrowed, and yellow on each side.

This species exceeds a foot in length, from the tip of the nose to the end of the tail; so that it is one of the larger of the land tortoises. The shell is very convex. The disk is composed of 13 pieces, which are five and six-sided; and each is transversely and strongly furrowed from the lower edge to the upper area; across these run three impressed lines in an opposite direction; the marginal pieces are furrowed in the same manner. The colour of the shell is in general a dull yellow; but both the shield and marginal pieces have a brown and yellowish division. The head is large and covered with six-sided scales of different sizes. The fore and hind legs are also scaly; on the former are five claws, on the latter only four. The tail is very short.

This species is a native of the West Indies; and it is supposed to be the same with the *hicatee* described by Browne in his History of Jamaica.

### 12. TESTUDO TABULATA, *Tabular Tortoise.*

*Specif. Char.*—Shell brown, oblong, gibbous; scutella of the disc rectangular and furrowed, having yellowish coloured centres.

The shape and size of the pieces of which the disc is composed, are more uniform than in any other belonging to this genus. This seems to be the principal mark of discrimination. Each piece is slightly convex, and in general six-sided, excepting some of the pieces towards the sides, which are five-sided. The central part of each piece is large, and slightly granulated, and the sides are distinctly sulcated. The whole has a kind of flattened or tabular appearance: the colour is a yellowish chesnut; it is paler on the centre of each division; the legs are thick, and spotted with red; the number of pieces on the disc is 13, that of the margin 23. The length of the shell is from five to six inches. It is supposed to be a native of Africa; but according to some, it has been found in Brazil.

### 13. TESTUDO CONCENTRICA; *Testudo Palustris*, Lin. *Concentric Tortoise.*

*Specif. Char.*—Shell somewhat depressed, slightly ridged, oval, of a yellow colour; having the scutella marked with brown concentric zones.

The shell of this species is flatter than that of others; in some of the larger specimens nearly smooth: the middle row of pieces, of which the disc is composed, are five in number; they are more elevated than those of the sides, are six-sided, and project behind into an obtuse carina. There are four side-pieces on each side, which are pentagonal. The ground colour of the whole is pale, and marked with brown zones and centres. The shell is from four to six inches long.

This tortoise is a native of North America, and is met with in the markets at Philadelphia, where it is sold under the name of *terrapin.* It is also a native of Jamaica, where it is very common. It is said by Browne, who seems first to have described it, to be a wholesome and delicate food. In that island, it grows to the length of eight or nine inches.

### 14. TESTUDO PICTA, *Painted Tortoise.*

*Specif. Char.*—The shell is oblong, and slightly convex, smooth, and of a brown colour; the scutella are bordered with yellow.

This species is well distinguished from all others, by the remarkable colours of the shield, which consists of 13 segments nearly square, and deeply edged with pale yellow. The marginal pieces are 25 in number. The shell is from four to six inches long.

The painted tortoise frequents fresh waters, and in particular, is found in the slow and deep rivers of North America. In bright sunshine weather they leave the water in great numbers, and bask themselves on stones, pieces of wood, and the banks of the streams, suddenly retreating into the water, when they are disturbed. They walk very slowly, but swim with great rapidity. They can remain for many hours together under the water, but live only a few days in the open air. They are extremely voracious, and are known to destroy young aquatic fowls, seizing them by the feet, and dragging them under water. Sometimes they are employed for the purpose of food.

### 15. TESTUDO GUTTATA, *Spotted Tortoise.*

*Specif. Char.*—Shell oblong, slightly convex, smooth, and of a brown colour, with scattered yellow spots.

This species is also sufficiently distinguished by its remarkable colour. The pieces both of the disc and margin being marked with a few distantly placed round yellow spots. These spots vary, as well as the ground, in different individuals. The young of this species, which itself is small, are not larger than a pigeon's egg, are very black, and beautifully spotted with gold colour.

This tortoise is a native of North America, frequenting lakes and rivers.

### 16. TESTUDO ELEGANS, *Elegant Tortoise.*

*Specif. Char.*—The shell is round, convex, and of a yellow colour, with transverse, oval, brown spots.

This is a very small species, only about two inches long; the shell is of a bright yellow colour, the surface apparently smooth. At each of the joinings which compose the disc, there is a large, leaf-shaped, dark brown transverse spot. The marginal pieces are marked with a transverse black zone; the head is short and thick.

Nothing particular is known of its natural history, or to what country it belongs.

### 17. TESTUDO AREOLATA, *Areolated Tortoise.*

*Specif. Char.*—The shell is slightly convex; the scutella are nearly four-sided, elevated, deeply furrowed, and are furnished with depressed rough areolæ.

The length of this species is from three to four inches. The scutella, which are nearly four-sided, are broader than long, with a pretty large, depressed, central part, which is of a yellow colour, roughish, and surrounded by a pale zone. The margin is composed of 25 pieces; the disc, in some individuals, of 15, and in others of 14.

This tortoise, according to some, is a native of Brazil, according to others, of the East Indies.

### 18. TESTUDO SERRATA, *Serrated Tortoise. Testudo Spengleri*, Lin.

*Specif. Char.*—Shell depressed, of a yellow colour, and minutely freckled with dusky specks. The scutella of the disc are all ridged; the hinder margin of the shell serrated.

This tortoise is considered and described by Dr Shaw as a new species; it is small, only about three quarters of an inch long, and about two inches and a half broad. It is of an oval form, and slightly convex. The colour is of a yellowish brown, and when closely examined, appears thickly marked with minute, confluent, dusky spots. The under shell is blackish, with a yellow margin.

The native country of this species is unknown.

### 19. TESTUDO PUSILLA, *Little Tortoise. African Land Tortoise* of Edwards.

*Specif. Char.*—Shell hemispherical, with convex, trapezoidal scutella, striated on the margin, and dotted on the disc. Feet subdigitated.

The shell of this species measures only about four inches in length. The whole animal, from the tip of the nose to the end of the tail, does not exceed six. This species has a considerable resemblance to the common tortoise, or *testudo græca.* It is particularly described by Edwards, who kept two of them which he received from West Barbary for two years in the garden of the college of physicians in London; but of its natural history, nothing farther is known.

### 20. TESTUDO TRICARINATA, *Tricarinated Tortoise.*

*Specif. Char.*—Shell oval, slightly convex; margin entire; all the scutella of the disc carinated.

This species resembles a good deal the *testudo orbicularis*, Lin. In size it scarcely exceeds that of a large walnut; the colour is blackish; the shell is composed of 13 scutella; the number of the marginal pieces is 23. Each scutella is marked in the middle with a longitudinal ridge, and wrinkled on the sides with several furrows and roughish points.

Its native place, and its natural history, are unknown.

### 21. Testudo Scabra, *Rough Tortoise.*

*Specif. Char.*—Shell flattish, the intermediate scutella elevated on the back; feet palmated.

This tortoise is about two inches and a half in length, and nearly two in breadth. Its form is somewhat cordated, of a light reddish colour, finely variegated on the head and shell, with waved white lines and spots. The feet, each of which is furnished with five toes, with sharp claws, are marked with red spots. The head is prominent, and the eyes are small.

It is considered by some naturalists as a native of Amboyna.

### 22. Testudo Scripta, *Letter'd Tortoise. Testudo Scabra* of Thunberg.

*Specif. Char.*—Shell depressed, orbicular; scutella marked with various figured characters; marginal pieces spotted underneath.

This species is either very small, or the specimen from which the descriptions have been taken were very young, as it did not exceed the size of a half-crown piece. It is flattish, of a round form, and whitish colour tinged with yellow. The upper surface is marked with various figures, having somewhat the appearance of written characters. The pieces of the margin, which are 25 in number, are marked with similar characters as those of the scutella. The feet are large, webbed, and have five toes furnished with sharp claws.

It is not mentioned to what country it belongs.

### 23. Testudo Galeata, *Galeated Tortoise.*

*Specif. Char.*—Shell depressed, oval; the three middle scutella sharply ridged; marginal pieces 24.

This is a small species, not exceeding two inches and a half long, and about two broad. The colour of the shell is pale brown, and the disc is composed of 13 scutella, of which the middle row is very broad, and strongly ridged in the middle. Marginal pieces 24 in number, and similar in colour to the disc, but having white edges. The head is smooth, furnished with a kind of shield, from whence it derives its specific name.

Its native place is unknown; but an individual of this species, brought from India, lived two years. It was kept in fresh water, and could occasionally remain for a few hours in the open air. Its food was bread and flies. It continued in a kind of dormant state during the winter, taking no food from the beginning of October till the middle of May, and scarcely ever raising its head above the surface of the water.

### 24. Testudo Denticulata, *Denticulated Tortoise.*

*Specif. Char.*—Shell roundish, and heart-shaped; marginal segments denticulated; feet subdigitated.

This species is about four inches long and three broad. The shell is of a pale yellowish brown colour; the disc is composed of broad five and six-sided scutella. They are flattish, and have a large distinct space in the middle, granulated with small tubercles. The other part of the scutellum is marked with five furrows; the marginal pieces are 23 in number, and project in a serrated form.

It is supposed to be a native of North America.

### 25. Testudo Pennsylvanica, *Pennsylvanian Tortoise. Small Mud Tortoise* of Edwards.

*Specif. Char.*—Shell brown, smooth, elliptic; back flattish; the middle row of scutella somewhat rhomboidal and imbricated. The first is subtriangular.

This is a small tortoise; the length of the shell, at its full growth, does not exceed three or four inches. In this species, the middle row of dorsal pieces are longer than in others, and are so arranged as to overlap each other at the tips. The marginal pieces are 23 in number, the upper one being very small. The edges of the shell are tinged with dull yellow. In the joinings of the pieces, this species resembles the structure of the close tortoise, so that the animal has the power of concealing itself almost entirely, by closing up its shell.

It is native of North America, and is particularly found in Pennsylvania, where it frequents muddy waters, and hence its trivial name of mud tortoise. When alive, it is said that it gives out a strong musk smell.

Several varieties of this species have been noticed by naturalists.

### 26. Testudo Longicollis, *Long-necked Tortoise.*

*Specif. Char.*—Smooth, ovate; neck very long.

This species is about five inches and a half long, and four and a half broad. The shell is of an oval form, of a dark olive brown colour, resembling in some parts of it the grain of common black leather. The disc is composed of 13, and the margin of 25 pieces. The under shell is of a yellowish colour, marked with black brown at the joinings. The claws on the feet, which are four in number, are like those of birds.

It is a native of New Holland.

### 27. Testudo Caspica, *Caspian Tortoise.*

*Specif. Char.*—Shell orbicular, head scaly, tail naked; five claws on the fore feet, four on the hind.

This species of tortoise grows to such a size, that several men can stand together on its shell. The pieces of which the disc is composed are nearly four-sided, and square: those of the margin are in the form of a parallelogram. The colour is variegated with black and green; the under shell is blackish, spotted with white.

It is a native of Hyrcania, and frequents fresh waters.

### 28. Testudo Ferox, *Fierce Tortoise.*

*Specif. Char.*—Shell ovate, cartilaginous; three claws on the feet, which are tubular; nostrils prominent.

Tortoises.

This species is about one foot and a half in length, and about 15 inches in breadth. The shield, which is hard or osseous in the middle only, while the edges become gradually flexible and coriaceous, is a sufficiently characteristic mark of distinction. The head is small, and somewhat trigonal, with the snout much elongated. The colour of this species is brownish; olive above; and on the under parts white.

This species is a native of Pennsylvania, Carolina, and other parts of America. It is extremely vigorous and swift in its motions, and when it is disturbed or attacked, it springs forward towards its enemy with great fierceness. Some which have been found in the rivers and lakes of East Florida, weighed from 30 to 40 lbs.; and it is said that they even grow to such a size as to weigh 70 lbs.

A species described by Thunberg, under the name of *testudo rostrata*, is supposed by Dr Shaw to be an individual belonging to the above, not yet arrived at its full growth. The *testudo triunguis* of Forskal seems also to be a variety of this species.

### 29. TESTUDO GRANULATA, *Shagreened Tortoise.*

*Specif. Char.*—Shell granulated, orbicular, flattish; border cartilaginous.

The shield of this species measures about 3¾ inches in length, and 3⅝ in breadth. It appears as if it were composed of two shields, the upper of which is the smallest and shortest. This is of a bony substance, roughened all over like the surface of shagreen. It is composed of 23 pieces, eight of which are placed on each side. The borders of this shield are cartilaginous and somewhat transparent, through which may be seen the ribs of the animal.

This species is said to be a native of India; but of its habits and natural history nothing is known.

### 30. TESTUDO FIMBRIATA, *Fimbriated Tortoise.*

*Specif. Char.*—Shell oval, a little convex, and having a triple ridge; neck fimbriated on each side; snout cylindrical, and feet subdigitated.

The length of the shell of this species is above 15 inches, and the breadth 11. The length of the animal, from the tip of the nose to the end of the tail, is two feet three inches. The head is large and flat, edged on the sides with wrinkled membranaceous appendages, and covered behind with a three-lobed prominence. The nose is cylindrical, and somewhat resembles a proboscis. It is 10 lines long, truncated, and pierced at the tip by the nostrils. The disc of the shell is a little convex, and composed of 13 semicircular pieces, which are nearly conical. They are all wrinkled, and irregularly notched at the hinder part. The marginal pieces are 25 in number, nearly square, radiated on the surface with oblique wrinkles, and toothed on the inner edge. The colour is brown, and somewhat paler beneath.

This species is said to be a native of Guiana, and was once common in the rivers of Cayenne; but it is now rarely to be met with, having been much sought after as a nourishing food. Its food is aquatic plants; and it is said that it leaves the river, and wanders about in the night, to some distance from the banks, in search of pasture. The individual from which the description is taken by M. Bruguierre, was brought to him alive, and lived for some time on herbs, bread, and some other substances. It laid several eggs, one of which produced a young tortoise in the box where it was kept.

Turtles.

### 31. TESTUDO SERPENTINA, *Snake Tortoise.*

*Specif. Char.*—Shell ovate, depressed, triply carinated, and sharp scaled; rounded and acutely serrated at the posterior margin.

This species grows to the weight of 15 or 20 lbs. The general colour is of a dull chesnut brown, but lighter or paler underneath. The head is large, triangular, and covered with a warty skin. The neck is also covered with scaly warts. The toes, which are five in number on the fore feet, and four on the hind feet, are all distinct, but connected by means of a web. They are armed with long claws. The tail is straight, two-thirds the length of the shell, compressed, and crested on the upper part with sharp bony scales, pointed backwards.

This species is a native of North America; inhabiting stagnant waters, where it preys on fish, ducklings, &c. seizing its prey with great force. And indeed, whatever it seizes with its mouth, it holds with such force, that it will suffer itself to be raised out of the water rather than quit its hold. The more easily to catch its prey, it is said too, that it conceals itself in muddy waters, leaving out only part of its back, which has the appearance of a stone.

### 32. TESTUDO SQUAMATA, *Scaly Tortoise.*

*Specif. Char.*—Body ovate, smooth beneath; but the upper part, with the neck, feet, and tail, covered with numerous scales.

The head of this species is small, resembling that of a snake; the eyes are small and moveable, the teeth sharp. All the upper part of the body is covered with scales; the under parts are soft, smooth, and tender; the tail is pretty long.

It is said to be a native of China and Java. The flesh is accounted a great delicacy, and the scales, pulverised and dissolved in water, are given by the Chinese as a remedy in cases of dysentery and colic.

## SECT. II. *Turtles, or Sea Tortoises.*

THE large and long fin-shaped feet, which inclose the bones of the toes, are the most obvious characteristic marks of distinction between the sea-tortoises, and the species included under the preceding section. In the sea tortoises the shield is also composed of a strong bony covering, which is coated externally with hard horny plates, which in some of the species are much thicker and stronger than those of the land tortoises.

### 33. TESTUDO CORIACEA, *Coriaceous Turtle.*

*Specif. Char.*—Colour brown, paler beneath; shell coriaceous, marked with five longitudinal, tuberculated ribs.

This species, in the form of its body, which is proportionally longer, and in its outer covering, which is

not

not of a horny substance, but resembles strong leather, is sufficiently distinguished from others. Five distinct, prominent, tuberculated ridges run along the whole length of this covering. This species is not furnished with an under or thoracic shell. The head is large, and the uper mandible is notched at the tip, which gives it the appearance of having two large teeth. The fins are large and long, and covered with a tough leathery skin. The general colour is dusky brown, but paler beneath.

The coriaceous turtle is a native of the European seas. It is also found on the coasts of South America and Africa. It frequents the Mediterranean sea, and has been occasionally met with on the coasts of France and England. This species, of all the turtles, grows to the largest size. Some have been taken eight feet in length, and weighing no less than 1000 lbs. One was taken in the month of August 1729, not far from the mouth of the Loire in France, which measured seven feet one inch in length, three feet seven inches in breadth, and two in thickness. It is reported that it uttered so hideous a noise when it was taken, that it might be heard at the distance of a quarter of a league. At the same time it foamed at the mouth, seemingly with rage, from which it emitted a noisome vapour. Another was taken in 1778, on the coast of Languedoc, which measured seven feet five inches in length. One taken on the coast of Cornwall in July 1756, measured, from the tip of the nose to the end of the shell, six feet nine inches, and the weight was supposed to be near 800 lbs.

The Greeks, it is supposed, were acquainted with this species of turtle, which they employed in the construction of the ancient lyre or harp. The flesh of this species is extremely fat, but coarse and ill-flavoured; but the religious order of Carthusians prefer it to that of every other.

### 34. Testudo Mydas, *Green Turtle.*

*Specif. Char.*—Of a brownish colour, with 13 scales on the disc.

This is the esculent, or common green turtle; the latter name being derived from the colour of the fat. This is supposed to be owing to the vegetable matters on which the animal feeds, and especially the *zostera marina*, or turtle grass, of which it is said to be extremely fond. This species is one of the largest of the genus, often exceeding five feet in length, and weighing 500 or 600 lbs. The shell is somewhat heart-shaped, pointed at the extremity, and composed of 13 dorsal divisions, with 25 marginal pieces. The colour is of a dull pale brown, more or less variegated with deeper undulations, but less strong and beautiful colours, than the hawksbill turtle, which yields the tortoise shell.

The green turtle is a native of all the seas within the torrid zone.

Mode of taking the turtle.

This species of turtle has been long esteemed a delicious food by the inhabitants of many of the islands and continents within the torrid zone. In the time of Sir Hans Sloane, the inhabitants of Port Royal in Jamaica employed 40 sloops for the purpose of catching them. The markets were at that time, as they are at present, supplied with turtle in the same way as those of Europe are with butcher's meat. Many of them, according to Catesby, are carried from the Bahama islands to Carolina, where they are esteemed as a great delicacy. "They feed," he adds, "on a kind of grass, growing at the bottom of the sea, commonly called *turtle grass*. The inhabitants of the Bahama islands, by frequent practice, are very expert at catching turtles, especially the green turtle. In April they go in boats to Cuba, and other little neighbouring islands, where in the evening, especially on moon-light nights, they watch the going and returning of the turtle, to and from their nests, at which time they turn them on their backs, where they leave them, and proceed on, turning all they meet, for they cannot get on their feet again when once turned. Some are so large, that it requires three men to turn one of them (A). The way by which the turtle is most commonly taken at the Bahama islands, is by striking them with a small iron peg of two inches long, put in a socket at the end of a staff of 12 feet long. Two men usually set out for this work in a little light boat or canoe, one to row and gently steer the boat, while the other stands at the head of it with his striker. The turtle are sometimes discovered by their swimming with their head and back out of the water; but they are oftenest found lying at the bottom, a fathom or more deep. If a turtle perceive he is discovered, he starts up to make his escape; the men in the boat pursuing him, endeavour to keep sight of him, which they often lose, and recover again, by the turtle putting his nose out of the water to breathe. Thus they pursue him, one paddling or rowing, while the other stands ready with his striker. It is sometimes half an hour before he is tired; then he sinks at once to the bottom, which gives them an opportunity of striking him, which is by piercing him with an iron peg, slipping out of the socket, but is fastened with a string to the pole. If he is spent and tired by being long pursued, he tamely submits when struck, to be taken into the boat, or hauled ashore. There are men who, by diving, will get on their backs, and by pressing down their hind parts, and raising the fore part of them by force, bring them to the top of the water, while another slips a noose about their necks.

Eggs hatched by the sun.

"The turtle never go on shore, except to lay their eggs, which is in the month of April. They then crawl up from the sea above high-water mark, where they dig a hole two feet deep in the sand, into which in a single night they drop above 100 eggs. At this time they are so little liable to be disturbed, that they have been known to drop their eggs into a hat held by a person under them. If, however, they happen to be disturbed before they begin to lay, they forsake the place, and seek another. They lay their eggs at three, and sometimes at four different times, a period of fourteen days elapsing between each time. When they have laid their complement of eggs, they fill the hole with

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(A) We have seen the same mode of watching and turning the turtle practised in Jamaica, and the phrase there is not to take or seize the turtle, but to *turn* it.

with sand, and leave them to be hatched by the heat of the sun. This is usually accomplished in about three weeks." The eggs are round, white, covered with a smooth parchment-like skin, and about the size of tennis balls.

Although the green turtle be a native of the seas within the torrid zone, it is sometimes found on the coasts of Europe, where it has probably been driven by storms, or has fallen overboard from ships from the West Indies. A turtle of this kind, of the enormous size of six feet long, by four broad, and of the weight of 800 or 900 pounds, was taken at Dieppe in France in 1752; and two years afterwards, another still larger was taken on the same cosat.

Introduced into Europe.

The flesh of the green turtle is not only highly esteemed in those countries of which it is a native, but also so much sought after in Europe, that the importation of it now forms a considerable article of trade, few ships returning from the West Indies without bringing some turtle. But the turtle which now forms a dish, by no means uncommon at the tables of the luxurious, seems to have been little known in Britain previous to the middle of the 18th century; and indeed it was so rare an occurrence, that when one was eaten, it was announced to the public as a piece of news. This appears from the following articles of intelligence: "Friday, August 31. a turtle weighing 350 pounds was eaten at the King's Arms tavern, Pall-mall; the mouth of an oven was taken down to admit the part to be baked." Gent. Mag. for 1753. "Saturday, September 29. the Turtler, Capt. Crayton, lately arrived from the island of Ascension, has brought in several turtles of above 300 pounds weight, which have been sold at a very high price. It may be noted, that what is common in the West Indies, is luxury here." Ibid. 1753. "Saturday, July 13th, the Right Honourable Lord Anson made a present to the gentlemen of White's chocolate house, of a turtle which weighed 300 pounds weight, and which laid five eggs since it was in their possession. Its shell was four feet three inches long, and about three feet wide. When its head was cut off, at least five gallons of blood issued from it, and so full was it of life, that the mouth opened and shut for an hour after it was cut off." *Ibid.* 1754.

### 35. Testudo Caretta, *Loggerhead Turtle.*

*Specif. Char.*—Variegated with 15 dorsal scales, of which those of the middle row are gibbous toward the tip.

This species most resembles in general appearance the last species, or green turtle. The larger size of the head, the proportional breadth of the shell, the deeper and more variegated colours, are marks of distinction sufficiently characteristic; but the number of dorsal segments, amounting to 15, affords the principal character; for not only the middle row, but those of the sides contain five pieces; and this number is almost always uniform and constant. There is a considerable protuberance on each of the pieces of the middle row, which constitutes a range of tubercles along the back of the shield: the fore feet are very large and long; the hind feet are broad, but much shorter.

This species frequents the same seas with the green turtle, but it is also found occasionally in very distant latitudes, as in the Mediterranean, and particularly about the coasts of Italy and Sicily.

Excepting the coriaceous turtle, this species is the largest in size which has yet been discovered. In the Leverian museum, there is a skull which seems to belong to this species. It measures above a foot in length, and it is said that it was taken from a turtle, the weight of which exceeded 1600 pounds.

In a commercial point of view the loggerhead turtle is of little importance; for the flesh is coarse and rank, and the plates of the shell are too thin to be applied to the usual purposes of tortoise shell. It yields, however, a considerable quantity of oil, which is fit for burning in lamps.

Great strength of this species,

This species is very strong and fierce; it can defend itself very vigorously with its legs, and with its mouth it is able to break the strongest shells and other substances. One which was exhibited at Bologna, in an instant bit in two a thick walking stick which was offered to it.

and fierceness.

The following is the account of this species of turtle which is given by Catesby. "The loggerhead turtles, says he, are the boldest and most voracious of all others; their flesh is rank, and therefore little sought for, which occasions them to be more numerous than any other kind. They range the ocean over; an instance of which, among many others that I have known, happened in April 1725, in N. Lat. 30°. when our boat was hoisted out, and a loggerhead turtle struck as it was sleeping on the surface of the water. This, by our reckoning, appeared to be the mid way between the Azores and the Bahama islands, either of which places being the nearest land it could come from, or that they are known to frequent, there being none on the north continent of America farther north than Florida. It being amphibious, and yet at so great a distance from land in the breeding time, makes it the more remarkable. They feed mostly on shell fish, the great strength of their beaks enabling them to break very large shells, as the large *buccinum* and *trochi*."

### 36. Testudo Imbricata; *Imbricated* or *Hawksbill Turtle.*

*Specif. Char.*—Variegated, and having thirteen imbricated scales on the disk.

In this species the outline of the shell exhibits more of a cordated form than any other; and the termination of the shell is more acute. Each of the middle row of scales on the back is also of a sharpened form at the tip, and a ridge runs down the middle. The head is proportionally smaller than in other turtles; and the neck is longer, narrower, and more curved, thus resembling the bill of a hawk; hence deriving its trivial name. The specific name of imbricated is taken from the peculiarity in the dispositon of its scales, which overlap each other at the extremities like the tiles on the roof of a house.

The length of this species is about three feet from the tip of the bill to the end of the shell; but some individuals have been found which measured five feet in length, and weighed from five to six hundred pounds; and it is said that some have been met with in the Indian occean, of enormous magnitude.

The hawksbill turtle is a native both of the American

rican and Asiatic seas; sometimes, but more rarely, it is met with in the Mediterranean.

The ancients employed the shell of this species of turtle for the purpose of a shield; and even at the present day it is used for a similar purpose among rude nations. The flesh of the animal is not held in any estimation as a food; but the plates of the shell being thicker, stronger, and clearer, than those of any other species, render it of great importance as an article of trade. These plates constitute the substance which is well known under the name of *tortoise shell*. Being semitransparent and finely variegated with many beautiful colours, they afford, after proper preparation and polishing, numerous elegant ornaments.

Tortoise shell.

Mode of obtaining

To obtain the tortoise shell, the external coating is separated from the bony part by means of heat. A fire is placed under the shell, the effect of which is to make the plates start, and then they are easily detached from the bone: the thickness of the plates varies according to the age and size of the animal. They measure from one-eighth to a quarter of an inch in thickness. Eight pounds of tortoise shell, it is said, may be obtained from a large turtle. Some even yield, according to other accounts, fifteen or twenty pounds; but unless the weight of the animal itself be equal to 150 pounds, the shell is worth little.

and preparing it.

It may, perhaps, not be uninteresting to our readers, to mention the method which is employed by the artist, to give to tortoise shell the particular forms which are wanted for the different purposes to which it is applied. The first part of the process is to soften it sufficiently. This is done by steeping it in boiling water, after which it is introduced into a strong metallic mould of the form wanted, and to this great pressure is applied. When a considerable extent of surface is required, different pieces must be joined together. This is done by scraping the edges of the pieces to be united, thin, and laying them over each other, while they are in the heated and softened state. Strong pressure being then applied, they become completely agglutinated. It is in this way that gold, silver, and other metals, for different ornaments, are made to adhere to tortoise shell.

This substance was greatly sought after by the Greeks and Romans for ornamental purposes. It was not unusual, among the latter people, to see their beds, the doors and pillars of their houses, decorated with tortoise shell; and especially in the reign of Augustus, when this kind of luxury reached its greatest height.

"The Egyptians, according to Mr Bruce, dealt very largely with the Romans in this elegant article of commerce. Pliny tells us, that cutting them for veneering or inlaying, was first practised by Carvilius Pollio, through which we should presume that the Romans were ignorant of the art of separating the laminæ by a fire placed in the inside of the shell when the meat is taken out; for these scales, though they appear perfectly distinct and separate, do yet adhere, and oftener break than split, where the mark of separation may be seen distinctly. Martial says that beds were inlaid with it. Juvenal, and Apuleius in his tenth book, mentions, that the Indian bed was all over shining with tortoise shell on the outside, and swelling with stuffing of down within. The immense use made of it in Rome may be guessed at by what we learn from Velleius Paterculus, who says, that when Alexandria was taken by Julius Cæsar, the magazines or warehouses were so full of this article, that he proposed to have made it the principal ornament of his triumph, as he did ivory afterwards, when triumphing for having happily finished the African war. This too, in more modern times, was a great article in the trade to China, and I have always been exceedingly surprised, since near the whole of the Arabian gulf is comprehended in the charter of the East India Company, that they do not make an experiment of fishing both pearls and tortoises, the former of which being so long abandoned, must now be in great plenty and excellence; and a few fishers put on board each ship trading to Jidda, might surely find very lucrative employment, with a long-boat or pinnace, at the time the vessels were selling their cargo in the port; and, while busied in this gainful occupation, the coasts of the Red sea might be fully explored."

37. Testudo ———, *Green-shelled Turtle. La Tortue Ecaille Verte* of Cepede.

*Specif. Char.*—Shell green and variegated.

This species, in general, resembles the common green turtle, both in appearance and manners; but is distinguished from it in having a small rounded head, and never growing to so large a size. It derives its name from the colour of the shell, which is of a fine green, beautifully transparent, and although it is thin, may be applied to many ornamental purposes.

The green-shelled turtle is a native of the South seas, and is found near the American rivers within the torrid zone. It is found particularly in great abundance near Cape Blanco in New Spain. The flesh is in great estimation, and is even preferred by some to that of the green turtle.

38. *Trunk Turtle.*

This species is mentioned by Catesby, who says that he never saw it; but from information he has described the upper shell as being more convex than in any other species. It is said that it grows to a very large size.—The flesh is rank; but it yields a great quantity of oil, on which account only it is valued.

39. *Rhinoceros Turtle.* Cepede.

This species also bears a strong resemblance to the common turtle; but it is distinguished from it in having a large soft tubercle on the tip of the snout, and in this are placed the nostrils.

This turtle is said to be a native of the American seas, within the torrid zone, and is eaten in the same way as the common turtle.

## II. RANA, Frog.

This genus has been divided by some naturalists into three genera; and undoubtedly there is some foundation for this distinction, both from the form and structure of their bodies, and from their manners and habits. 1. The *ranæ* or *frogs*, properly so called, and by the French *grenouilles*, have light active bodies, and are furnished with strong limbs, which enable them to perform their motions by leaping. 2. The *hylæ*, in French *rainettes*, or tree-frogs have slender limbs, and have soft tubercles on the toes, by which they can adhere to smooth surfaces,

faces, as to the leaves of trees on which many of them reside. 3. The *toads* or *bufones*, in French *crapauds*, which constitute the third genus or division, have large heavy bodies, thick short limbs, and a slow crawling motion. But without multiplying genera, we shall consider the whole under one, distributing them into three sections, according to the division which we have just mentioned.

### Sect. I. Ranæ, or *Frogs*.

#### 1. Rana Temporaria, *Common Frog*.

*Specif. Char.*—Colour yellowish brown, spotted with black; a lengthened brown patch beneath the eyes.

Of all the European species this is the most common. The general colour is of an olive brown, variegated on the upper parts of the body, with irregular blackish spots. The patch beneath each eye, which reaches to the setting on of the fore legs, seems to constitute one of the principal specific distinctions. The under part of the body is of a pale greenish colour, and but obscurely spotted. But it ought to be observed, that the colour of the frog varies at different seasons of the year, and perhaps in different places. Towards the end of summer, for instance, the colours are much brighter; and as this species frequently casts its skin, the cuticle falling off irregularly from different parts of the body, produces considerable variations in the intensity of the colours.

The frog has a light elegant form, and a lively appearance; the limbs are well calculated for its peculiar motions, and the hind feet being strongly webbed, enable it to swim well. The frog, it is said, does not reach its full size till it is five years old, and it lives from 12 to 15 years. It retires during the heat of summer to the water, and in winter it becomes torpid, and is generally found in the soft mud at the bottom of stagnant waters, or in the cavities beneath their banks, where it remains till the beginning of spring.

The frog, as well as many other of the reptile tribe, is extremely tenacious of life. It survives for a considerable time, the loss even of some of its essential organs, and it has been found to exist for several days when entirely confined under water.

History of the tadpole.

The frog deposits its spawn in the month of March. This is composed of a gelatinous transparent mass, including the ova or eggs, in each of which is imbedded the embryo or tadpole, which has then the appearance of a round black globule. The period of hatching varies according to the temperature of the season, but it is commonly about a month or five weeks. In its progress the egg becomes gradually larger, and before the tadpole is excluded, it is seen in motion within the surrounding gluten. When they are first hatched, their only food is the remains of the gluten in which they were excluded. A few days afterwards, if they are minutely examined, a pair of ramified branchiæ, or temporary organs, may be observed on each side of the head, which after a short time disappear. The tadpole, which is so extremely unlike the animal in its perfect state, seems to consist only of a head and tail. The head is large, black, and roundish; the tail is slender, and margined with a broad transparent fin. The motions of the tadpole are very lively. Its food consists of duckweed and other small water plants, with different kinds of animalcula. The mouth is furnished with very minute teeth, and when the tadpole has reached a certain size, it may sometimes be heard gnawing the edges of the leaves on which it feeds. By means of a sucker placed between the lower jaw, with which the animal in this state is furnished, it can attach itself at pleasure to the under surface of aquatic plants. When it is very young, it sometimes hangs from this part by means of a glutinous thread, similar to some small slugs.

Structure and changes.

The internal structure of the organs of the tadpole is very different from that of the future animal. In no respect is this difference greater than in the disposition of the intestines, which are coiled in the form of a flat spiral like a cable. The first change which appears on the tadpole is at the end of five or six weeks after it is hatched. It is about this time that the hind legs first appear; and gradually increasing in length and size, they are succeeded about two weeks afterwards by the fore legs. These latter, indeed, are formed at an earlier period beneath the skin, and are sometimes protruded and again drawn back by the animal, through a small hole on each side of the breast, before their complete evolution. The tail now gradually decreases, and afterwards more rapidly, so that in the space of a day or two it is quite obliterated. After this change, the animal leaves the water, and covers the banks in myriads. The sudden appearance of such multitudes of young frogs, has probably induced the groundless but popular belief of their having fallen from the clouds in showers. The frog having now arrived at its perfect form, it changes entirely the nature of its food. It lived formerly on vegetables, now it depends solely for its existence on animal food. It lives chiefly on small snails, worms, and insects. To seize its prey, the structure and position of the tongue are remarkably well fitted. It is of considerable length, and it is attached to the fore part of the mouth, and when at rest it lies backwards. The extremity is bifid, and secretes a glutinous matter, so that in this way it can secure its prey, by darting out its tongue with great celerity, and to some distance from the mouth. This it does with so instantaneous a motion, that it is scarcely perceptible to the eye.

#### 2. Rana Esculenta, *Green Frog*, or *Edible Frog* of Pennant.

*Specif. Char.*—Olive colour, spotted with black, with three yellowish lines on the back; abdomen whitish.

This is the largest species of the European frogs. The general appearance resembles that of the preceding; but it is larger in size, and of an olive-green colour, strongly marked on the upper part of the body with roundish black spots. The limbs are elegantly marked with transverse bands of the same colour. Three distinct pale yellow stripes run from the tip of the nose down the whole length of the back, the middle one being slightly depressed; but the two lateral ones are considerably elevated. The head is proportionally larger than that of the common frog.

The green frog is rare in England, but is very common in France, Italy, and Germany, where it is employed as an article of food.

This species, it is observed by naturalists, does not

Frogs.

leave its winter retirement till a much later period than the common frog; and in those countries where it is used as food, it is worth while to attend to this fact, for if they are pretended to be brought to market at an earlier period, the common frog, and sometimes even toads, must be substituted. During the breeding season, the croaking of the male is so loud, that it may be heard at a great distance; and in those places where they are numerous, it becomes so intolerable to those who are unaccustomed to hear them, that they are often deprived of sleep. At this time, too, a large inflated globular vesicle is protruded from each side of the head of the male. The globules of spawn in the green frog are proportionally smaller than in the former species. They have somewhat of a yellowish cast. The progress of the tadpole, towards the evolution of the perfect animal, is considerably slower in this species. The fore legs do not appear before October, and the animal does not assume its perfect shape till the beginning of November. The tail at this time begins to decrease, and in the space of four days entirely disappears.

This species is extremely voracious, seizing, it is said, on young birds of different kinds, mice, and even ducklings, and, as it does with the rest of its prey, swallowing them whole. At the age of four years it has reached its full growth. It begins to breed the year following, and the period of its life is sometimes extended to sixteen years.

### 3. Rana Pipiens, *Piping Frog*.

*Specif. Char.*—Olive-coloured, with ovate black spots, edged with yellow.

This species is smaller than the green frog, but in its general habit bears a considerable resemblance to that animal. From the nose to the tips of the hind feet, it measures only five or six inches. The body and limbs are of a dusky green, spotted with black. Two yellow lines run from the eyes to the rump, and two white lines from each eye to the nose. In the living animal the ears have a bright golden colour.

It is a native of North America. It frequents rivulets and ditches of water, and is so strong and vigorous, that it is said it can leap to the distance of five or six yards. In the spring and beginning of summer, it is supposed to indicate the approach of rain, by a peculiar sound which it emits.

### 4. Rana Catesbeiana, *Bull Frog*.

*Specif. Char.*—Olive brown, spotted with black; large ocellated spots near the ears; hind feet palmated.

This species grows to a very large size, measuring, it is said, more than 18 inches from the tip of the nose to the end of the hind feet. The upper part of the body is brownish, and somewhat irregularly marked with numerous spots of a deeper brown. The under parts are of a whitish cast, with a shade of yellowish green. They are also marked with numerous spots; but these are less bright than those of the upper part.

The bull frog is a native of many parts of North America. It derives its name from the sound of its voice, which resembles the distant lowing of cattle. It usually frequents springs; and in Virginia, where these abound in the sides of the hills, a pair of these frogs are usually

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seen sitting on the edge of the small pond formed by the running of the water from the spring; and when they happen to be surprised, they retreat to the mouth of the spring, and, entering it, find themselves in safety. In Virginia, too, a popular opinion prevails, that they are useful in purifying the water of the spring. This opinion is greatly in their favour, and saves them from that persecution with which the frog and other reptiles are wantonly and unnecessarily harassed in other countries. But the bull frog being extremely voracious, and sometimes devouring young ducks and goslings, is occasionally devoted to destruction.

### 5. Rana Ocellata, *Argus Frog*.

*Specif. Char.*—Feet having each five toes, and unwebbed; toes tuberculated beneath; back fasciated, and sides ocellated.

This is one of the largest of the genus, exceeding, perhaps, the bull frog in the size of its body, but having limbs proportionally thicker and stronger. It has sometimes been confounded with the bull frog; but it is distinguished from it in its general appearance, and particularly in the form of the feet.

This frog is a native of Pennsylvania, Carolina, and other parts of North America, frequenting moist places in the vicinity of springs and rivulets. In its manners and habits it is supposed to be nearly the same with the bull frog.

### 6. Rana Virginica, *Lineated Frog*.

*Specif. Char.*—Cinereous, spotted with red; beneath yellowish; back angular, and marked with five pale stripes.

This species, in shape, size, and structure of the feet, resembles the common frog. It is greenish above, and paler beneath. The back and limbs are variegated with dark-brown marks of different sizes.

It is a native of Virginia.

### 7. Rana Ovalis, *Oval Frog*.

*Specif. Char.*—Colour brownish, beneath yellowish; the head beaked, and scarcely distinct from the globose body.

The snout projecting beyond the lower jaw, constitutes the specific character. The hind legs are short, the feet unwebbed, and there is a callus at the base of the inner toe. Its native country is unknown.

### 8. Rana Cyanophlyetis, *Studded Frog*.

*Specif. Char.*—Brownish blue, having a tuberculated line on each side; beneath whitish, spotted with brown.

In this species the legs are branded with blackish blue and white. In the upper jaw there is a row of thickset conical teeth, resembling those of lizards. The hind feet are webbed, and furnished with a callus like a sixth toe.

It is a native of India.

### 9. Rana Spinipes, *Spiny-footed Frog*.

*Specif. Char.*—Brown, beneath bluish; sides speckled with

with an ochreous colour; toes of the fore feet furnished with spines.

This species is larger than the common frog. The feet are unwebbed, and in its habit it approaches to the toad.

It is a native of New Holland.

### 10. Rana Cerulea, *Blue Frog*.

*Specif. Char.*—Blue, speckled with grayish beneath; feet divided into four toes; hind feet webbed.

The blue frog is of the size of the common one. The toes are not orbiculated; but in its habit and slender limbs it approaches somewhat to the tree frogs.

It is a native of New South Wales.

### 11. Rana Vespertina, *Vespertine Frog*.

*Specif. Char.*—Cinereous, and tuberculated above; a transverse spot between the eyes, and forked behind; marked with longitudinal, subconfluent, brown dorsal spots, which vary into green.

In this species the head is short, and the body is covered with warts or papillæ. It is about the size of a toad, having the habit of a frog. It can scarcely be said to leap.

It is a native of Siberia.

### 12. Rana Ridibunda, *Laughing Frog*.

*Specif. Char.*—Cinereous, the body spotted with brown, the thighs dusky, with milk-white spots.

This species is of a very large size, weighing half a pound. It has the habit of the common frog, but is broader.

It is very frequent about the rivers Wolga and Ural, and the Caspian sea. It never leaves the water. In the evening it emits a sound, somewhat resembling a hoarse laugh, whence it derives its specific name.

### 13. Rana Sitibunda, *Thirsty Frog*.

*Specif. Char.*—Glaucous gray, variegated with blackish green spots; beneath whitish; the hind feet semipalmated, and having the appearance of seven toes.

The body is warted, the head short, and has the general habit of a toad, but is larger. There are two curious toes on the hind feet.

It is a native of desert places about the river Ural. It conceals itself during the day.

### 14. Rana Leveriana, *Leverian Frog*.

*Specif. Char.*—Dusky blue, whitish beneath; hind feet palmated; body marked above, with two long and two short white stripes.

Excepting that the body is plumper, and the limbs proportionally shorter, this species has the habit of the common frog. On the back of the head there is a small trifurcated spot, two upper divisions of which point forwards. The lower surface of the body is yellowish white and granulated. The fore feet have four toes, which are slightly orbiculated at the tips.

Its native country is unknown.

### 15. Rana Ignea, *Fire Frog*. *Rana Bombina*, Lin.

*Specif. Char.*—Olive brown, orange colour beneath, spotted with blue.

This is the smallest of the European frogs, and is not equal even to the tree frog in size. It derives its name of fire frog from the peculiar colour of the under surface of the body; but this is subject to considerable variation.

It is a native of Germany, Italy, and other parts of Europe, but has not been found in England. It frequents turbid stagnant waters, and scarcely ever appears on land. It breeds at the age of three years, and may therefore be supposed to live about ten. It deposits its spawn in the month of June, and the ova are proportionally larger than those of others. The tadpoles, which are of a pale yellowish brown colour, are hatched towards the end of June. When young, they have been frequently observed to hang from the surface of leaves by means of a glutinous thread, issuing from the small tube near the lower lip. About the end of September they are at their full size. At that time the tail appears more fleshy and muscular, and therefore proportionally stronger than in other tadpoles. In the beginning of October they assume their perfect form.

This is one of the most active and lively of the whole genus. It leaps and swims even with greater celerity than the common frog. When it is surprised on the land, and finds that it cannot escape, it squats down close to the ground, turning back its head and limbs in a singular manner. If it be farther disturbed, it emits from the hinder part of the thighs a frothy kind of fluid which has no disagreeable smell, but some degree of acrimony when it comes in contact with the eyes and nostrils. The sound emitted by the male of this species is sharper than that of other frogs, and somewhat resembles a kind of laugh, or, according to some, the note of a cuckoo or the tone of a bell. Hence the Linnæan specific name, *rana bombina*.

### 16. Rana Salsa, *Saline Frog*.

*Specif. Char.*—Colour olive brown, whitish beneath, with dusky variegations: all the toes are unwebbed.

When this species is first taken out of the water, the brown colour has a shade of blue; the back is beset with tubercles; the legs are fasciated with brown, and the insides of the feet are yellow.

It is a native of the salt marshes of some parts of Germany.

### 17. Rana Paradoxa, *Paradoxical Frog*.

*Specif. Char.*—Yellowish and olive-coloured; variegated with rufous bands; hind legs obliquely striated.

This species resembles in its general form the common frog. The oblique longitudinal stripes on the hind legs constitute the principal mark of distinction. There are four toes on the fore feet, and they are unwebbed. The hind feet have five toes, and are deeply palmated to the very ends of the toes. Near the shortest toe there is an oblong callus, forming a spurious one. The upper jaw is beset with a row of small denticulations.

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This species is a native of South America, and is more common in Surinam than in other places.

Naturalists have been extremely puzzled with regard to the real nature of what has been taken for the tadpole of this frog. At one time it was considered by Linnæus as a species of lizard, and therefore arranged by him under the genus *Lacerta*. At another time he has placed it under the present genus, with the specific name *piscis*. It was described by Edwards under the denomination of the *frog fish of Surinam*. The structure of the animal, which has been the subject of so much discussion, shews clearly that it is the larva or tadpole of a frog; and it is supposed, with no small degree of probability, that the differences in the accounts given of this animal by naturalists have arisen from the different stages of its progress in which it has been found. But as this tadpole is so much larger in size, in proportion to the perfect animal, than any other species yet known, it may be the larva or tadpole of some of the larger species, and not that of the rana paradoxa, which is but a small frog.

### Sect. II. Tree Frogs.

Tree frogs have slender bodies, long limbs, and the tips of the toes are flat, orbicular, and dilated. The species included under this section have been formed, according to the arrangement of some naturalists, into a separate genus, under the name of *Hyla;* and no doubt the peculiar structure of the toes, which enables them to adhere to smooth bodies, affords a very striking character, and in some measure warrants the arrangement.

18. Rana Zebra, *Zebra Frog*. *Rana Maxima*, Linn.

*Specif. Char.*—Yellowish and rufous, spotted and fasciated with brown. There are double bands on the legs, and the feet are palmated.

This species is the largest of the whole of this section, measuring about five inches from the nose to the end of the body. The colour is an elegant, pale, rufous brown, beautifully marked on the back and limbs, and even to the very ends of the toes, with transverse chesnut-coloured bands. The head is large, the eyes protuberant, and the mouth wide. The fore feet have four toes, and the hind ones five.

It is a native of Carolina and Virginia.

Two other species have been described by naturalists, which more accurate observation has shewn to be nearly allied to the preceding. The first is the *rana boans*, Linn. in which the difference is so slight, that as Dr Shaw observes, it may depend on a sexual distinction. The other is the *rana venulosa*, which is supposed to be the same animal as the zebra frog, before it has arrived at its full size.

19. Rana Bicolor, *Blue-and-Yellow Frog*.

*Specif. Char.*—Colour blue, ochreous beneath; feet unwebbed; toes flattened and orbicular.

This elegant species is of a moderate size; it measures more than four inches in length. The whole of the upper surface is of a beautiful blue, while the under parts are of a pale orange or ochre colour. The head is large, the mouth wide, and the tip of the nose truncated. All the toes are furnished with a large orbicular tip; and beneath each of the joints there is a process or tubercle. The upper parts of the female have a deeper shade of violet than those of the male.

It is supposed to be a native of Surinam.

20. Rana Leucophyllata, *White-Leaf Frog*.

*Specif. Char.*—Colour rufous, variegated above, with snow-white spots of different shapes.

The variegated spots on the body and limbs are milk-white, and are observed to vary greatly in different individuals, in number, form, and disposition. The toes of the fore feet are slightly webbed at the base.

It is a native of America.

21. Rana Quadrilineata, *Four-Lined Frog*.

*Specif. Char.*—Colour blue, having a double, longitudinal, yellow line on each side of the body.

This species bears a near resemblance to the preceding; but the blue colour above, and the double yellow line, which runs along each side of the body, from the eyes to the vent, sufficiently distinguish it.

Its native country is unknown.

22. Rana Castanea, *Chesnut Frog*.

*Specif. Char.*—Chesnut-coloured and granulated; whitish beneath, with a white line on each side of the body.

In this species, the whole of the upper surface, both of body and limbs, is scattered over with minute warts or tubercles. On each shoulder there is a large, long, white spot; the fore arms, hind legs, and thighs, are barred transversely with white; the feet are unwebbed, the toes rounded, and all the joints tuberculated beneath.

It is supposed to be a native of Surinam.

23. Rana Fasciata, *Fasciated Frog*.

*Specif. Char.*—Colour rufescent, with whitish transverse bands.

In this species the colour is pale rufous; the head, body, and upper parts of the limbs, are marked with pale transverse bands; the eyes are blue, with a silvery lustre; the outside of the arms and legs are of a blackish brown colour.

Its native place is unknown.

24. Rana Arborea, *Tree Frog*.

*Specif. Char.*—Colour green, whitish beneath, with a blackish lateral line and granulated abdomen; feet unwebbed.

This species is of a smaller size than any other of the European frogs. The colour of the upper part of the body is green; the abdomen is whitish, and marked with numerous granules. The under surface of the limb is reddish, and on each side of the body there is a longitudinal blackish or violet-coloured streak, which separates the green of the upper parts from the white of the lower. The lower edge of the dark lateral stripe is shaded with yellow. The hind legs are long and slender. There are four toes on the fore feet, and five on the

the hind feet. All of the toes terminate in flat, round, and dilated tips. It is by means of this peculiar structure that the animal is enabled to hang from the leaves of trees, or from any smooth substance; for the under surfaces of these tips or tubercles on the toes is soft and glutinous. There is a similar structure on the skin of the abdomen.

The tree-frog is a native of France, Germany, Italy, and other parts of Europe. It has never been found in the British islands. During the summer months, it chiefly frequents the upper parts of trees, and wandering among the leaves in search of insects, it seizes them with extreme celerity. It steals softly towards its prey, and when it has reached the proper distance, it makes a sudden spring of more than a foot in height. For this it is peculiarly fitted, from its nimble and active movements. It conceals itself beneath the shade of the leaves, by attaching itself to their under surface by means of the feet, or abdomen.

On the approach of winter, the tree-frog leaves the woods, and retires to the waters, where it buries itself in the soft mud, or conceals itself beneath the banks, where it remains torpid till the spring, when it deposits its spawn in the water. At this time the throat of the male is greatly inflated, and the loud sharp croak which it then emits, is heard at a very considerable distance. The spawn is deposited in small clustered masses, about the end of April, and the tadpoles assume the form of the perfect animal about the beginning of August, at which time they begin to ascend the neighbouring trees, where they reside while the warm season continues. It has been observed that they are more noisy on the approach of rain; and the males particularly, if kept in glasses, and furnished with food, afford certain indications of the changes of the weather.

### 25. RANA MERIANA, *Merian Frog.*

*Specif. Char.*—Colour yellowish green, variegated with brown, with conically shaped auricular vesicles.

This species is three times the size of the common tree-frog, and on each side of the neck there is a remarkable protuberance like an obtusely conical, inflated pouch.

This species is sometimes found on trees, and sometimes in the water, according to the different periods of its growth. According to Madame Merian's description, these frogs are found in stagnant waters. They have, she observes, ears in their heads, and knobs or balls on their feet, which have been given them by nature to enable them to pass easily over the morassy places which they inhabit.

### 26. RANA AURANTIA, *Orange Frog.*

*Specif. Char.*—Orange-coloured; body and limbs very slender.

This species is entirely of a reddish orange colour, long-limbed and slender-bodied. It is smaller than the European tree frog.

It is a native of South America, inhabiting trees.

### 27. RANA TINCTORIA, *Tinging Frog.*

*Specif. Char.*—Of a reddish colour; the body fasciated with white.

It is of a bright red or ferruginous colour above, marked longitudinally with a pair of white stripes. These at an early age are often crossed with a transverse stripe; and indeed the individuals of this species have been found to vary greatly in the disposition of the colours.

It is a native of South America, and inhabits trees.

The Indians employ this species of frog to change the colour of green parrots. For this purpose they pluck the feathers from that part of the parrot on which they wish the new colour to be introduced. They rub the skin with the blood of the animal, and the renovated feathers, instead of being green as formerly, are yellow or red.

### 28. RANA ALBA, *White Frog.*

*Specif. Char.*—Entirely of a white colour.

On the upper part of the body there are some spots or patches, which are of a brighter white than the ground. It is, however, subject to some variations.

It is a native of the woods in the warmer parts of North America.

### 29. RANA BILINEATA, *Bilineated Frog.*

*Specif. Char.*—Colour green, with a straight yellow line on each side of the body.

The only difference between this species and the common tree-frog is, in the yellow line on each side of the body of the former being somewhat straighter, and without undulations.

It is a native of the warmer parts of North America, inhabiting the woods.

## Sect. III. TOADS.

### 30. RANA BUFO, *Common Toad.*

*Specif. Char.*—Colour brown, with reddish brown tubercles, pale beneath.

The common toad is too well known to require any detailed description. The colour is generally of an obscure brown above, but much paler, and irregularly spotted beneath. It is, however, subject to considerable variations, being sometimes found of an olive cast; and, in the earlier part of summer, the shoulders and limbs are marked with reddish spots, while the under parts of the body have a yellowish tinge. The body is always covered with pustules or tubercles of a darkish green, or bright red colour, and they are of different sizes in different individuals. The common toad is not only a native of Europe, but of other countries of the world.

History of the toad.

The common toad usually frequents shady places, in gardens or fields; is found under stones, or makes its way into cellars or other obscure recesses, anxious, as it would seem, to conceal itself, or, that it may lie protected from excessive cold, and find a supply of food. The toad, like the common frog, becomes torpid in winter; and it would appear, that they sometimes collect together in numbers, and take up their habitation in the same hole or cavity, with the view of preserving and retaining their heat for a greater length of time. At the return of spring, the toad leaves its lurking place, and retires to the waters, where it deposits its spawn.

spawn. The ova are included in a transparent gluten, which is in the form of chains or strings, somewhat resembling a necklace. The length of these strings is from three to four feet; and through the whole length the ova, which have the appearance of black globules or beads, are disposed in a double series. The tadpole is hatched at the end of 14 or 15 days, according to the temperature of the season; and having burst from the surrounding gluten, they swim about in the water, feeding on different animalcules, and leaves of water plants. Early in the autumn they assume the form of the perfect animal, when they retire from the water, and are sometimes found in such numbers on the ground in its vicinity, that it has probably given rise to the common opinion of their having fallen from the clouds in showers.

Age.

The age of the toad is supposed to be about 15 or 20 years, but sometimes they exceed this period. One, of which Mr Pennant has given an account in his British Zoology, lived to the great age of 40 years. This individual had been known for that time in a domesticated state. It was kept by a Mr Ascot in Devonshire, and had become so tame, that it left its hole at the approach of its master, to receive food. It grew to a very large size, and had become an object of so much curiosity, that in spite of the aversion and horror which this animal usually inspires, it was visited by all, and even by ladies, who came to the house. It was frequently brought to table, and fed with insects, and without any degree of embarrassment, or seeming desire to get away, it seized them with great celerity. Its usual place of residence was under the steps of the door of the house which led to the garden. It was unfortunately seized by a raven, and severely wounded, before it could retreat to its hole; and although it was liberated from its enemy, and lived for more than a year afterwards, it never recovered its usual health and vigour, otherwise the period of its life might have been greatly extended.

Not poisonous to large animals.

It has been long supposed that the toad, when it is irritated, secretes a fluid from its skin which is of a poisonous quality. This fluid, however, has no effect whatever, except producing a little irritation, on larger animals. A dog, it has been observed, carrying a toad for a short time in his mouth is affected with a slight swelling of the lips, and an increased discharge of saliva. This fluid undoubtedly answers some purpose in the economy of the animal, and it is probably intended for its protection against the troublesome attacks of smaller animals. This seems to be in some measure proved from the experiments of Laurenti. In these experiments it appeared that small lizards which had bitten the common toad, became disordered and paralytic, and even apparently dead. They were, however, completely recovered in the space of a few hours.

Error concerning its being found alive, enclosed in solid substances.

Many wonderful stories have been related of the toad having been found inclosed in the solid substance of wood and stone, or marble; and what is still more wonderful, that it has been in such circumstances without any visible outlet, or the smallest passage for the access of air, alive, and seemingly uninjured. It is not indeed a little surprising, that a supposed fact of this kind, so contrary to the nature of animal existence, should even for a moment have gained any degree of belief; yet many such stories have been currently reported, and readily, we might almost say universally, admitted to be true; for being established on what was said to be the most undoubted testimony, they were received and acknowledged as fully authenticated. But on closer investigation, in all cases where inquiry could be made, it was found that some links in the chain of evidence were always wanting. In no instance whatever, it may be asserted, has the fact been ascertained from direct information, founded on any credible or respectable authority. It has always been first communicated by report, or from a distance; circumstances which always give room for mistake and error. Toads may have been found inclosed in wood, or even in stone, perhaps without having received any material external injury; but that they should have remained in such situations for any great length of time, as for years, nay, in some cases, for hundreds of years, totally deprived of food, and completely excluded from all access of air, is not only highly incredible, but impossible. But if farther evidence were necessary, this supposed fact is fully disproved by the experiments of Herissant, which he performed in presence of the French Academy. It had been asserted that a living toad was found in the year 1771, in a wall at a seat belonging to the duke of Orleans. The wall, which was then pulled down, had been built 40 years; and its hind feet were found imbedded in the mortar. In Herissant's experiments, three toads were inclosed in separate boxes, and these were immediately covered with a thick coat of mortar, and kept in the apartments of the academy. At the end of 18 months the boxes were opened, and two of the toads were found living. They were again enclosed; but being re-opened after some months had elapsed, they were found dead.

### 31. Rana Alliacea, *Alliaceous Toad*.

*Specif. Char.*—Colour pale gray, marked with brown, and having a whitish dorsal line; pupils perpendicular.

This species, excepting in a greater proportional length of the head, has a considerable resemblance to the common toad. It differs from it also in being nearly smooth. The colour above is a brownish gray, with spots of deep brown, which on the sides are disposed in a reticular form. The eye has a very peculiar structure. The form of the pupil, when the eye is contracted, is perpendicular, as in the eyes of cats. On the hind feet there is a spurious claw, or horny callus, situated beneath the heel.

This animal gives out, when irritated, a peculiar odour, which resembles that of onions or garlic, and produces a similar acrid effect on the eyes. A smell like that of the smoke of gunpowder is also sometimes combined with the garlic smell.

This species is a native of Germany. It is found in the neighbourhood of Nuremberg.

It has been already mentioned, that the spawn of the common toad is deposited in the form of a double string; but in this species there is only one string, which is of considerable thickness, and the numerous ova are disposed, not in a double row, as in the former, but in a confluent manner through the length of the spawn, which is sometimes found nearly two feet long.

The tadpole of the alliaceous toad, like the supposed one of the *rana paradoxa*, is considerably larger in size than the young frog when it has first assumed its perfect form.

form. Indeed it is so large, that in the vicinity of the places where it is found, it is employed as food by the country people, who consider it as a kind of fish. It seems also to be one of the most voracious tadpoles.

The alliaceous toad, contrary to the habits of the common toad, remains almost constantly in water, and but very rarely appears on land. It is also more lively and active in its nature, and its motions are performed by a kind of leaping, rather than by the crawling sluggish pace of the latter.

### 32. Rana Mephitica, *Mephitic Toad.*

*Specif. Char.*—Colour olive, spotted with brown; warts on the skin reddish; dorsal line sulphur-coloured.

Excepting in the colour, and being of a smaller size, this species greatly resembles the common toad. The body and limbs are short and thick; the fore feet are furnished beneath with a pair of bony processes, by means of which it is enabled to climb up the sides of walls. The hind feet have no webbed structure. In its motion it runs somewhat like a mouse. It comes out only in the night, from the cavities of walls and rocks, where it conceals itself by day.

This species is a native of Germany, in some parts of which it is known by the name of *roerhling*, or reed frog, because in the spring it frequents places which are overgrown with reeds. At this season, too, it is well known by the strong and peculiar note or croak which it utters.

In the month of June, when this species breeds, it resorts to the water, to deposit its ova. These are emitted, as is the case with the common toad, in double rows, in a pair of long glutinous strings; and so rapid is the progress of hatching, that the tadpoles appear in the space of five or six days, having separated themselves from the spawn. The hind legs appear about the end of August, are soon succeeded by the fore legs, and by September or October the animal has assumed its complete form.

The mephitic toad has derived its name from a most offensive smell which it diffuses when it is irritated. This odour proceeds from a white acrid fluid which exudes from the pores of the skin. The animal has the power of emitting this fluid to the distance of three or four feet, and it is said that if it fall on any part of the room where the animal is kept, it will scarcely be entirely dissipated for two months afterwards. This odour resembles the smoke of gunpowder, but is considerably stronger; or that of the fumes of arsenic.

*Var.* The natter-jack of Pennant is, according to some, a variety of the above species. It is not, however, said, that, like the mephitic toad, it emits any peculiarly offensive odour; but its running motions bear a near resemblance; for it does not leap, nor does it crawl with the sluggish pace of the common toad.

It is a native of England, and is found in Pulteney common, and near Reevesby abbey in Lincolnshire, frequenting dry and sandy places.

### 33. Rana Viridis, *Green Toad.*

*Specif. Char.*—Colour pale, varied with greenish spots; tubercles reddish. *Rana variabilis*, Linn.

In this species the green spots or patches are bounded with a blackish margin, and the whole has somewhat of the appearance of a map. The spots on the legs and thighs are transverse, forming a kind of bars; the eyes are remarkable for a beautiful golden colour, and when the animal is irritated, seem to emit a kind of phosphoric light.

This species is a native of Germany and other parts of Europe, and is not unfrequently found about Vienna, where it inhabits the cavities of walls.

This species, like the mephitic toad, emits a very strong odour, which resembles that of garden nightshade. It is so powerful, that it diffuses itself through a large room.

During the breeding season this species frequents the waters, and in winter it retires under ground. Its croaking is said to resemble the creaking of the hinge of a door. It would appear, that the fluid which exudes from the skin of this toad, and probably also from that of others, is poisonous to small animals; for it is said that the smaller kinds of the gray lizard, on biting this toad, became immediately strongly convulsed, and died in a few minutes.

### 34. Rana Marina, *Marine Toad.*

*Specif. Char.*—Colour yellowish brown, with a large porous prominence over each shoulder; very large size.

This species even exceeds the bull frog in size. On each shoulder there is a protuberance of a light-brown colour, which is marked with many pores. These are the parotid glands, which are peculiarly conspicuous. The feet have no webs, and there are four toes on the fore feet, and five on the hind. The toes are furnished with claws, somewhat resembling the human hair. There are some tubercles at the extremity of the body, which are said to be owing to the folding of the skin, when the animal is placed in a particular attitude; for these disappear when the attitude is changed.

This species is said to be a native of America; and, according to some, is calculated to live both by land and sea.

### 35. Rana Dubia, *Doubtful Toad.*

*Specif. Char.*—Colour yellowish brown, warty, having a large porous prominence over each shoulder; hind feet subpalmated and subhexadactyle.

In size this species comes near that of the common toad; but it is different in shape, as it tapers from the shoulders to the hind legs like the tree frogs. The upper surface of the body is covered with oval tubercles, and there are protuberances on the shoulders like the *rana marina*. The under parts of the body are also beset with smaller tubercles. The joints of the toes of the fore feet are tuberculated beneath, and there are two remarkable protuberances under the foot.

Of the native country of this species, or of its manners and habits, nothing is yet known.

### 36. Rana Typhonia, *Mitred Toad.*

*Specif. Char.*—Colour brown, dorsal line whitish; head triangular.

This species is about the size of the common toad; the

the thighs are barred with brown, and the skin of the whole body is covered with numerous small protuberances of a pearly colour. The sides of the head beyond each eye have somewhat of an angular appearance, and from this it has derived the name of *mitred toad.*

### 37. Rana Braziliana, *Brazilian Toad.*

*Specif. Char.*—Colour rufous, with numerous brown spots on every part of the body.

In its general appearance this species resembles the common toad, but is much larger, and the head is proportionally shorter. The spots or stripes on the body are red brown, placed transversely, and are somewhat waved.

It is a native of South America; but, according to some, has been found in the island of Cuba.

### 38. Rana Ventricosa, *Granulated Toad.*

*Specif. Char.*—Colour pale brown; abdomen dilated, and marked on the sides with blackish spots.

In this species the head and eyes are large, the mouth wide, the body somewhat depressed; the abdomen is very broad; the limbs are rather short. The upper surface of the body and limbs is covered with tubercles of different sizes, pretty distinctly arranged.

It is supposed to be a native of Brazil.

### 39. Rana Cornuta, *Horned Toad.*

*Specif. Char.*—Colour cinereous, banded with brown; eyelids conical.

In this species a broad white band runs along the back, from the head to the extremity of the body, and becoming gradually narrower. It is covered with small specks like pearls. The rest of the body, excepting the head, is rough, with sharp points. The head is large and thick, and a broad thick tongue appears when the mouth is opened. It is covered with papillæ, and fastened to the anterior part of the lower jaw. The gape of the mouth extends almost half the length of the body; the eyes are rather small, and are placed nearer than in other frogs. Each of the upper eyelids rises up into a large conical callus, or horn. From this extraordinary width of the mouth, and singular structure of the upper eyelids, this species exhibits the most deformed and hideous aspect of any of the whole tribe.

It is a native of South America.

### 40. Rana Pipa, *Pipa,* or *Surinam Toad.*

*Specif. Char.*—Colour brown; toes of the fore feet quadrifid at the extremities.

This species is considerably larger than the common toad. The body is flattish; the head somewhat triangular; the mouth wide, and the corners are furnished with a kind of rugged appendage. There are four long thin toes on the fore feet, and each of the toes is divided into four distinct processes; and these, when minutely examined, are found to be still farther divided. The hind feet have five toes, and are webbed to the tips. The male is larger than the female, measuring sometimes seven inches from the tip of the nose to the extremity of the body. The nose in both sexes is truncated, and the eyes very small.

This singular species is a native of Surinam.

Ova hatched in a singular manner.

The economy and habits of the pipa greatly occupied the attention of naturalists for a long time after it was first known to Europeans, which was about the end of the 17th century. It was then supposed that the ova were produced in cells on the back of the animal, without being first excluded, as in the other species of this tribe, in the form of spawn. But future observers have added new facts, and greater accuracy, to the natural history of this species; and it is now found that the spawn being excluded in the usual manner, is received into a number of open cells on the back of the animal, and is there retained till the young have reached some degree of maturity. This discovery is owing to Dr Fermin, who made his observations on the spot, during a residence at Surinam. The female pipa, he observes, deposits her spawn near stagnant water. The male collects the ova, and places them carefully on the back of the female, where, after being impregnated, they are pressed into the cells, which are then open to receive them. The cells close over them, and retain them for near three months, when the young animals, having arrived at their perfect state, emerge from the back of the parent. During this period of concealment, it has been discovered by other naturalists, that the ova undergo the same change as in those which are hatched out of the body; first assuming the form of the tadpole, and then acquiring the complete shape before they are excluded from the cells. In this mode of hatching its young, some naturalists have observed an analogy in this process of nature between the Surinam toad and the opossum.

This animal, from the uncouthness of its shape, and its general appearance, will, by many, be considered at first view as little less hideous and deformed than the horned toad.

### 41. Rana Breviceps, *Short-headed Toad.*

*Specif. Char.*—Colour brown, pale beneath; body ovate, convex, and marked with a longitudinal, ash-coloured, dentated band. *Rana gibbosa,* Linn.

This is a small species, and scarcely exceeds half the size of the common toad. The head is very small, obtuse, and sunk in the thorax. The toes of the fore feet are unwebbed, have no claws, and are furnished with tubercles beneath the joints. The hind feet are furnished with six toes.

It is a native of Senegal, and some other parts of Africa.

### 42. Rana Systoma, *Indistinct Toad.*

*Specif. Char.*—Body somewhat globose; head indistinct, and mouth small.

In its general appearance this species greatly resembles the preceding. The body is thick and roundish, and the head is so little distinguished from the body, that the mouth is scarcely perceptible. The legs are very short, and the thighs seem enclosed in the wrinkled skin of the sides. The whole body is smooth.

It is a native of the East Indies.

### 43. Rana Acephala, *Headless Toad.*

*Specif. Char.*—Colour brownish, marbled with white; head indistinct, and mouth very small, bending downwards.

Excepting in the colour, which is very different, and in the head being still less distinguished from the body, this species in appearance comes very near the two former. The mouth also is smaller, and is curved downwards at each corner. Its native country is unknown.

### 44. Rana Lentiginosa, *Carolina Toad.*

*Specif. Char.*—Colour gray, freckled with brown; head somewhat pointed.

This species, in its general appearance, greatly resembles the common toad, excepting that the head is smaller, and the snout sharper. The colour is of a dusky brown, mottled with minute blackish or dark-brown spots. In its motions this species is different from the common toad, for it leaps rather than crawls.

It is a native of North America, and particularly of Carolina and Virginia. It is said to be most common in wet weather, and frequents the higher grounds, appearing not only in the evening, but even in the hottest part of the day.

This species, like others of the same tribe, feeds on insects, and seems to be extremely fond of luminous insects, as fire-flies, glow-worms, &c. It is said that it will seize a piece of live wood coal, mistaking it for a luminous insect, and swallow it, seemingly with impunity.

### 45. Rana Semilunata, *Crescent Toad.*

*Specif. Char.*—Colour blackish, paler beneath; a white crescent-shaped spot at each ear.

This species is larger than the common toad, and is particularly distinguished by a large, round, white spot behind the parotids. The body is covered above with tubercles.

### 46. Rana Melanostica, *Black-lipped Toad.*

*Specif. Char.*—Colour yellowish brown; warts black, speckled; upper lip and eyelids edged with black; hind feet subhexadactylous and semipalmated.

This species is nearly the size of the common toad, and resembles it in its general appearance. The space between the eyes is depressed and smooth. The edges of the projecting orbits of the eyes are black; the upper jaw is surrounded with a similar border, and the tips of the toes and the two tubercles of both hind and fore feet are also black.

It is supposed to be a native of China.

### 47. Rana Arunco, *Arunco.*

*Specif. Char.*—Body warted; all the feet webbed.

This species is nearly of the same colour as the common frog, but it is larger in size. The body is warted, and all the feet are palmated.

It is a native of Chili.

### 48. Rana Lutea, *Yellow Toad.*

*Specif. Char.*—Colour yellow; feet subpalmated.

In its general habit this species resembles the common frog, but is smaller in size. The skin is covered with warts, and all the feet are subpalmated.

It is also a native of Chili, and frequents the waters.

## III. DRACO, Dragon.

*Gen. Char.*—The body is four-footed, and is furnished with a tail; on each side there is an expansile, radiated, wing-like skin.

### 1. Draco Volans, *Flying Dragon.*

*Specif. Char.*—The fore legs are unconnected with the wings.

The flying dragon, in many respects, both in its structure and habits, resembles the tribe of lizards; but on account of the expansile cutaneous processes with which the sides are furnished, Linnæus has arranged it under a distinct genus.

The body of this animal is about four inches in length; but from the tip of the nose to the extremity of the tail, it is commonly about nine or ten inches, and sometimes a foot. The form of the head is very singular; it is furnished beneath with a large triple pouch or process, one part of which hangs beneath the throat, while the other two project on each side. They are all sharp-pointed, and are more conspicuous, in proportion to the size of this animal, than the same processes in lizards. The mouth is wide; the tongue large and thick at the base; the teeth are small and numerous; the neck is also small; the body and limbs are slender, and entirely covered with small pointed scales. On the upper part of the body the colour is pale blue, or bluish gray; but the back and tail are marked with transverse dusky bars. The wings are elegantly spotted with patches of black, deep brown, and white, of different forms. The under surface is of a whitish-brown colour.

The flying dragon is a native of Asia and Africa, where it is found frequenting trees; and for this it is peculiarly adapted, from the cutaneous processes with which it is furnished on each side. For by means of these lateral membranes, it is enabled to spring with more facility from branch to branch, and even to support itself for some time in the air, like the bat or flying squirrel. Like the lizard, it feeds on insects.

### 2. Draco Præpos, *American Flying Dragon.*

*Specif. Char.*—Wings united with the arms.

This species is considered by some naturalists only as a variety of the former. The circumstances in which it differs are, that the body and neck are more slender, and the pouch at the throat is single.

It is said to be a native of America.

The real dragon of modern naturalists, it may be observed, is not that terrible and destructive monster, the mere creature of imagination, which existed only in the descriptions of romance, and the older poetry; nor is it

Lizards.

Lizards.

the animal which we find described and figured in some of the writings of the older naturalists. For these, it is now well known, are either entirely fictitious beings, or have been prepared artificially, by joining together the limbs of different animals; and thus producing a monster, under the name of dragon, unknown in nature. This has been done by warping some species of the skate tribe, into what was supposed to be the shape of a dragon, and having raised the fins, and dried them in this position, by adding the legs of birds or other animals. Hence have originated the monstrous representations, which are found in some of the older naturalists, of many-headed dragons, having necks and tails like those of snakes, and feet like those of birds. Deceptions of this kind, it would appear, have been often successfully practised; by which means, not only the vulgar, but also men of science, have been misled and imposed upon. The following is an instance of this kind, which happened about the end of the 17th century. It is quoted by Dr Shaw, and he observes, is thus commemorated by Dr Grainger from a note of Dr Grey, in his edition of Hudibras, vol. i. page 125.

"Mr Smith of Bedford observes to me on the word dragon, as follows: Mr Jacob Bobart, botany professor (or rather superintendant of the garden) of Oxford, did about 40 years ago, find a dead rat in the physic garden, which he made to resemble the common picture of dragons, by altering its head and tail, and thrusting in taper sharp sticks, which distended the skin on each side, till it mimicked wings. He let it dry as hard as possible. The learned immediately pronounced it a dragon, and one of them sent an accurate description of it to Dr Magliabechi, librarian to the grand duke of Tuscany. Several fine copies of verses were wrote on so rare a subject; but at last Mr Bobart owned the cheat; however, it was looked upon as a masterpiece of art, and as such deposited in the museum or anatomy school, where I saw it some years after."

We shall relate another instance of an artificial dragon, with which a similar deception was practised, and which was detected by Linnæus. This dragon was in the possession of a merchant at Hamburgh, and was valued by the proprietor at 10,000 florins. Linnæus, while he was on a visit to that city, detected the cheat, and shewed that it was entirely an artificial animal, composed of the skins of snakes, the teeth of weasels, the claws of birds, &c. It is even said, that Linnæus having made this discovery, was obliged to make a precipitate retreat from Hamburgh, to avoid a prosecution which was threatened by the proprietor on the score of the reputation and value of his property being injured by this discovery.

## IV. LACERTA, Lizard.

*Gen. Char.*—The body is four-footed, elongated, and furnished with a tail; there is no secondary integument.

The numerous genus Lacerta includes a great variety of animals, which, although they possess many characters in common, yet they exhibit considerable differences, not only in their economy and habits, but also in structure and external form. On this account this genus has been divided by some naturalists into a number of distinct genera. We have here, however, according to the Linnæan arrangement, retained the whole under the same genus; but we shall divide the species comprehended under it, as other naturalists have done, into different sections, as follows: 1. Crocodiles; 2. Guanas; 3. Cordyles; 4. Lizards proper; 5. Chamelions; 6. Geckos; 7. Scinks; 8. Salamanders, Newts, or Efts; 9. Snake Lizards.

### Sect. I. Crocodiles.

The character of the animals included under this section is, that they are furnished with very strong scales.

1. Lacerta Crocodilus, *Common Crocodile*, or *Crocodile of the Nile*.

*Specif. Char.*—Head mailed; neck carinated; tail furnished on the upper part with two lateral crested processes.

The crocodile sometimes arrives at a very great size. Individuals of 20 feet long have frequently been seen, and instances are mentioned of some which have exceeded the length of 30, and even 40 feet. When it is full grown, the colour of the upper part of the body is blackish brown; beneath it is yellowish white. The upper parts of the legs and sides are varied with deep yellow, and in some parts tinged with green. The colour of the younger animal is different; for that of the upper part is a mixture of brown and pale yellow, while the under parts are nearly white. The opening of the mouth is of great width, and exhibits somewhat of a flexuous outline. Both jaws are furnished with numerous sharp-pointed teeth; those in the middle part of the jaw being largest, and resembling the canine teeth of viviparous quadrupeds. Each jaw contains 30 teeth or more, for the number is found to vary in different individuals, perhaps from the difference of age. The disposition of the teeth is such, that when the mouth is shut, they alternate with each other. When the teeth have been taken out, and the alveoli examined, it has appeared that small teeth were forming beneath, to supply the loss of the others when shed. The external openings of the ears are placed on the top of the head, above the eyes; they are of moderate size, of an oval form, and covered with a membrane, in which there is a longitudinal slit, giving them the appearance of closed eyes. The eyes are furnished with a nictitating membrane, or transparent moveable pellicle, similar to that of birds. The legs of the crocodile are short, strong, and muscular. There are five toes on the fore feet, and they are unwebbed. On the hind feet there are only four toes, which, towards the base, are united by means of a strong membrane. The two anterior toes on each of the fore feet, and the interior one of the hind feet, have no claws; but the other toes are furnished with claws, which are strong, sharp, and curved. The tail is long, compressed on the sides, and furnished above with an upright process, formed by the gradual approach of two elevated crests which proceed from the lower part of the back. The upper part of the body of the crocodile is covered with strong armour; which, in its structure, exhibits the appearance of a regular and curious carved work, and is indeed a most elaborate piece of mechanism. It is so strong

strong and thick, when the animal has reached its full growth, that it easily resists the force of a musket-ball. On the lower parts of the body, it is more pliable, and much thinner, so that it is in these parts only that wounds can be inflicted.

The crocodile deposits its eggs in the sand or mud, in the banks of the rivers which it inhabits; and as soon as the young are hatched, they proceed to the water. When the young are first excluded, the head is proportionally much larger than that of the full grown animal. The egg of the common crocodile is about the size of that of a goose, and resembles greatly that of a bird. It is covered with a calcareous shell, which is lined with a membranous substance. Various birds, the ichneumon and other animals, make great havock among the eggs of the crocodile during the period of hatching, thus diminishing the numbers which would otherwise be produced. The eggs of the crocodile, and indeed the flesh itself, are regarded as delicacies among some African nations, and compose a part of their favourite repasts.

The crocodile is a native of Asia and Africa, but it seems to be more common in the latter than in the former country. It inhabits the large rivers, as the Nile, the Niger, &c. frequenting the low sand islands of these rivers, and preys chiefly on fish, although, being extremely voracious, it seizes any other animal that comes within its reach.

The crocodile has been long regarded as one of the most formidable animals of the countries which it inhabits; but from the accounts of later naturalists, it appears, that it is by no means so ferocious as has been pretended. Denon, who visited Egypt along with the French army, observes, that many stories are related of crocodiles, but that he had not any opportunity of verifying a single one. "Daring, (says he) even to imprudence, our soldiers set them at defiance. Even I myself bathed daily in the Nile; for the tranquil nights that I thus obtained, rendered me regardless of dangers, which we had not as yet verified by a single fact. If the crocodiles had devoured a few of the carcases which the war left at their disposal, such a food, it might be imagined, would only excite their appetite, and engage them to pursue, when alive, so favourite a prey. And yet we were never once attacked by them, nor did we ever meet with a single crocodile at a distance from the water. Hence it appears probable, that they find in the Nile itself a sufficient quantity of easily procurable food, which they digest slowly, being like the lizard and serpent, cold-blooded, and of an inactive stomach. Besides, having in the Egyptian part of the Nile no enemies but each other and man, they would be truly formidable; if, covered as they are, with an almost impenetrable defensive armour, they were alert and skilful in making use of those which nature has given them for attack *."

The same author observes, that no crocodiles were seen at Syene on the river Nile, but that they are to be met with above the cataracts. "They seem (he says) to prefer certain reaches of the river, and particularly from Tentyra to Ombos; they abound most of all near Hermontes. We here saw three of them; one much larger than the rest, was nearly 25 feet long: they were all asleep, so that we could approach them within 20 paces, and we had time to distinguish all the peculiarities which gave them such a hideous aspect. They resembled dismounted cannon. I fired on one with a heavy musket; the ball struck him, and rebounded from his scales. He made a leap of 10 feet, and dived into the river †."

In the large rivers of Africa, vast shoals of crocodiles are seen swimming together, when they exhibit the appearance of the trunks of large trees floating on the water. It is said that the negroes venture to attack, and often succeed in killing a single crocodile, by stabbing it with a sharp instrument under the belly, where the skin is soft and vulnerable. In some countries, we are told, the hunting of the crocodile with strong dogs is practised for amusement. For this purpose the dogs are properly trained and instructed; and to protect them against the attack of the crocodile, they are armed with collars furnished with spikes.

It is even said, that crocodiles are occasionally tamed in some parts of Africa, and that they constitute an article of royal magnificence with some of the African monarchs, in which case they are kept in large ponds or lakes. It is well known that crocodiles were exhibited by the ancient Romans during their public spectacles. In the edileship of Scaurus, he presented the people with a sight of five crocodiles in a temporary lake; and one was introduced by Augustus in his triumph over Cleopatra, for their entertainment.

*Var.*—A variety of the common crocodile, it is said, has been found in the river Senegal; according to M. Adanson, it has a longer snout, and is almost entirely black. It is said that it is very rapacious, and has only been observed in the above river, where the common crocodiles are very numerous.

### 2. LACERTA ALLIGATOR, *The Alligator* or *American Crocodile.*

*Specif. Char.*—Head flat, imbricated; neck naked, or uncarinated; tail furnished above with two lateral lines.

The alligator is considered by some naturalists only as a variety of the crocodile; any differences which are observable, they suppose, may be ascribed to the effect of climate. They have the same number of teeth, and their manners and habits are nearly similar in the old and new world; but the difference, although not at first sight obvious, seems to be fully established from the more accurate observations of others. The head of the alligator is smooth, and is not furnished with the rugosities and hard carinated scales which appear on the head of the crocodile; and besides, the snout of the alligator is flatter, wider, and more rounded at the extremity. The size of the alligator is little inferior to that of the crocodile. Individuals have been often seen from 18 to 20 feet long.

Catesby, in his history of Carolina, has given a fuller account of the economy and habits of the alligator, than any other author. "Though the largest, says he, and greatest numbers of alligators, inhabit the torrid zone, the continent abounds with them 10° more north, particularly as far as the river Neus in North Carolina. In the latitude of about 33°, beyond which I have never heard of any, which latitude nearly answers to the northernmost parts of Africa, where they are likewise found, they frequent not only salt rivers near the

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* Travels vol. iii. p. 310.

† Ibid. 186.

the sea, but streams of fresh water in the upper parts of the country, and in lakes of salt and fresh water; on the banks of which they lie lurking among reeds, to surprise cattle and other animals. In Jamaica, and many parts of the continent, they are found about 20 feet in length. They cannot be more terrible in their aspect than they are formidable and mischievous in their natures, sparing neither man nor beast they can surprise, pulling them down under water; that being dead, they may with greater facility, and without struggle or resistance, devour them. As quadrupeds do not so often come in their way, they almost subsist on fish; but as Providence, for the preservation, or to prevent the extinction of defenceless creatures, hath in many instances restrained the devouring appetites of voracious animals by some impediment or other; so this destructive monster, by the close connection of his vertebræ, can neither swim nor run any way, but straight forward, and is consequently disabled from turning with that agility requisite to catch his prey by pursuit; therefore, they do it by surprise in the water, as well as by land; for effecting which nature seems in some measure to have recompensed their want of agility, by giving them a power of deceiving and catching their prey by a sagacity peculiar to them, as well as by the outer form and colour of their body, which on land resembles an old dirty log or tree, and in the water frequently lies floating on the surface, and there has the like appearance; by which, and his silent artifice, fish, fowl, turtle, and all other animals are deceived, suddenly catched, and devoured.

"Carnivorous animals get their food with more difficulty and less certainty than others; and are often necessitated to fast a long time, which a slow concoction enables them to endure; reptiles particularly, by swallowing what they eat whole, digest slowly, eat seldom, and live long without food. Wolves are said to gorge themselves with mud, to supply the want of better food. For the like cause, many alligators swallow stones and other substances to distend and prevent the contraction of their intestines when empty, and not to help digestion, which they seem in no need of. For in the greater number of many which I have opened, nothing has appeared but lumps of light wood and pieces of pine-tree coal, some of which weighed eight pounds, and were reduced and worn so smooth from their first angular roughness, that they seemed to have remained in them many months. They lay a great number of eggs at one time on the sandy banks of rivers and lakes, which are hatched by the heat of the sun without further care of the parents. The young, as soon as they are disengaged from their shells, betake themselves to the water, and shift for themselves; but while young, they serve as a prey, not only to ravenous fish, but to their own species. It is to be admired, that so vast an animal should at first be contained in an egg no bigger than that of a turkey.

"In South Carolina they are very numerous; but the northern situation of that country occasions their being of a smaller size than those nearer the line; and they rarely attack men or cattle, yet are great devourers of hogs. In Carolina they lie torpid from about October to March in caverns and hollows in the banks of rivers, and at their coming out in the spring, make a hideous bellowing noise. The hind part of their belly and tail are eaten by the Indians. The flesh is delicately white, but has so perfumed a taste and smell, that I never could relish it with pleasure.

"The alligators of South America, like the turtles, deposit their eggs at two or three different periods, at the distance of several days, and from 20 to 24 eggs each time. They have been observed to raise a small hillock near the banks of the river; and, after hollowing it out in the middle, to collect a quantity of leaves and other vegetable matters, in which they deposit their eggs. These are covered with the leaves, and are hatched by means of the heat extricated during their putrefaction, along with that of the atmosphere. The alligators about Cayenne deposit their eggs in the month of April."

To the account of the alligator which we have now given, we add the following particulars concerning its natural history by Don Ulloa, in his voyage to South America. The observations were made on the river Guayaquil; and we shall detail them in his own words.

"The increase of fish, says he, in this river is greatly hindered by the prodigious numbers of alligators, an amphibious creature, living both in the rivers and the adjacent plains, though it is not often known to go far from the banks of the river. When tired with fishing, they leave the water to bask themselves in the sun, and then appear more like logs of half-rotten wood thrown ashore by the current, than living creatures; but upon perceiving any vessel near them, they immediately throw themselves into the water. Some are of so monstrous a size as to exceed five yards in length. During the time they lie basking on the shore, they keep their huge mouths quite open, till filled with musquetoes, flies, and other insects, when they suddenly shut their jaws and swallow their prey. Whatever may have been written with regard to the fierceness and rapacity of this animal, I, and all our company know from experience, they avoid a man, and on the approach of any one, immediately plunge into the water. Its whole body is covered with scales impenetrable to a musket ball, unless it happens to hit them in the belly near the fore legs, the only part vulnerable.

"The alligator is an oviparous creature. The female makes a large hole in the sand near the brink of a river, and there deposits her eggs, which are nearly equal to those of an ostrich, and as white as those of a hen, but much more solid. She generally lays about a hundred, continuing in the same place till they are all deposited, which is about a day or two. She then covers them with the sand; and the better to conceal them, rolls herself not only over her precious depositum, but to a considerable distance. After this precaution she returns to the water, till natural instinct informs her, that it is time to deliver her young from their confinement, when she comes to the spot, followed by the male, and tearing up the sand, begins breaking the eggs, but so carefully, that scarce a single one is injured, and a whole swarm of little alligators are seen crawling about. The female then takes them on her neck and back in order to remove them into the water; but the watchful gallinazos make use of this opportunity to deprive her of some; and even the male alligator, which indeed comes for no other end, devours what he can, till the female has reached the water with the few remaining; for all those which either fall from her

her back, or do not swim, she herself eats; so that of such a formidable brood, happily not more than four or five escapes.

"The gallinazos mentioned in our account of Carthagena, are the most inveterate enemies of the alligators, or rather extremely fond of their eggs, in finding which they make use of uncommon address. These birds often make it their whole business to watch the females during the summer, the season when they lay their eggs, the sands on the sides of the river not being then covered with water. The gallinazo perches in some tree, where it conceals itself among the branches, and there silently watches the female alligator till she has laid her eggs and retires, pleased that she has concealed them beyond discovery. But she is no sooner under the water, than the gallinazo darts down on the repository, and with its beak, claws and wings, tears up the sand, and devours the eggs, leaving only the shells. This banquet would indeed richly reward its long patience, did not a multitude of gallinazos, from all parts, join the fortunate discoverer and share in the spoil. I have often been entertained with this stratagem of the gallinazos, in passing from Guayaquil to the custom-house of Babahoyo; and my curiosity once led me to take some of the eggs, which those who frequent this river, particularly the mulattoes, make no difficulty of eating when fresh. Here we must remark the methods used by providence in diminishing the number of these destructive creatures, not only by the gallinazos, but even by the males themselves. Indeed neither the river nor the neighbouring fields would otherwise be sufficient to contain them; for, notwithstanding the ravages of these two insatiable enemies, their numbers can hardly be imagined.

"These alligators are the great destroyers of the fish in this river, it being their most safe and general food: nor are they wanting in address to satisfy their desires, eight or ten, as it were by compact, draw up at the mouth of a river or creek, whilst others of the same corps go a considerable distance up the river, and chase the fish downwards, by which none of any bigness escape them. The alligators being unable to eat under water, on seizing a fish raise their heads above the surface, and by degrees draw the fish from their jaws, and chew it for deglutition. After satisfying their appetite, they retire to rest on the banks of the river.

"When they cannot find fish to appease their hunger, they betake themselves to the meadows bordering on the banks of the river, and devour calves and colts; and in order to be more secure in seizing their prey, take the opportunity of the night, that they may surprise them in their sleep; and it is observed that those alligators which have once tasted flesh, become so fond of it, as never to take up with fish but in cases of necessity. There are even too many melancholy instances of their devouring the human species, especially children, who, from the inattention natural to their age, have been without doors after it is dark; and though at no great distance, these voracious animals have dared to attack them, and having once seized them with their mouth, to make sure of their prey against that assistance which the cries of the victim never fail to bring, hasten into the water, where they immediately drown it, and then return to the surface and devour it at leisure.

"Their voracity has also been felt by the boatmen, who, by inconsiderately sleeping with one of their arms or legs hanging over the side of the boat, these animals have seized and drawn the whole body into the water. Alligators who have once feasted on human flesh are known to be the most dangerous, and become, as it were, inflamed with an insatiable desire of repeating the same delicious repast. The inhabitants of those places where they abound are very industrious in catching and destroying them. Their usual method is by a casonate, or piece of hard wood sharpened at both ends, and baited with the lungs of some animal. This casonate they fasten to a thong, the end of which is secured on the shore. The alligator, on seeing the lungs floating on the water, snaps at the bait, and thus both points of wood enter his jaws in such a manner, that he can neither shut nor open his mouth. He is then dragged ashore, where he violently endeavours to rescue himself, while the Indians bait him like a bull, knowing that the greatest damage he can do is to throw down such, as for want of care or agility do not keep out of his reach.

"The form of this animal so nearly resembles that of the lagarto or lizard, that here they are commonly known by that name; but there is some difference in the shape of the head, which in this creature is long, and towards the extremity slender, gradually forming a snout, like that of a hog, and, when in the river, is generally above the surface of the water; a sufficient demonstration that the respiration of a purer air is necessary to it. The mandibles of this creature have each a row of very strong and pointed teeth, to which some writers have attributed particular virtues; but all I can say to this is, that they are such as I and my companions, notwithstanding all our enquiries to attain a complete knowledge of every particular, could never hear any satisfactory account of *."

### 3. LACERTA GANGETICA, *Gangetic or Indian Crocodile.*

*Specif. Char.*—Jaw somewhat cylindrical, elongated; tail furnished above with two crests uniting in one towards the extremity.

In this species, the jaws are long, narrow and straight; and the upper mandible is terminated above by an elevated tubercle. This structure of the snout is more remarkable in the young animal. The teeth of this species are more numerous than in the common crocodile, being nearly double the number, and they are of equal size through the whole length of the jaws. Excepting that the third and fourth toes, both on the fore and hind feet are connected together by a web; the structure of the feet is the same as that of the common one. The eyes are extremely prominent; and it has been observed, are so constructed, that they may be raised above the water, when the rest of the body is under the surface; by which the animal is enabled to see its prey either on the surface of the water, or on the banks of rivers. In the general form and colour of the body and limbs, this species resembles the common crocodile, only the number of transverse bands formed by the rows of scales on the back, is greater.

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* Vol. i. p. 300.

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It is a native of India, and is chiefly found in the Ganges, where it is nearly equal in size to the common crocodile.

### Sect. II. Guanas.

The animals belonging to this section have the back and tail serrated or carinated.

### 4. Lacerta Iguana, *Common* or *Great American Guana.*

*Specif. Char.*—Tail long and round; back serrated; gular crest denticulated.

The guana, which of all the lizard tribe is of the most peculiar form, grows to a considerable size. It is often seen, three, four, and sometimes five feet long. The general colour is green, shaded with brown. The back is strongly serrated; which, as well as the denticulations of the pouch at the throat, gives it a formidable appearance.

The guana is a native of many parts of America, and the West Indies. It is said also that it has been found in some parts of the East Indies. It frequents rocky and woody places, and feeds chiefly on insects and vegetables.

The guana itself is reckoned very nourishing and delicate food. The usual method of taking it, is by casting a noose over its head, and then drawing it from its place; for without making any attempt to escape, it stands with its eyes fixed stedfastly at its discoverer, while at the same time it inflates its throat to a very large size.

Catesby has given a good account of the guana, which we shall detail in his own words. "They are," he says, "of various sizes, from two to five feet in length; their mouths are furnished with exceeding small teeth, but their jaw is armed with a long beak, with which they bite with great strength. They inhabit warm countries only, and are rarely to be met with anywhere north or south of the tropics. Many of the Bahama islands abound with them, where they nestle in hollow rocks and trees. Their eggs have not a hard shell like those of alligators, but a skin only like those of a turtle, and are esteemed a good food. They lay a great number of eggs at a time in the earth, which are there hatched by the sun's heat. These guanas are a great part of the subsistence of the inhabitants of the Bahama islands, for which purpose they visit many of the remote keys and islands in their sloops to catch them, which they do by dogs trained up for that purpose, which are so dexterous as not often to kill them; which, if they do, they serve only for present spending: if otherwise, they sew up their mouths to prevent their biting, and put them into the hold of their sloop till they have catched a sufficient number; which they either carry alive for sale to Carolina, or salt and barrel up for the use of their families at home. These guanas feed wholly on vegetables and fruit, particularly on a kind of fungus growing at the roots of trees, and on the fruits of the different kinds of anonas. Their flesh is easy of digestion, delicate, and well tasted. They are sometimes roasted, but the more common way is to boil them, taking out the leaves of fat, which are melted and clarified, and put into a calabash or dish, into which they dip the flesh of the guana as they eat it. It is remarkable that this fat, which adheres to the inside of the abdomen, imbibes the colour of the fruit the animal eats last, which I have frequently seen tinged of a pale red, yellow, or sometimes of a purple colour; which last was from eating the *prunus maritima*, which fruit at the same time I took out of them. Though they are not amphibious, they are said to keep under water above an hour. When they swim, they use not their feet, but clap them close to their body, and guide themselves with their tails. They swallow all they eat whole; they cannot run fast, their holes being a greater security to them than their heels. They are so impatient of cold, that they rarely appear out of their holes but when the sun shines."

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Dr Browne, in his Natural History of Jamaica, gives the following particulars of the guana. "Like most of the tribe, he observes, it lives a very considerable time without food, and changes its colour with the weather, or the native moisture of its place of residence. I have kept a grown guana about the house for more than two months: it was very fierce and ill-natured at the beginning; but after some days it grew more tame, and would, at length, pass the greatest part of the day upon the bed or couch, but it went out always at night. I have never observed it to eat any thing, except what imperceptible particles it had lapped up in the air; for it frequently threw out its forked tongue, like the chamelion, as it walked along. The flesh of this creature is liked by many people, and frequently served up in fricasees at their tables; in which state they are often preferred to the best fowls. The guana may be easily tamed while young, and is both an innocent and beautiful creature in that state."

*Var. Horned guana.* This is considered as a variety of the former. It is nearly the same in size and general proportion; the back is also serrated, and the form of the scales is the same. It wants, however, the gular pouch, and there are in front of the head, between the eyes and nostrils, four pretty large scaly tubercles, behind which there is a bony conical process, which is covered with a single scale.

It is a native of St Domingo, where it is said to be very common.

### 5. Lacerta Amboinensis, *Amboina Guana.*

*Specif. Char.*—Variegated, tail long, tail fin radiated, dorsal suture dentated.

This species, which grows to the length of three feet, and sometimes more, is at once distinguished by the singularity of its appearance, and the beauty of its colours. The head and neck are green, and variegated with white transverse undulations. The back and tail are brown, with a shade of purple. The sides and belly are grayish, or pale brown; the head is tuberculated above, and covered with small roundish scales; the mouth is wide, and the teeth are sharp and numerous.

This species is a native of the East Indies, but is most frequent in the island of Amboina, frequenting the neighbourhood of rivers and other fresh waters. It is often seen on the banks of rising grounds, and on low shrubs which grow near the water. It does not ascend tall trees. Whenever it is disturbed by the approach

proach of men or any animal, it plunges into the water, and conceals itself beneath the rocks or stones under the banks. It may be easily taken, as it does not attempt to bite or defend itself, but seems in some measure stupified.

This species, like others of the tribe, deposits its eggs in the sand, on the banks of the rivers which it frequents. The eggs in the body of the animal are disposed in two long groups or clusters, and are of a yellow colour; but when they are excluded, they are white, and of an oblong shape. The Amboina guana is reckoned a more delicate food than the common one; its flesh is said to be white, sweet, and of a penetrating odour.

### 6. Lacerta Basilicus, *Basilisk.*

*Specif. Char.*—Tail long; dorsal and caudal fins radiated; occipital crest pointed.

The basilisk is about one foot and a half in length, of a pale ash-brown colour, with some darker variegations about the upper part of the body. In the young animal, the dorsal or caudal process, and the pointed occipital crest mentioned in the specific description, are less distinct.

The basilisk is chiefly a native of South America. It resides principally among trees, and feeds on insects.

It is said to be a very active animal, and by means of its dorsal crest or fin, it is enabled to spring from tree to tree. It can also swim with great ease.

This animal has a very formidable appearance, but is quite harmless; but in the poetical descriptions of the ancients, we find that it was considered to be the most malignant of all poisonous animals; even its look was regarded as fatal. The terrific glance of the basilisk in the African deserts, according to the poetical representation of Lucan, obliged the rest of the poisonous tribe to keep at a distance.

### 7. Lacerta Calotes, *Galeot Lizard.*

*Specif. Char.*—Tail long and round; back dentated on the fore part, and the head on the hind part.

This species seldom exceeds a foot and a half in length, from the tip of the nose to the extremity of the tail; but otherwise in its general habit and appearance, it resembles the common guana. It wants, however, the gular pouch; in its place there is only a slight enlargement of the throat. The colour, which occasionally varies, is most commonly of an elegant bright blue, variegated with broad, irregular, white, transverse bands on each side of the body and tail. The limbs are slender, and this is particularly the case with the toes.

This species is a native of the warmer regions of Africa, Asia, and many of the Indian islands. It is very common in Ceylon. It is said also to be a native of Spain, where it wanders about the tops of houses, in search of spiders. According to some, it preys on rats, and, like some other lizards, attacks small serpents.

### 8. Lacerta Agama, *American Galeot.*

*Specif. Char.*—Tail long, round; neck above, and head behind, aculeated; scales of the hind head reversed.

This species in some respects resembles the calotes; but it wants the strong serratures on the back, in place of which it has only a small denticulated carina. The head is proportionally larger, and on the back part is furnished with sharp-pointed scales, some of which are reversed at their extremities. The colour is brownish, and variously clouded. In the male, the crest on the back is composed of longer spines, and extends to the lower part.

It is a native of South America, and some of the islands of the West Indies.

Var. *Lacerta Muricata*, Muricated Lizard. Tail long, round; body grayish; scales carinated and sharp-pointed.

This lizard, which is considered as a variety of the preceding, measures more than a foot in length, and has even been sometimes found to exceed that size. The want of the reverse scales on the back part of the head, constitutes the principal difference between this and the former species.

It is a native of New South Wales.

### 9. Lacerta Bicarinata, *Bicarinated Lizard.*

*Specif. Char.*—Tail of moderate length; four rows of strong carinated scales on the back.

In its general habit, this species bears some resemblance to a small crocodile, on account of the hard tuberculated and carinated scales on the upper parts of the body, two rows of which are more prominent than the rest, and extend from the upper part of the back to the tail, where they coalesce and form a serrated crest to the extremity.

The head is small, the mouth wide, and the snout somewhat sharp. The colour is reddish-brown, tinged in some parts with various shades of green.

It is a native of South America, where it is sometimes used as food. The eggs, it is said, are also greatly esteemed for the same purpose. Woody and marshy regions are the usual places of its resort. One of this species, which was kept alive for some time by M. de la Borde, was observed to remain for hours together in the water, and when it was disturbed or alarmed, it concealed itself, but delighted to come out occasionally and bask in the sun.

*Var.* A lizard known by the name of *ignaruca*, and said to be a native of Brazil, is considered as a variety of the preceding, differing only in the colour, which is darker, and the claws which are shorter; but, like it, it has some resemblance to the crocodile, and readily climbs trees.

### 10. Lacerta Monitor, *Monitory Lizard.*

*Specif. Char.*—Colour black; tail very long, compressed, carinated; body marked with transverse rows of white, ocellated.

This is one of the largest of the whole tribe of lizards. From the tip of the nose to the extremity of the tail, it sometimes measures no less than four or five feet. It is also one of the most beautiful. The head is small, the snout gradually tapers, the limbs are slender, and the tail, which is laterally compressed, gradually decreases towards the extremity. Indeed the shape altogether is slender and elegant; and although the colours are simple, they

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they are so disposed as to produce an agreeable and pleasing effect. This species is a native of South America, inhabiting woody and marshy places.

It is said that the monitory lizard, from the gentleness of its disposition, is remarkable for its attachment to mankind, warning them of their danger from the alligator by emitting a peculiar and shrill sound.

Var. *Lacerta Varia*, Variegated Lizard.—Although this lizard is somewhat different in colour, and in the disposition of its variegations, which are rather of a pale yellow than white, yet it is considered only as a variety of the preceding. It is a native of New Holland.

### 11. Lacerta Acanthura, *Spine-tailed Lizard.*

*Specif. Char.*—Throat plaited beneath; body covered with minute scales; tail long, and verticillated with carinated triple-spined scales.

The length of this species is about a foot and a half. The head is covered with scales, which are small and nearly six-sided; it is quite distinct from the body. The whole skin about the neck, throat, and beginning of the sides, is quite loose, which in the specimen described, may have had a pouched appearance. All the other parts of the body are covered with very small scales. The tail is very long, and strongly marked into numerous rings, which are composed of long and strongly carinated scales, each of which terminates in a lengthened point, and produces the spiny appearance. There are five long toes on each foot; the claws are strong and sharp. The colour on the upper parts of the body is glaucous, variegated with small whitish clouds and marblings.

It is described by Dr Shaw from a specimen in the British Museum.

### 12. Lacerta Lophura, *Sharp-tailed Lizard.*

*Specif. Char.*—Body covered with dissimilar scales; back serrated; tail long, and somewhat compressed.

This is a very large species; there are large, rounded, and oval scales scattered here and there among the smaller ones. The tail is long and sharp-pointed; the back and tail are serrated throughout their whole length.

This species is also described by Dr Shaw from a specimen in the British Museum.

### 13. Lacerta Dracæna, *Dracæna Lizard.*

*Specif. Char.*—Large tail; long and denticulated along the upper part.

This is one of the largest species belonging to the tribe. Not only in the size of the body, but in the proportion of the limbs and tail, it exceeds that of the guana. The colour is brown, with a slight shade of chesnut. On the outsides of the limbs there are numerous small pale yellowish spots. The head is small, and the snout tapering.

It is a native of South America, and some of the Indian islands; and it is said that in some countries it is preferred as an article of food to the guana.

### 14. Lacerta Superciliosa, *Supercilious Lizard.*

*Specif. Char.*—Tail carinated; back and eyebrows ciliated, with upright lanceolated scales.

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The general appearance of this species bears some resemblance to the guana, and still more to the horned guana, in having the appearance of a pair of sharp pointed horn-like processes above and beyond each eye; between these are placed some aculeated scales. The size of one which has been described, measures from 12 to 16 inches, from the tip of the nose to the extremity of the tail.

It is a native of Asia, and some of the Indian islands.

### 15. Lacerta Scutata, *Scutated Lizard.*

*Specif. Char.*—Tail of moderate length, compressed; dorsal suture dentated; two pointed processes on the back of the head.

This species is distinguished from the former by having a proportionally larger head, and a row of scales more elevated than the rest, passing over each eye; and from these a ridge is continued towards the back of the head, where they unite and extend down the middle of the back, in form of a short denticulated crest, to the beginning of the tail. The body is covered with acuminated scales which are but small; the limbs and tail with larger ones.

### 16. Lacerta Principalis, *Smooth-crested Lizard.*

*Specif. Char.*—Tail subcarinated; gular crest plain edge; back smooth.

This species is in general of a slender form, and small, rarely exceeding eight or nine inches in length, including both the body and tail. The colour is blue, the head small, and the snout taper.

It is a native of South America.

Var. *Lacerta bimaculata*, Linn.

This is considered as a variety of the former; the colour is blue, spotted here and there with black, with two larger black spots over the shoulders.

It is a native of St Eustatia, and is found also in Pennsylvania.

Var. *Le Roquet*, of Cepede, is considered by Dr Shaw also as a variety of the smooth-crested lizard, as it resembles it both in size and habit; it is however destitute of the gular crest.

It frequents gardens, moving nimbly among trees, and devours great multitudes of smaller insects.

### 17. Lacerta Strumosa, *Strumous Lizard.*

*Specif. Char.*—Tail long, round; breast gibbose, projecting.

This is of a small size, has no dorsal serratures, but is furnished with a large flat gular crest of a pale red colour; the rest of the animal is of a pale bluish gray, with some slight shades of a more dusky hue. The limbs are slender.

It is a native of South America.

### 18. Lacerta Marmorata, *Marbled Lizard.*

*Specif. Char.*—Tail long, round; throat subcrestated; back smooth.

This species is of a slender and elegant form, and measures, including the tail, about a foot in length. The

The head is small, the snout taper. The colour is pale blue, variegated with undulating transverse bands of a whitish shade. The belly is of a pale rose colour.

It is a native of America and the West Indies.

### 19. Lacerta Umbra, *Umber Lizard.*

*Specif. Char.*—Tail long, round; neck subcrestated above; hind head callous; back striated.

This is a small species; the body is covered with scales, which are carinated and pointed; the head is obtuse, and marked on the hind part with a large callous bare spot.

It is a native of North America.

## Sect. III. CORDYLES.

Having denticulated or spiny scales, on the body or tail, or both.

### 20. Lacerta Pelluma, *Pelluma Lizard.*

*Specif. Char.*—Tail long, and verticillated with rhomboidal scales.

This lizard is about two feet in its total length, and is distinguished on the upper parts of its body by a beautiful variety of green, yellow, blue, and black colours. The under parts of the body are of a glossy yellowish green.

It is a native of Chili.

### 21. Lacerta Azurea, *Azure Lizard.*

*Specif. Char.*—Tail short, verticillated with mucronated scales.

This is of a fine blue colour, transversely banded with black or blue. It is sometimes only a few inches long, but others are found of a larger size.

The larger variety is a native of South America, the smaller of some parts of Africa.

### 22. Lacerta Cordylus, *Cordyle Lizard.*

*Specif. Char.*—Body smooth; tail short and verticillated with denticulated scales.

This species, at first sight, bears a considerable resemblance to the former; but the scales which cover the body, are of an oblong square form, and larger, and the tail is verticillated with rows of large scales of the same form. The colour is sometimes blue, sometimes a livid brown, and the total length is about ten inches.

### 23. Lacerta Stellio, *Rough Lizard.*

*Specif. Char.*—Tail verticillated, with denticulated scales; body and head muricated.

The whole upper surface of the body is remarkably rough, from being covered with projecting pointed scales. It is of a pale bluish brown colour, with some deeper and lighter transverse variegations. It is about eight inches long.

This species is a native of many parts of Africa.

### 24. Lacerta Angulata, *Angulated Lizard.*

*Specif. Char.*—Tail long, hexagonal, and furnished with carinated and mucronated scales.

This is a small species of a brown colour. Beneath the throat there are two large rounded scales. The tail is longer than the body, and strongly marked with six longitudinal ridges.

It is a native of America.

### 25. Lacerta Orbicularis, *Orbicular Lizard.*

*Specif. Char.*—Body brown, round; tail short, round; scales muricated.

The colour of this species is dusky brown, variegated with different shades, the body is large and ventricose, and in this respect it resembles the toad.

This is a native of South America, but is a rare species.

## Sect. IV. LIZARDS PROPER.

The surface of the body is smooth, and they are generally furnished with broad square plates or scales on the abdomen.

### 26. Lacerta Agilis, *Green Lizard.*

*Specif. Char.*—Of a green colour, with minute dusky variegations. There is a collar of large scales beneath the neck; tail long, verticillated.

The length of this species is from 10 to 15 inches; but it sometimes arrives at such a size as to measure more than two feet to the end of the tail. The colour consists of a mixture of different shades of green, with spots of yellow, brown, black, and sometimes red. The head is covered with angular scales, and the rest of the upper parts of the body with small ovate ones. The tail is longer than the body, and is marked with numerous rings of oblong square scales.

This species is a native of all the warmer parts of Europe. It is found in gardens about warm walls, buildings, &c. It is a very active animal, and pursues its prey, which consists of insects, with great celerity. When it is caught, it soon becomes familiar, and may even in some measure be tamed.

*Var.* The gray lizard, or little brown lizard, which is also a native of many parts of Europe, is considered as a variety of the former. It is about six or eight inches long, of a greenish brown, or pale grayish colour.

This variety is a native of Britain, and is found on the sides of dry banks or sand hills, where it is occasionally seen basking during the heat of summer. It is also found about the roots of trees, old walls, &c.

### 27. Lacerta Teguixin, *Variegated Lizard.*

*Specif. Char.*—Tail long, round; sides somewhat wrinkled; plate under the throat triple.

This species is sometimes larger than the guana. The head is covered with large scales or plates, and the body with smaller and square scales. The colour is extremely beautiful; it consists of an elegant variegation of black, brown, and purple spots, and a pale bluish, white, and yellowish ground.

It is a native of South America.

### 28. Lacerta Erythrocephala, *Red-headed Lizard.*

*Specif. Char.*—Colour blackish green, undulations transverse and black; abdomen longitudinally banded with black, white, and blue; breast black; top of the head red.

This species is of a moderate size; the scales on the head are largest, and there is a row of tubercles beneath the thighs.

It is a native of the island of St Christopher.

### 29. Lacerta Cerulea, *Ameiva Lizard.*

*Specif. Char.*—Colour blue, with black and white variegations; tail long, verticillated; abdominal scuta 30.

The ameiva greatly resembles the green lizard, but it wants the scaly collar. The scales on the upper part of the body are not distinctly visible; those of the abdomen are composed of square plates, and there is a row of tubercles beneath each thigh.

It is a native of South America, and it is said that it is sometimes found in Africa and Asia.

### 30. Lacerta Lemniscata, *Striped Lizard.*

*Specif. Char.*—Colour dusky blue; eight white lines down the back; limbs spotted with white; tail long, round.

This is of a smaller size than the last species, but in its general appearance bears a considerable resemblance. The white stripes on the back vary in breadth, and sometimes in number.

It is a native of Guinea, but is also found in some parts of India and South America.

### 31. Lacerta Quadrilineata, *Four-striped Lizard.*

*Specif. Char.*—Colour blackish blue; four white or yellowish lines down the back; tail long, round; fore feet tetradactylous.

This is a smaller species than the last, but resembles it greatly. The claws are very small.

It is supposed to be a native of North America.

### 32. Lacerta Teniolata, *Ribband Lizard.*

*Specif. Char.*—Body marked above with black and white stripes; beneath white; tail long and round.

This is a small species; the colour above is chesnut brown, and the scales on every part of the body are smooth, round, and imbricated. From the head to the middle of the tail there are six white linear stripes. The limbs are striped longitudinally with black.

It is a native of New Holland.

### 33. Lacerta Sexlineata, *Six-lined Lizard.*

*Specif. Char.*—Colours gray brown; six white lines down the back; tail long, verticillated.

This is a small species. Beneath the throat there is a double plate, and a row of tubercles beneath the thighs. The legs are long and the feet slender; the tail is carried curved over the back, from which it has been called the lion lizard.

It is a native of the West Indies, where it frequents the rocks on the sea coast.

### 34. Lacerta Fasciata, *Fasciated Lizard.*

*Specif. Char.*—Colour of the body brown; tail blue and rather long. There are five yellowish lines down the back.

This is a small species, rarely exceeding eight inches in its whole length. The head is short.

It is a native of Carolina, inhabiting hollow trees.

### 35. Lacerta Quinquelineata, *Five-lined Lizard.*

*Specif. Char.*—Colour dusky; five whitish lines down the back; tail round, and of a moderate length.

This is a small species. The tail is twice the length of the body. There are six stripes on the head. The abdomen is imbricated with striæ.

It is a native of Carolina.

### 36. Lacerta Interpunctata, *Punctated Lizard.*

*Specif. Char.*—Tail long, round; dorsal lines two, and yellow, having black specks interspersed.

This is a small species; the body is smooth and glossy, and the head is covered with large scales.

It is a native of Asia.

### 37. Lacerta Bullaris, *Red-throated Lizard.*

*Specif. Char*—Colour green; gular pouch red; tail long, round.

This species is about six inches long, of a shining grass-green colour. When it is approached, the throat swells into a globular form, and the protruded skin becomes of a bright red colour. This is supposed to be a threatening aspect, but probably without foundation.

This species is a native of Jamaica, where it is common about hedges and trees.

*Var.* Green Carolina lizard.—This resembles the former in every respect, except in the appearance of the gular pouch. In dry hot weather it appears of a bright green colour; but in cold weather this changes to a brown.

It is a native of Carolina, where it is very common about houses.

### 38. Lacerta Cruenta, *Red-tailed Lizard.*

*Specif. Char.*—Colour brown; on the neck there are seven white stripes, and four on the back. Under the throat there is a plate; the tail is verticillated and red beneath.

There is a very small species, resembling the *lacerta velox*, but differs from it in having a sharper snout. The limbs are marked with white round spots; the tail is red beneath and white at the tip. There is a row of tubercles on the thighs.

It is a native of the southern parts of Siberia, and is found about the salt lakes.

### 39. LACERTA LOBATA, *Lobe-cheeked Lizard. Lacerta Aurata*, Lin.

*Specif. Char.*—Colour brownish, with a roundish denticulated lobe on each side of the neck.

This species is of moderate size, and in appearance is somewhat thick or ventricose. Body rather depressed; the head rounded on each side. From the corner of the mouth extending to the shoulders, there is a flat semiorbicular lobe of a red colour, with serrated edges. The whole of the body is rough, with small pointed granules.

It is a native of the southern deserts of Siberia, and is found among the sand hills.

### 40. LACERTA HELIOSCOPA, *Sun-gazing Lizard.*

*Specif. Char.*—Colour brownish; head rough, with celli; a transverse plate beneath the throat; tail imbricated, thick at the base, and sharp at the tip.

This is a small species, scarcely exceeding a finger's length. The colour of the upper parts of the body is gray, with brown and bluish spots and linear streaks. The neck is often marked above with a red spot. The tip of the tail is red beneath.

It is a native of the southern parts of Siberia, where it basks in sunny situations, with its head turned up towards the sun.

### 41. LACERTA TURCICA, *Turkish Lizard.*

*Specif. Char.*—Colour brown; body roughish; tail of moderate length, and somewhat verticillated.

This is a small species; the head is rather large, and the body thickish; the tail short, thick at the base, and pointed at the tip.

It is a native of eastern countries.

### 42. LACERTA PLATURA, *Broad-tailed Lizard.*

*Specif. Char.*—Colour gray brown, paler beneath; body rough; tail depressed, lanceolated, and spiny on the margin.

This species is from four to six inches long, and is remarkably distinguished by the singular form of its tail. The feet are pentadactylous; the toes slender, and the claws curved.

It is a native of New Holland.

### 43. LACERTA PLICA, *Plica Lizard.*

*Specif. Char.*—Hind head callous; eyebrows excoriated above; neck plated beneath, and warted at the sides; tail long and round.

This is a small species, not exceeding a finger's length. It is entirely covered with conical scales; there is a double plate beneath the throat.

It is a native of South America and India.

### 44. LACERTA JAPONICA, *Japanese Lizard.*

*Specif. Char.*—Tail long, round; feet unguiculated; fore feet tetradactylous; a single stripe on the back.

This is a small species; the colour above is livid brown, and the yellow stripe from the hind head to the beginning of the tail is brown and dentated. The claws are black.

### 45. LACERTA NILOTICA, *Nilotic Lizard.*

*Specif. Char.*—Tail long and triquetrous; body smooth, with four lines of scales down the back.

This likewise is a small species.

It is a native of Egypt.

### 46. LACERTA TILIGUERTA, *Tiliguerta Lizard.*

*Specif. Char.*—Tail verticillated, twice the length of the body, and having eighty abdominal scuta.

This, like the former, is a small species, measuring not more than seven or eight inches long. The female is of a brown, and the male of a green colour, with black spots. It seems to bear some relation to the green lizard.

It is a native of Sardinia, where it is to be met with in fields, about walls, &c.

### 47. LACERTA DESERTI, *Desert Lizard.*

*Specif. Char.*—Tail round, longish; feet pentadactylous; body black above, and marked with six longitudinal white lines,

This is a very small species; the body is white beneath, and the stripes on the back are composed of oblong spots.

It is a native of the Uralian desert.

### 48. LACERTA ARGUTA, *Argute Lizard.*

*Specif. Char.*—Tail short, verticillated; thick at the base and filiform at the tip; collar marked with obscure scales. There is a remarkable double plate under the neck.

This species is somewhat similar to the green lizard, but is shorter and more ventricose, and has a sharper snout.

It is a native of the south of Siberia.

### 49. LACERTA ALGIRA, *Algerine Lizard.*

*Specif. Char.*—Tail long, verticillated; two yellow lines on each side of the body.

This species is about a finger's length, brown above, and yellowish beneath.

It is a native of Algiers.

### 50. LACERTA VELOX, *Swift Lizard.*

*Specif. Char.*—Tail longish, verticillated; scaly collar beneath the neck; body cinereous, with five longitudinal paler bands, variegated with black specks; the sides spotted with black, and speckled with blue.

This species is much smaller and more slender, but in other respects comes very near to the *lacerta agilis.* The hind feet are marked with orbicular spots.

It is a native of Siberia.

### 51. LACERTA URALENSIS, *Ural Lizard.*

*Specif. Char.*—The tail is long and round; the neck plated beneath; the feet are pentadactylous, and the back is livid, rugose, and subverrucose.

The length of this animal is about four inches; the head is roundish; the colour of the upper parts is livid brown, and the skin is wrinkled and slightly tuberculated.

It is a native of the desert of Ural, and moves about with great swiftness.

### 52. Lacerta Seps, *Seps Lizard.*

*Specif. Char.*—Colour bluish brown; tail longish, verticillated; lateral suture reflexed; scales square.

This is a small species, and is easily known from the thin lengthened form of its body, and long slender tail, as well as from the square scales with which it is entirely covered. The tail is marked with about 50 divisions.

It is a native of the southern parts of Europe.

## Sect. V. Chameleons.

These are distinguished by having a granulated skin, a large head, a long missile tongue and cylindrical tail.

### 53. Lacerta Chamæleon, *Common Chameleon.*

*Specif. Char.*—Crown flat; tail cylindrical and incurvated; toes united by two and three.

The length of the chameleon, from the tip of the nose to the beginning of the tail, is about ten inches. The tail is nearly of the same length. The skin on every part of the animal is granulated. A series of obscure denticulations runs down the back, and forms a ridge on that part. There are five toes on each foot, two and three of which are united by a common skin, as far as the claws; the two outward and the three inward toes of the fore feet are united, and the two inward and three outward of the hind feet. The structure of the tongue of the chameleon is very peculiar; it is very long, and furnished with a dilated somewhat tubular tip, by which means it is enabled easily to seize insects, which are its prey, by darting it out and securing them on the tip.

The chameleon, like others of the amphibia, has the power of inflating its lungs, and retaining the air for a long time. It is in this way that it sometimes appears plump and fleshy, while at other times, when the air is ejected, and the lungs in a collapsed state, it exhibits nothing but skin and bone. The natural colour of the skin of the chameleon is of a bluish ash, and the usual changes are from this to a green or yellowish colour, spotted unequally with red. When the animal is exposed to full sunshine, the darkened side appears in a few minutes of a pale yellow, with large roundish spots of red brown; but when the animal is turned round, the reverse takes place. The side formerly in the shade appears of a brown or ash colour, and the other side yellow and red. These changes, however, vary greatly, both with regard to the disposition of the spots and the intensity of the colours.

The chameleon is a native of Europe, Africa, and Asia. It is indeed chiefly found in tropical regions; but is also sometimes met with in the warmer parts of Spain and Portugal.

No animal has been more celebrated than the chameleon, and particularly on account of the power which it was supposed to possess of changing its colour. This account was greatly exaggerated, when it was asserted, that it could produce this change at pleasure, and assimilate it to that of any particular object. But the more accurate observations of modern naturalists have shewn, that this change of colour varies greatly, and seems to depend on the state of the animal's health, the temperature of the weather, and probably some other unknown causes. Another erroneous assertion with regard to the chameleon was, that it could live entirely on air. This no doubt arose from the long abstinence which this animal, as well as many others belonging to the class *amphibia*, can endure.

### 54. Lacerta Africana, *African Chameleon.*

*Specif. Char.*—Colour blackish; crown carinated.

This is one of the largest yet discovered. Along the back to the end of the tail there runs a pure white stripe, bounded by a broad blackish band. The other parts of the animal are variegated with pale ash-coloured undulations.

It is supposed to be a native of Barbary.

### 55. Lacerta Pumila, *Little Chameleon.*

*Specif. Char.*—Body bluish on each side, and marked with two yellowish lines.

The head of this species is somewhat flatter than the former, but still elevated in the middle, and edged on each side with a denticulated margin.

By some the two latter seem to be considered only as varieties.

## Sect. VI. Geckos.

In the animals of this division the skin is granulated or tuberculated; the feet are lobated, and the toes lamellated beneath.

### 56. Lacerta Gecko, *Common Gecko.*

*Specif. Char.*—Livid, with brown variegations; upper part of the body warted, and the lamellæ of the feet not divided.

This animal is said to have received the name of *gecko* from the peculiar sound of its voice, which bears some resemblance to that word when uttered in a shrill tone. Its length, in general, is about a foot or more, and therefore it ranks among the middle-sized animals of the lizard tribe. Its form is thicker and stronger than the greater part of lizards. Its head is flattish, somewhat triangular and large, with a covering of minute scales; its mouth is wide, eyes large, teeth small, and its tongue is broad and flat. The limbs of this animal are moderately long, with broader feet than the rest of the tribe; the toes are dilated on the margins, and beneath are divided into a number of transverse lamellæ parallel to each other, without any longitudinal furrow. The general colour of the gecko is a pale brown,

brown, with some irregular dusky or bluish variegations; but this colour becomes much more brilliant in warmer regions.

It is a native of Asia and Africa, and some of the warmer parts of Europe, inhabiting obscure recesses, caverns, old walls, &c. It has been supposed to be of a poisonous nature. A fluid exudes from the lamellæ of the feet, which is said to be extremely acrid; and when any of it has remained on fruit, when it is eaten, it is said that it produces troublesome symptoms. The peculiar structure of the feet enables the animal to attach itself to the smoothest surfaces.

Var. *Tokai.*—This, which is considered as a variety of the former, is about a foot long. The body is covered above with a granulated skin, varied with red and blue undulations; the belly is ash colour, and interspersed with red spots; the head is large and triangular.

This is a native of Siam, where it occasionally enters the houses, and is considered as a poisonous animal.

The Indian salamander, described by Bontius, seems to be of the same kind; the length is about a foot; the colour sea-green, spotted with red; the head large, and like that of a toad; the body is broad and the tail long.

It is a native of Java. It is said that the inhabitants hold up the animal by the tail to make it discharge saliva from its mouth, which is collected for the purpose of poisoning their arrows.

### 57. Lacerta Dubia, *Geckotte.*

*Specif. Char.*—Livid colour; upper surface covered with pointed warts; no femoral papillæ.

This species bears some resemblance to the gecko; but differs from it in being thicker and shorter, and in wanting the papillæ under the thighs. The tail in the young animal is divided into strongly marked aculeated rings. These become gradually less conspicuous with the age of the animal, and are at last totally obliterated.

It is a native of the south of France, where it is known by the name of *tarente*, and is regarded as an innocent animal. It frequents ruins, walls, houses; delights greatly in sunshine, and avoids damp shady situations. It remains concealed in the hollows of walls during winter, not, however, in a torpid, but in an inert state.

### 58. Lacerta Perfoliata, *Perfoliated Gecko.*

*Specif. Char.*—Colour brownish, smooth above; lamellæ of the feet divided by a furrow; tail frequently turbinated.

This species is of a thicker form, has shorter limbs, and the tubercles on the back are less distinct than the common gecko. It is also different in wanting the papillæ under the thighs. The tail is remarkably swelled immediately beyond its origin, and then tapers to the extremity, somewhat resembling a young turnip root, from whence it has been denominated *lacerta rapicauda*.

Its native country is not mentioned.

### 59. Lacerta Mauritanica, *Mauritanic Gecko.*

*Specif. Char.*—Colour brown, covered above with sharp warts; tail flat, and furnished with scuta beneath; lamellæ of the feet lunulated and divided.

This species resembles the common one, but is different from being covered with spiny or sharp-pointed warts on the upper surface. The toes are lamellated beneath, but are not divided by a middle sulcus.

### 60. Lacerta Sinensis, *Chinese Gecko.*

*Specif. Char.*—Tail flat, all the toes unguiculated; face perforated with several pores.

The head is broad and flat; the teeth small; the tongue flat, and emarginated at the tip. About the sides of the nose and eyes there are several scattered pores.

It is a native of China, and is frequently seen in houses, running about the walls, and climbing readily on the smoothest surfaces. It preys chiefly on the smaller kind of cock-roach. It is considered as an innocent animal.

### 61. Lacerta Vittata, *White-striped Gecko.*

*Specif. Char.*—Colour yellowish brown, with a white dorsal band, which is forked over the head.

This is a small species, not exceeding seven or eight inches in length; the head is large in proportion to the body; the toes are lamellated beneath, divided by a sulcus, and terminated by curved claws. The upper surface is covered with extremely small tubercles: they are so minute as to be scarcely perceptible.

This species is said to be a native of India.

### 62. Lacerta Fimbriata, *Fimbriated Gecko.*

*Specif. Char.*—A membranaceous fimbriated border on each side of the body; tail flat; lamellæ of the feet divided by a furrow.

This is a very remarkable species, which, as the count de Cepede, who describes it, observes, seems in some degree to connect the chameleon, the gecko, and the water-newts. The largest individual which he examined measured about eight inches and a half in length. The head is large and flattened, and its outline seen from above is nearly triangular, as in the chameleon; but the triangle is of a longer form, and there is no rising crest. The most remarkable part of its structure is the fringed process which commences on each side of the head, and is continued along the sides of the body. The colour of this animal varies as in the chameleon, exhibiting different shades of red, yellow, green and blue.

It is a native of Madagascar, where it is pretty common. It is a harmless animal, and yet is regarded with great abhorrence by the natives, who consider it as of a poisonous nature, and run from it with great precipitation. This popular prejudice is supposed to have arisen from a peculiar habit of the animal, of running with open mouth towards the spectator, instead of making its escape when it is discovered. It appears chiefly in rainy weather, moving about with great agility, and springing

ing from one branch of a tree to another in search of insects, which are its proper food.

### 63. Lacerta Tetradactyla, *Four-toed Gecko.*

*Specif. Char.*—Colour yellow, varied with green; tail flat; feet tetradactylous.

This species is about 12 inches long, and is nearly allied to the preceding species, except that it wants the fimbriated margin, and the number of the toes on the fore feet being only four.

It is also a native of Madagascar, and is not held in less abhorrence by the inhabitants than the former. It lives in the woods, appearing in the rainy season during the night.

### 64. Lacerta Caudiverbera, *Scollop-tailed Gecko.*

*Specif. Char.*—Tail flat, pinnatifid; feet palmated.

This species, which is a very singular one, is about 16 inches long, and of this the tail measures about one-half. The head is large and flat, the body thick, and the limbs short. The fore feet are like the rest of the species, but the hind feet are strongly palmated. The tail tapers gradually to the tip, but through its whole length is edged with a broad deep scolloped fin: this gradually widens towards the tip, and is considerably broader than on the sides. The back is marked with numerous distant red tubercles, each of which is surrounded by a circle of small white scales. The webs of the hind feet, and the finny part of the tail, are of a bright red.

This species is said to be a native of Arabia; but being a very rare animal, its natural history is not well known.

### 65. Lacerta Schneideriana, *Schneiderian Gecko.*

*Specif. Char.*—Colour gray; tail convex above and flat below; a black band on each side of the head; lamellæ of the feet lunulated and divided.

The colour of this species is cinereous, with a brown band on each side of the head; on each side of the body there is a suture or wrinkling of the skin; and the tail is edged with a row of sharper and longer scales than on the other parts.

### 66. Lacerta Sparmanniana, *Sparmannian Gecko.*

*Specif. Char.*—Body papillated above; tail lanceolated; fore feet tetradactylous.

This is a small species, measuring not more than three inches in total length. The colour on the upper part of the body is variegated with darker and lighter shades; on the under part it is whitish.

It is a native of the Cape of Good Hope, where it is regarded as a poisonous animal. It is said that the fluid secreted from its pores, as well as the saliva, produces inflammatory tumours, and sometimes even gangrenes.

### 67. Lacerta Sputator, *Spitting Gecko.*

*Specif. Char.*—Colour gray, marked above with brown transverse bands; tail round, furnished with scuta beneath.

The total length of this species does not exceed four inches, and sometimes it is smaller. The scales on the whole animal are smooth and glossy.

It is a native of the island of Eustatia, where it is found about houses, walls, &c. When it is alarmed, it is said to eject from its mouth a black acrid fluid, which occasions slight inflammation of the skin, and is usually removed by rubbing the part with camphorated spirit of wine.

## Sect. VII. Scinks.

The animals of this division are covered with rounded fish-like scales.

### 68. Lacerta Scincus, *Officinal Scink.*

*Specif. Char.*—Colour a yellowish brown, with transverse brown bands on the upper part of the body; tail short, compressed at the tip; upper jaw longest.

The scink is from six to seven inches long, and sometimes more. The head is rather small, the body thick and round, and the tail in general shorter than the body. The surface of the body has a more glossy appearance.

This species is a native of many of the eastern countries. It is very common in Libya, Syria, Egypt, and Arabia, frequenting dry and sandy soils. It was once in considerable estimation as a medicine, in leprous and similar diseases.

This animal is described under the name of *el adda*, by Mr Bruce, and is represented as very common in the province of Atbara in Abyssinia. "It burrows says he, in the sand, and performs this operation so quickly, that it is out of sight in an instant, and appears rather to have found a hole than to have made one; yet it comes often out in the heat of the day and basks itself in the sun, and, if not very much frightened, will take refuge behind stones, or in the withered ragged roots of the absinthium, dried in the sun to nearly its own colour. Its length is rather more than six inches; though its legs are long it does not make use of them to stand upright, but creeps with its belly almost close to the ground. It runs, however, with very great celerity. It is very long from its shoulder to its nose, being nearly two inches: its body is round, having scarce any flatness in its belly; its tail, too, is perfectly round, having no flatness in its lower part; it is exceedingly sharp-pointed, and very easily broken. Yet I have seen several, where the part broken off has been renewed, so as scarcely to be discernible. It is the same length between the point of the tail and the joint of the hinder leg, as was between the nose and the shoulder of the fore leg; its forehead from the occiput is flat: its shape conical, not pointed, but rounded at the end, in shape of some shovels or spades: the head is darker than the body, the occiput darker still. Its face is covered with fine black lines, which cross one another at right angles like a net; its eyes are small, defended with a number of strong black hairs, or eyelashes. Its upper jaw is longer, and projects considerably over the under. Both its jaws have a number of short, fine, but very feeble teeth; and when holding it in my hand, though it struggled violently to get loose, it never attempted to make use of its teeth: indeed it seems to turn turns its neck with great difficulty. Its ears are large, open, and nearly round. Its body is a light yellow, bordering on straw colour, crossed with eight bands of black, almost equally distant, except the two next the tail. All these decrease both in breadth and length, from the middle towards each extremity of the animal. The scales are largest along the back. They are very close, though the divisions are sufficiently apparent. Their surface is very polished, and seems as if varnished over. Its legs, from the shoulder to the middle toe, are nearly an inch and three quarters long. Its feet are composed of five toes, the extremity of which is armed with a brown claw of no great strength, whose end is tipped with black."

The same author, speaking of the immense multitudes of lizards which are found in eastern countries, adds, "I am positive that I can say, without exaggeration, that the number I saw one day in the great court of the temple of the sun at Balbec, amounted to many thousands. The ground, the walls, and the stones, were covered with them; and the various colours of which they consisted, made a very extraordinary appearance, glittering under the sun, in which they lay sleeping and basking.

### 69. LACERTA RUFESCENS, *Greater Scink.*

*Specif. Char.*—Colour yellowish rufous; feet short; tail of moderate length.

This species sometimes exceeds 15 inches in total length. The head is covered in front with large angular scales; the legs are short and thick; the feet pentadactylous, and furnished with small claws.

It is a native of Arabia and Egypt, living both on land and in water. It is frequent on the shores of the Nile. It is also met with in some European islands, and particularly in the island of Cyprus.

### 70. LACERTA LONGICAUDA, *Long-tailed Scink.*

*Specif. Char.*—Colour olivaceous yellow; tail very long.

The great length of the tail in this animal forms the specific distinction; the colour, which is greenish yellow, varies in the shade in different individuals.

It is said to be a native of America, and frequents the sea coasts, where it feeds on small crabs and spiders.

### 71. LACERTA MABOYA, *Mabouya Scink.*

*Specif. Char.*—Colour golden yellow; sides brownish; jaws equal; tail of middling length.

The length of this species is about eight inches; it greatly resembles the common scink, but differs from it in the length of the legs, and the jaws being equal.

It is a native of America, of Jamaica, and some other West India islands. It is also found in the island of Sardinia.

### 72. LACERTA OCCIDUA, *Galliwasp.*

*Specif. Char.*—Colour brownish; transverse bands somewhat waved; legs short; tail of middling length.

Except being larger, somewhat thicker, and having a tail proportionally shorter, this species comes very near the greater scink. It is about two feet in total length. The teeth are small in front; but as they approach the back part of the jaws, they gradually increase in size, like the *molares* teeth of the mammalia.

The galliwasp is a native of the American islands. It is very common in woody and marshy places in Jamaica, and has been reckoned, but without foundation, a poisonous reptile.

Var. *Lacerta scincoides*, australasian galliwasp.—This, although it is of a darker colour, has a longer tail, and larger scales, is considered only as a variety of the former. On each side of the neck there is commonly a longitudinal brown spot.

It is a native of New Holland.

### 73. LACERTA GUTTATA, *Spotted Scink.*

*Specif. Char.*—Colour gray, spotted with white; tail long, marked with four transverse black bands, and black tip.

This species does not exceed three inches in length. It is a native of the Ural desert.

### 74. LACERTA OCELLATA, *Ocellated Scink.*

*Specif. Char.*—Colour greenish-gray, white beneath, marked above with roundish ocellated brown spots, which have white rectangular disks.

This species is about a span long. The body is depressed; the feet are short and pentadactylous. It has no femoral warts.

It is a native of Egypt, and frequents houses.

## Sect. VIII. SALAMANDERS, *Newts* or *Efts.*

The species included under this section have soft skins, and some of them are water lizards.

### 75. LACERTA SALAMANDRA, *Salamander.*

*Specif. Char.*— Colour black, spotted with golden yellow; tail round, and of moderate length.

The colours of the salamander afford sufficient marks of distinction. It is of a deep shining black, variegated with large oblong and irregular spots of bright orange yellow. The sides are marked with many large transverse wrinkles. The parotid glands form protuberances on each side of the head. On the back and sides of the body there are several large open pores, from which is exuded a peculiar fluid, which serves to lubricate the skin. This fluid is of an acrid nature; and when the animal is irritated, is copiously secreted, and even it is supposed, ejected to some distance for its defence. It is in general from seven to eight inches in length. Sometimes it is seen entirely black.

The salamander is a native of many parts of Germany, Italy, France, and other parts of Europe, delighting in moist shady places, woods, &c. During the winter it conceals itself in recesses under ground, in the cavities of old walls, or about the roots of old trees.

This species lives chiefly on insects, small snails, &c. It is capable of living in waters as well as on land, and sometimes resorts to stagnant pools. It is slow in its motions, and torpid in its manners.

The salamander is viviparous. The young are produced perfectly formed in the same way as the viper. It is said that it retires to the water to deposit its young, the number of which at one birth amounts to 30 or 40, and when they are first excluded, they are furnished with branchial fins on each side of the neck, which are temporary organs, and are afterwards obliterated like those of the tadpole.

Many popular errors concerning the salamander have long prevailed. One of these was, that it was a venomous animal, and that its poison is of so malignant a nature, as scarcely to admit of any remedy. It is now, however, found from the observations of later naturalists to be perfectly innocent, and although the fluid secreted from the skin may be noxious to smaller animals, it is incapable of inflicting either wound or poison on any large animal. In an experiment made on purpose, a gray lizard, which had bitten a salamander, and swallowed some of the fluid secreted from the skin, was almost immediately seized with convulsions, and soon after died. It was another popular error that the salamander could exist uninjured in the fire, and that it could even extinguish it by means of the fluid secreted from its skin. This fluid, it is probable, is secreted in greater abundance when the animal is exposed to heat, and thus it is protected for a short time against the action of the fire, which can produce no effect till the moisture on the skin is evaporated; and from this circumstance, and hasty observation, has arisen the improbable story of its being able to resist the action of fire.

### 76. LACERTA VULGARIS, *Common Newt.*

*Specif. Char.*—Colour yellowish brown; dorsal line double; abdomen orange-coloured, spotted with brown.

This species is the smallest of the British lizards, the general length not exceeding three inches and a half.

It is a native of Europe, and is found in gardens in the neighbourhood of dunghills, &c. Like the slug and toad, it makes its way into cellars. It is altogether a land species, and it seems to be viviparous; for some of a very small size, yet perfectly formed, have been discovered at a very great distance from any water.

### 77. LACERTA PALUSTRIS, *Great Water Newt.*

*Specif. Char.*—Colour blackish; sides speckled with white; abdomen orange, with irregular black spots.

This species is small in size, and marked with a different distribution of colours, but in its general appearance it bears a considerable resemblance to the salamander. It is from five to six inches in length. The tail is flat, with thin sharp edges, and terminating in a point; on each side of it in the male there is a silvery white broad band, accompanied with a bluish tinge. This stripe and the dorsal crest are sometimes wanting in the female.

It is a native of Europe, but is rare in Britain. It frequents stagnant waters in cool shady places, and lives entirely on insects. It is to larger animals quite innoxious; but the fluid exuded from its skin seems to act as a poison on small animals.

### 78. LACERTA AQUATICA, *Common Water Newt.*

*Specif. Char.*—Colour olive brown, spotted with black; abdomen orange-coloured; tail sharp-edged and sinuated.

The general length of this species is from three to four inches. The male is readily distinguished from the female by a conspicuous dorsal crest, which is more elevated, and more regularly situated than that of the former species. This broad crest is very transparent, and when examined with a magnifying glass, shews the ramifications of the blood vessels and the circulation of the blood. In the female the dorsal crest is nearly wanting. The colour of the male is olive brown, marked with numerous round black spots, which are largest on the sides and tail. The female is of a pale yellowish brown, and the spots are much less distinct. The fore feet are tetradactylous; the hind feet pentadactylous, and in all the claws are wanting; but with regard to the colour, the breadth of the tail, and that of the toes, it ought to be observed, that the water newt, at different times of the year, different states of the weather, and even in the course of the same day, is subject to considerable variation.

This species is a native of Europe, and is met with in Britain in all soft stagnant waters.

This animal breeds early in the spring, and deposits small oblong strings or clusters of spawn. The ova, according to Spallanzani, are of a kidney shape, and the larva are ready formed, because long before they leave the gluten, their motions are brisk and frequent. In about 10 days they extricate themselves from the gluten. When they are first excluded, the branchial fins are distinctly seen, and soon after the fore legs appear. After a fortnight the hind legs are visible, and about the beginning of September the branchial fins become obliterated, and the animal assumes its perfect form. While the animal remains in the larva state, it is furnished with a triple pair of ramified branchial fins on each side of the neck, which gives it the appearance of a small fish.

The water newt frequently casts its skin, which may be occasionally seen floating on the waters which they frequent, and is sometimes so perfect as to represent the whole form of the complete animal. The reproductive power of the water newt is a striking circumstance in its natural history. They have been known to have their legs, tails, and even the eyes, according to some, completely restored, after they were cut off or destroyed. This animal is also remarkable for its tenacity of life. Cases have occurred in which the water newt has been found completely inclosed in a mass of ice, in which it must have remained for weeks, or even months, and yet, when the ice is melted, the animal was restored to its former health and vigour. Yet it is very readily destroyed by the application of certain substances. The water newt, immersed in salt water, soon dies; or even by having common salt rubbed on the back for a short time.

### 79. *Leverian Water Newt.*

This is a very large species of the water newt, described by Dr Shaw, and of which there is a specimen in the Leverian museum. The total length is $17\frac{1}{2}$ inches, and

and of this the tail measures 6$\frac{1}{2}$ inches. The head is flattened, the mouth moderately wide, and the upper jaw is furnished in front with two concentric rows of numerous, small, bristly teeth. The under jaw has only a single row. The eyes are small, round, and situated on each side of the front of the head, so that they are very remote from each other. The colour is pale brown, marked in a confluent manner with darker variegations. The legs are about one inch in length, and they are all furnished, along their whole length behind, with a dilated skin or crest. The tail is like that of the common water newt, but is shorter, and less deeply finned.

Its native country, and farther particulars of its natural history, are unknown.

### 80. Lacerta Maculata, *Spotted Water Newt.*

*Specif. Char.*—Colour blackish; a double row of white spots down the back.

The length of this species is about five inches. The head is large; there are four toes on the fore feet, and five on the hind. The colour is deep brown, and the double row of white spots, which begins at the top of the head and continues to the tail, becomes a single row to the end.

It is a native of Carolina, and inhabits ponds, ditches, and stagnant waters.

## Sect. IX. Snake Lizards.

The species belonging to this section have very long bodies, and short legs.

### 81. Lacerta Chalcides, *Chalcides Lizard.*

*Specif. Char.*—Colour ferruginous; feet tetradactylous; body long, and marked with six brown dorsal lines.

The usual length of this animal is about eight or nine inches; but it is sometimes found only a few inches long, and sometimes exceeds a foot. The head is anteriorly covered with large scales; the snout is tapering; the eyes are small, and the openings of the ears are very distinct. The colour is ferruginous or chesnut brown above, and yellowish brown beneath.

This animal is a native of Africa and the warmer parts of Europe, frequenting moist shady places. It is quite inoffensive, and feeds on insects, small worms, &c. The motions of the chalcides are rather slow. It is viviparous, and is said to produce a great number of young.

### 82. *Annulated Chalcides.* *Chalcide* Cepede.

This is nearly allied to the former, but differs from it in having square scales, and in being marked through its whole length with a continued series of annuli or rings, to the number of 48. The length of the body is about 2$\frac{1}{2}$ inches, and is somewhat shorter than the tail. The feet are shorter than in the former species, and are all tetradactylous.

The native country of this species is unknown.

### 83. Lacerta Serpens, *Serpent Lizard.*

*Specif. Char.*—Head, body, and tail cylindrical; feet small, remote, pentadactylous.

The length of this species is about 5$\frac{1}{2}$ inches. The colour is cinereous or pale ferruginous above, marked with from 15 to 20 dusky lines: beneath it is ash coloured, with a silvery gloss. It is entirely covered with imbricated scales.

This animal is a native of Java.

### 84. Lacerta Anguina, *Snake Lizard.*

*Specif. Char.*—Body long; tail very long; feet oval-shaped, and without toes.

The body of this species measures four, the whole length 15 inches. The colour is brown above, ash-coloured on the sides, yellowish beneath, and the upper surface is marked throughout its whole length with several dark stripes. The head is small; the legs very short, and placed near the head and vent, and seemingly terminated in one undivided process. The whole body is covered with ovate scales.

It is a native of the Cape of Good Hope, and is frequently found in the water, and about the rocks in Table bay.

### 85. Lacerta Apus, *Apodal Lizard.*

*Specif. Char.*—This snake-formed lizard is ferruginous, has no fore feet, and its hind feet are very short and monodactylous.

The chalcides itself does not approach so near to the snake tribe as this large and singular species of the lizard. It measures almost three feet in length, and its general appearance bears such a striking resemblance to a large snake, that it requires a very attentive examination to ascertain the difference; as it has only a pair of extremely short-pointed processes by way of feet, at a great distance from the anterior parts of the body, almost on either side of the vent, and without toes. The head is rather large, and covered with large scales; the snout is tapering; the upper jaw projects a little over the lower; the mouth is of a moderate wideness, and the ears are very visible. There is no appearance of a neck, as the body gradually tapers from the head to the extremity of the tail, which is longer than the body, and terminates in a point. The whole animal is covered with rows of scales of a moderately large size, in a longitudinal direction, and emarginated at the tips. From the head to nearly half the length of the tail, a deep continued channel runs along each side of the body. Its colour is a pale chesnut, and beneath a pale yellow-brown.

Two specimens of this lizard were brought from Greece by Dr John Sibthorp, professor of botany in the university of Oxford. It is rather a singular circumstance that an animal of such magnitude should have remained so long unknown to the inquisitive naturalist.

It is a native of Greece, of the southern parts of Siberia, and unquestionably of many other parts both of Europe and Asia, although the knowledge of it has been but lately acquired, the first describer of it being Dr Pallas, by whom it was found in the south of Siberia. It frequents moist and shady places, and, as far as is yet known, is an innocent animal.

### 86. Lacerta Bipes, *Biped Lizard.*

*Specif. Char.*—Long bodied, cylindrical, pale yellow, speckled

speckled with brown, having no fore feet; hind feet very small, and didactylous.

This species, which is not larger in diameter than that of a goose quill, measures about six inches in length; its colour is a pale yellow, spotted with brown; the head is small, body cylindrical, tail short and taper; on each side of the vent there is a small subulated foot, which is furnished with two small unequal toes.

It is a native of India and South America.

87. **Lacerta Lumbricoides**, *Lumbriciform Lizard*.

*Specif. Char.*—Body cylindrical, two-footed, and annulated with square scales, having a lateral furrow, and no hind feet.

This is about eight inches long, and half an inch in diameter. The whole body, including head and tail, is of the same diameter, and is covered with rings of square scales. Along each side there is a continued furrow, which separates the upper and lower surfaces. The legs are two, very short, and placed near the head. They are divided into five minute toes, which are furnished with claws. The colour of the living animal is supposed to have been green, and paler beneath.

It is a native of Mexico.

Number of species in each genus, included under the order *Reptilia*.

| | |
|---|---|
| Testudo, | 39 |
| Rana, | 48 |
| Draco, | 2 |
| Lacerta, | 87 |
| Total | 176. |

## CHAP. II. OF THE ANATOMY AND PHYSIOLOGY OF REPTILES.

HAVING in the former chapter taken a brief and comprehensive view of the classification, and such particulars of the natural history of reptiles, as were connected with the different species, we now proceed to give a slight sketch of the anatomy and physiology of this order of animals. These shall be the subjects of the two following sections. In the first we shall treat of the anatomy, in the second of the physiology of reptiles.

### Sect. I. *Of the Anatomy of Reptiles.*

Between this order of animals, and the quadrupeds belonging to the class mammalia, there are many points of resemblance, making allowances for the difference of size; and hence they have been denominated *oviparous quadrupeds*. This resemblance, however, only extends to external appearance.

The body of reptiles is supported by four feet, and these form the principal external character. They are disposed like those of the mammalia, two before and two behind. With the exception of some animals which have been arranged under this order, and which have only two feet, all reptiles are furnished with four feet.

The body is furnished with a tail, which is different from that of quadrupeds, in having no hair. This is common to the tortoises and the whole of the lizard tribe. The genus *rana* is an exception to this. All the species included under it are unprovided with a tail.

The body is either lengthened, that is, when it is considerably longer than broad, as is the case with lizards; or rounded, that is, when the body, seen from above, exhibits an orbicular form, as in the tortoise and some toads.

With regard to the surface of the body, it is never covered with hairs, but sometimes with scales; such are reptiles without a tail, the salamanders and some lizards. It is sometimes covered with inequalities or asperities, the whole surface being rough with elevated points, which resemble warts or pustules. This is the case with some lizards, and several frogs and toads. The body is covered sometimes with a shell both above and below; this bony covering protects the animal from external injury. With such a covering the genus tortoise is furnished.

In the sketch which we propose to give of the anatomy of reptiles, the parts of the body may be divided into external and internal; the external parts comprehend the head, the trunk, the tail, and the feet. Under the internal parts are included the skeleton, the muscles, and the viscera.

#### *External Parts of the Body.*

1. The **Head**.—The head is that part of the body which is articulated with the first vertebra of the neck. It is rounded, that is, when its external surface is round in every direction, as is the case with tortoises; or flattened or depressed, when it is compressed above and below, which is the case with almost the whole order; or triangular, when the head, seen from above, represents a triangle, as in some toads and frogs.

The mouth is semicircular, when the outline forms a semicircle, as in the genus *rana*, and in almost all the lizard tribe; or inferior, when the upper jaw comes over the lower, so that the mouth necessarily occupies the lower part of the head. This is the case with the tadpole.

The beak or snout either forms an inclined plane from the top of the head to the end of the jaws, as in the chameleon, and many lizards; or conical, when the two jaws gradually diminish, as in the crocodile; or reflected upwards, when both jaws are flattened and turned upwards towards the extremity of the beak; or rounded, when they are thick and ventricose towards the extremity, as in several tortoises; or pointed, when the upper jaw terminates like the beak of a bird.

The jaws, are either equal, as in most part of the genus *rana*, in many of the lizards, and salamanders; or unequal, as is the case with many of the tortoises and lizards, in which case, the upper jaw is always the longest. Among the whole order of reptiles, there is

no

no instance of the contrary; that is, of the lower jaw being longest, and perhaps this structure would be inconvenient, or incompatible with the nature of the animal, or its habits and mode of life.

A common error long prevailed with regard to the motion of the jaws of the crocodile. It was asserted, that this animal only moved its upper jaw; but the more accurate observations of later anatomists have proved the contrary, and that the articulations of the head and jaws of this animal are precisely the same as in other quadrupeds. The head is articulated with the last vertebra of the neck, and the lower jaw is articulated with the upper, so that the former, namely the lower jaw, only has the power of motion.

All the animals belonging to the order of reptiles, are not furnished with teeth. The tortoises and some lizards, have none. All the species belonging to the genus *rana* may be considered also as having none, the jaws being only crenulated or notched; but in other tribes belonging to this order, the teeth are conical, as those of the crocodile, which are hollow, and filled with a soft substance; or recurved, when the extremity of the tooth turns backward towards the throat, as in the Indian crocodile; or straight, as in most of the lizard tribe; compressed at the sides, as in the guana; or notched, when the summit of the tooth is truncated and crenulated, as in the horned lizard.

*Tongue.*—In almost all the tribes of animals belonging to this order, the tongue is peculiarly fitted for seizing their prey. The form of it varies in all the families. Another error has prevailed with regard to the tongue of the crocodile. It was said that it had no tongue, but in place of it is furnished with a strong membrane, which adheres to the two edges of the lower jaw. Even the observations of later naturalists tend to confirm this error. Denon, who had numerous opportunities of seeing the crocodile both dead and alive, in its native haunts on the borders of the Nile, believes in this opinion, that the crocodile has no tongue; but it does not appear that any accurate anatomical inspection was made to ascertain this point, or indeed that he was accompanied by any anatomist at all, by whom alone the truth or falsehood of the opinion could be investigated. This organ of the crocodile, however, is very large, and even proportionally larger than that of the ox, but it is strongly connected with the sides of the lower jaw, and being thus fixed or tied down, cannot be stretched forwards, as is the case with other animals.

Tongue of the crocodile.

In some of the animals belonging to this order, the tongue is nearly of equal length and breadth. This is the case with the tongue of frogs, tortoises, the salamander, and the guana.

In some it is very narrow at the base, and divided in two at the extremity, as in most of the lizard tribe, which are thus furnished with a bifid tongue.

Of the chameleon.

But the structure of the tongue of the chameleon, is perhaps the most singular of any belonging to the order. It is composed of a white solid flesh, 10 inches long, and about three broad. It is round, and flattish towards the end; hollow and open, somewhat resembling the termination of the trunk of the elephant. The tongue is attached to the os hyoides by a kind of trunk, of the shape of an intestine, about six inches long, and a line in breadth. This trunk is furnished externally with a membrane, and internally with a soft, but solid and compact, nervous substance, which is with difficulty divided into fibres. It is by means of this trunk that the tongue, which is attached to it, is projected from the mouth. This is done by the extension of the trunk, and it is again drawn back by its contractile power. These motions are performed by a kind of cartilaginous stilus, to which the investing membrane is attached, and over which it is plaited like a silk stocking on the leg. This stilus is an inch long, and originates from the middle of the base of the os hyoides. In consequence of this extensile and retractile power which the tongue of the chameleon possesses, it has obtained the epithet of *vermiform*, because in those motions it resembles those of an earth-worm.

Nostrils.

There is no great peculiarity about the nostrils of any of this order of animals. In general they are almost always of a round form. In some, however, they are lunulated, or shaped somewhat like a crescent, the horns of which are turned backwards. This is the case with the nostrils of the crocodile.

Eyes.

The eyes, as in most other animals, are placed on the sides of the head; but in some they are vertical, or placed on the top of the head, as in several of the toads and the crocodiles; approximating, when the distance between the eyes is very small; or protuberant, when the globe of the eye on each side forms a considerable projection, as in those belonging to the genus *rana*, the *crocodiles*, and the *salamanders*.

The nictitating membrane, which is peculiar to some birds, belongs also to some of the animals of this order. By means of extending this membrane over the eye, the excessive brightness of sunshine, to which many of them, being natives of warm climates, are exposed, is greatly moderated, and perhaps this membrane may be useful to those animals of this order which frequent the water.

The iris of the eye is differently coloured in the animals of this order. In many it is red; in the chameleon it is of a golden yellow colour.

Ears.

Externally, the ears of reptiles do not exhibit any remarkable peculiarity. The opening is more or less round, and it is usually covered with a membrane. There is no external ear, by which the vibrations of the air might be collected, and conveyed to the sense of hearing; from which it has been concluded, that this sense is more obtuse than in quadrupeds.

2. The TRUNK.—The trunk of the body includes the neck, the breast, the back, the ribs, the abdomen, and the anus; and some of these parts, in different reptiles, present considerable varieties.

Neck.

The neck, which unites the head with the trunk, is very different in the different tribes belonging to this order. In all those included under the genus *Rana*, the head is so closely attached to the trunk, that the neck is scarcely to be distinguished. In others, however, it is considerably elongated, and quite distinct, as in the crocodile and the salamander. The neck is also pretty long in some of the tortoises. Sometimes it is covered with wrinkles or folds, when the skin forms several transverse wrinkles, as in the neck of some of the tortoises.

Thorax.

The breast or thorax is situated on the anterior part

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of the trunk; it forms a close cavity which is covered beneath by the sternum, on the sides by the ribs, and above by the vertebræ at the back bone.

Calipash of the turtle.

The back is the upper part of the trunk, extending from the last vertebra of the neck to the first of the tail. In reptiles it is sometimes convex, sometimes more or less flattened. It is either furnished with scales, when there extends along the superior surface a row of scales from the neck to the extremity of the tail, as in the guana and horned lizard; or it is furnished with a toothed suture, when the upper extremity of the trunk terminates in a notched ridge, as in the chameleon of the Cape; or is supplied with a kind of radiated fin, somewhat resembling the fin of a fish, as in the basilisk; or it is protected with a strong bony covering, known by the name of *calipash*. This is the name by which the bony covering of the turtle is distinguished. This covering is composed of different pieces closely united to each other, and they are sometimes smooth and convex, sometimes striated and flat, disposed in three rows; and there are about 24 pieces situated on the edges of this covering.

Ribs.

The ribs include the lateral parts of the trunk, from the neck to the anus. In the tortoises, the ribs are defended by the edges of the calipash, which is here united with the inferior shell, or bony covering.

Abdomen.

Calipee.

The abdomen or belly constitutes the inferior part of the body, and extends from the extremity of the breast or thorax to the anus. In the tortoises, this part is composed of a bony covering; and in some species belonging to this tribe, there are openings in those places which correspond to the head, the four feet, and the tail; but in some other species, as in the *testudo clausa*, there is no opening whatever, but the bony covering is transversely divided into two parts, which play on a kind of hinge, so that when the animal wishes to move, it opens the anterior division to put out the head and the fore feet; and in the same way for the opening behind. This inferior bony covering is united with the upper one by means of a cartilage placed near the middle of the body. This is usually known by the name of *calipee*. Sometimes the abdomen is covered with plates or scuta, which is the case with most of the lizards, which have on the inferior surface of the body, very large plates regularly arranged.

The anus is not only the passage for the evacuation of the excrement, but is besides the canal in which are contained the parts of generation of the male lizards and tortoises. The males of the animals belonging to the genus *Rana*, which are destitute of these parts, eject by this opening the fluid which impregnates the ova of the female.

3. The TAIL.—This part terminates the trunk. Many reptiles, as those belonging to the genus *Rana*, have no tail whatever; but the animals belonging to the other genera of this order are furnished with a tail of different lengths. The tail is covered with scales, as in almost all the lizards; and these scales are sometimes disposed in rings or circular bands, as in several lizards; or they are somewhat elevated, forming a kind of notched appearance on the upper surface of the tail, as in the guana.

4. The FEET.—The feet of the animals belonging to this order greatly resemble those of quadrupeds; their position and articulations are nearly the same, but they are much shorter, and placed at a greater distance from each other. The feet terminate in a certain number of toes, and thence, according to the number of the toes, assume different names; as tridactylous, tetradactylous, &c. The structure of the toes is similar to that of other animals. They are separated from each other, as in lizards; palmated, when united by means of an intermediate membrane, as in the hind feet of the frog; furnished with nails or claws at the extremity, which are sometimes flat, as in the frogs; or hooked, as in the lizards; or destitute of nails or claws, as in the salamander.

*Internal Parts.*

Under the internal parts are included the skeleton, the muscles, and the viscera.

1. The SKELETON.—With regard to the skeleton of reptiles, it may be observed, that the structure of the bones is less complicated than that of quadrupeds, and the texture is less compact. They possess at the same time somewhat of the transparency of cartilages. The bones may be divided into those of the head, the neck, the thorax, the spine, the tail, and the feet.

Bones of the head.

The bones of the head are composed of those of the cranium, and those of the lower jaw. In the greatest number of reptiles, the cranium consists of a single bone. The bone of the upper jaw, and that of the forehead, are completely united in the crocodile, the chameleon, and some others. They do not seem to be separated by any distinct suture. The lower jaw of the chameleon terminates on each side in a separate bone, which unites on one hand with the region of the temples, and forms on the other an angular articulation with the jaw.

Of the neck.

The bones of the neck are composed of a series of vertebræ, the number of which varies in the different tribes of this order. The species belonging to the genus *Rana* have no cervical vertebræ; but in the other tribes the number varies, as has been mentioned, as will appear from the following table.

| | Number of Vertebræ. |
|---|---|
| Chameleon, | 2 |
| Most of the Lizards, | 4 |
| Crocodile, | 7 |
| Tortoise, | 8 |

The number of processes with which the vertebræ are furnished, also varies. In those of the chameleon there are seven; but in those of the crocodile, there are nine, viz. five above, and four below.

Of the thorax.

The bones of the thorax comprehend those of the vertebral column, corresponding to this cavity, the ribs, and the sternum. The vertebræ, which correspond to the cavity of the thorax, are not the same in all the individuals belonging to this order. In the crocodile there are only 12, but in the chameleon, the number amounts to 18. Each of these vertebræ is in general furnished with seven processes, which are sometimes simple and sometimes spiny.

Ribs.

The ribs are wanting in the reptiles belonging to the genus *Rana*: the salamander also is destitute of ribs. In the other tribes they are always found, but unequal in number. In the tortoise there are eight on each side; in the crocodile 12; in the chameleon 18. The ribs

ribs are articulated with one vertebra only; but in the structure and articulations of these bones there is a peculiarity in the crocodile and chameleon. The two first and the two last ribs of the crocodile do not terminate in the sternum. The cartilages which attach the other eight are broken, so that each rib from the vertebra to the sternum is composed of three parts, one of which is bony, the other two cartilaginous. In the chameleon the two first anterior ribs are not supported by the sternum; the four following are attached to it by means of appendages, which form at the point of junction an angle with the ribs, and which are not composed of a substance purely cartilaginous, but as hard as that of the ribs. The 10 other following ribs do not reach the sternum. Each is joined to that which is opposed to it by a bony appendage, forming an arch on the middle of the thorax and abdomen. The three last are loose, separated, and as it were truncated in the middle.

Sternum.

The sternum or breast-bone is a flat bone, placed on the anterior part of the thorax, the figure and dimensions of which vary considerably. In the crocodile this bone reaches to the third rib; it is composed of a single piece, having at its upper part a kind of cartilage which forms a point towards the throat, and which enlarging at the sides covers the clavicles. The sternum of the chameleon and the frog is composed of four bones, the first of which is very large.

Spine.

The back bone comprehends the vertebræ which occupy the upper part of the back, including those of the loins. In the chameleon there are 22; in the crocodile 19, and in the gray lizard 22.

The vertebræ of the tail form the posterior extremity of the spiral column. Their number is always proportional to its length. The tail of the chameleon is furnished with 50 vertebræ; that of the crocodile 33, and that of the gray lizard 60. All these vertebræ are furnished with transverse, oblique, and spinous processes, excepting those towards the end of the tail, which are usually destitute of the oblique processes.

Feet.

The bones of the feet bear a considerable resemblance to those of other animals. The fore feet are composed of the scapula, the humerus, the cubitus and radius, the bones of the carpus and metacarpus, and the joints of the toes.

Scapula.

The scapula or shoulder blade is sometimes single, and sometimes double, in the animals belonging to this order. The frog, the chameleon, and the salamander, have only one; but it is of such a length that it extends from the dorsal spine to the sternum, with which it is articulated, answering the purpose of a clavicle. In the tortoises and crocodile, there are two shoulder-blades, viz. one on the back, and one placed anteriorly, and articulated with the sternum. These also perform the functions of the clavicle. The humerus is articulated on the one hand with the scapula, and with the two bones, the cubitus and radius of the arm, on the other. The two latter bones, the cubitus and radius, are placed parallel to each other, between the humerus and the bones of the carpus and metacarpus. These latter are situated between the two bones of the fore-arm, and the phalanges or joints of the toes.

The hind feet are composed also of the femur or thigh-bone, the tibia, and the peronea of the leg; the bones of the tarsus and metatarsus, and the phalanges or joints of the toes. These, excepting that they differ somewhat in structure, bear so near a resemblance to those of the fore feet, that it would be quite unnecessary to enumerate or describe them particularly.

Muscles of the back.

2. The Muscles.—The muscles are the instruments of motion. The muscles of the back of the crocodile take their origin from the vertebræ and ribs, and they are attached by means of their tendons, to the bands or rings which are formed by the tubercles of the back. These tendons act in different directions; some of them pull these bands from above downwards, while others pull them from below upwards. The use of these muscles is apparently to lock together more strongly the rings of which the tubercles of the back are composed.

Of the abdomen.

The muscles of the abdomen in the same animal, which are four in number, one external, and one internal on each side, are not only different from those of other quadrupeds in number, but also in their situation and structure. The external muscle is placed upon the ribs, and the internal under them, immediately above all the viscera, which it embraces in the manner of a peritoneum. The internal muscle is attached on one side to the bones of the pelvis, and to the transverse processes of the lumbar vertebræ; and on the other it terminates in a broad tendon, which envelopes all the intestines in the form of a membrane. The fibres of these two muscles are disposed lengthwise.

3. The Viscera.—The parts contained in the three great cavities of the body are the viscera. These are the brain, the heart, the lungs, the stomach, the intestines, the liver, the spleen, and the kidneys.

Brain.

The brain is situated within the cavity of the skull. This organ, in reptiles, is in general of small size. The brain of the chameleon, which is of a reddish or grayish red colour, is not more than a line in diameter. The same organ in the crocodile is very small, and similar to that of fishes. The cavity within which it is contained, does not exceed 14 lines in length, and about 12 in breadth and depth.

Heart.

The heart is a strong muscular body, from which proceed the great arteries, and in which the great veins terminate. From the contractile force of this organ, the blood receives its first impulse. The heart in this order of animals is small. It has in general been considered as having only one ventricle and two auricles; differing from the heart of the more perfect animals, which is furnished with two ventricles and two auricles. But from the observations of later naturalists, it would appear that the structure of the heart of reptiles has not been accurately described; for, according to some anatomists and physiologists, the heart of this order of animals is really double; that is, consisting of two auricles which have a direct communication with each other, and two ventricles as in other animals.

Lungs.

The lungs which constitute the principal organ of respiration, are spongy cellular bodies, in which the bronchia or air-vessels are ramified. The substance of which the lungs of reptiles are composed, is not fleshy and parenchymatous like those of quadrupeds, but they consist of a bundle of vesicles divided into two lobes. The lungs of the turtle are remarkable for a vesicle which adheres to their surface on the left side, and which may be contracted and dilated at the pleasure of the animal. It is conjectured, that it is by means of this

this organ, like the swimming bladder in fishes, that the turtle raises itself to the surface of the water.

**Stomach.** The stomach, which is destined to receive the food, is situated between the gullet and the intestinal canal. This organ in reptiles is very like that of birds. The stomach of a crocodile four feet long is not larger than four inches in length, and the same in breadth; and although the fibres of which it is composed are neither so strong, nor so numerous, as those of the stomach of birds, they form a body which is incapable of extension or enlargement. This renders it extremely difficult to believe what is said of the crocodile, of its prodigious voracity, swallowing animals of so considerable a size, since it is neither furnished with teeth fit for the mastication of its food, nor a stomach of sufficient capacity to receive so great a quantity.

**Intestines.** The intestines form a canal composed of different convolutions, extending from the stomach to the anus. It is quite unnecessary to enter into a minuter description, than merely to state, that they are divided, as in other animals, into great and small. In the crocodile and other reptiles, the intestines going out from the stomach, form two great convolutions similar to those of birds. They are afterwards convoluted in different ways, till they reach the bottom of the cavity and terminate in the anus.

**Liver.** The liver is the organ destined for the secretion of bile. In this order of animals it is large, and divided into two unequal lobes, between which the heart is situated. The right lobe is somewhat larger, and the gall bladder occupies the middle of this lobe.

**Spleen.** The spleen is an organ placed on the left side. In this situation it is exposed to the pressure of the diaphragm and the abdominal muscles. The spleen of frogs is double, and of an oblong form. In the crocodile it is oval, somewhat oblong and equal at the two extremities. The substance of which this organ is composed, consists of a great number of large whitish points on a dark red ground.

**Kidneys, &c.** The kidneys are bodies of an oval lengthened form, situated within the abdomen, and destined for the secretion of urine. In the frog, between the kidneys and the testicles, there are certain appendages which resemble some kind of leaves. The kidneys are attached to the back, having at their posterior extremity the seminal vessels. The urinary bladder is situated near the orifice of the anus.

## SECT. II.—*Of the Physiology, Manners, and Habits of Reptiles.*

WE shall now, according to the arrangement proposed, make a few observations on the physiology, manners and habits of reptiles.

From the small proportion of brain, and dull habits of reptiles, it seems to be justly concluded that their senses are not very acute.

SENSE OF SIGHT.—Of all the senses, that of sight is probably the most perfect among reptiles; but as their most common haunts are on the shores of the ocean, or the margin of lakes and of stagnant waters, and on the banks of rivers, where the rays of the sun are strongly and incessantly reflected, it was necessary that the eyes of these animals should be protected from the too powerful impressions of light. For this purpose the moveable eye-lids, and the nictitating membrane, are peculiarly fitted; as by their means the animal is enabled to diminish the quantity of light received into the eye. The peculiar power which many of them possess also of contracting and dilating the pupil at pleasure, like the cat, and some other animals, which seek their prey in the dark, extends the utility of this organ, and renders it more sensible and delicate. From this peculiar structure of the eye, the animal is enabled to see objects at a considerable distance, and is thus fitted to pursue its prey in the dark, or at great depths under the surface of the water; circumstances which are highly necessary for the situation in which many of the tribes of reptiles are placed, and exactly accommodated to their habits and mode of life.

**Peculiarities in this sense.**

**Not very acute.** SENSE OF HEARING.—This sense in reptiles is probably not very acute. The structure of the internal ear is considerably different from that of the more perfect animals. Indeed some of the parts which seem to render perception more acute, are wanting in these animals. There is neither *cochlea* nor *fenestra ovalis*, and the semicircular canals are destitute of extremities. The membrane of the tympanum is very thick, and the bone immediately connected with it is of a very irregular figure. But, besides, these animals have no external ear whatever, by which means the vibrations of the air might be collected, and condensed in the seat of sensation. In place of these external parts, there are only very narrow openings, which can admit but a small number of vibratory undulations. As a farther proof of the dulness of this sense in these animals, few of them emit any sound, excepting a harsh croaking, whence it may be concluded, that their perception of sound is very indistinct, or they are destitute of the organs necessary to express it; otherwise, with these requisites, the habit of hearing distinctly would very soon improve the power of expression.

**Supposed to be more perfect.** SENSE OF SMELLING.—Almost all reptiles are furnished with the external organs of this sense. The nostrils of the crocodile are placed in a round space, filled with a black, soft, and spongy substance; those of the tortoise and lizard occupy the extremity of the snout, and consist of two very distinct openings. It appears, indeed, from anatomical inspection, that the nerves which terminate in these organs are of a very large size, which circumstance leads us to conclude, that the sense of smelling must be pretty acute. But when it is considered that a great proportion of reptiles have their abode in the midst of putrid marshes, it would incline us to suppose that the sense of smelling is not very acute.

Dr Townson, in some experiments which he made with the water lizard, very justly concludes, that their sense of smell is extremely acute. "I kept, says he, a considerable number of water lizards, in a jar, which I fed from time to time with worms; if they were in the greatest stillness, and I dropt in a worm ever so gently, they all immediately began to fight, each attacking its neighbour and seizing it by the foot or tail. This was not a contention for the worm, which often lay for a short time unnoticed, but it originated rather from the acuteness of their sense of smell, which immediately informed them of the presence of their food, and in the dulness of their discriminating powers. This is similar to what I have invariably observed in frogs and toads,

toads, which will suffer their natural food to remain before them untouched, yet seize it instantly on the smallest motion it makes. It was from a knowledge of this instinct that I was able in winter to feed my constant companion and favourite pet, Musidora.

Before the flies, which were her usual food, had disappeared in autumn, I collected a great quantity as provision for winter. When I laid them before her, she took no notice of them; but the moment I moved them with my breath she sprung and ate them. Once when flies were scarce, I cut some flesh of a tortoise into small pieces, and moved them by the same means, she seized them, but instantly rejected them from her tongue. After I had obtained her confidence, she ate from my fingers dead as well as living flies.

"Frogs will fly at the moving shadow of any small objects, and both frogs and toads will soon become so tame as to sit on one's hand and be carried from one side of the room to the other, to catch the flies as they settle on the wall. At Gottingen, I made them my guards for keeping these troublesome creatures from my dessert of fruit, and they acquitted themselves to my satisfaction. I have seen the small tree-frogs eat humble bees, not indeed without a battle; they are in general obliged to reject them, being incommoded by their stings and hairy roughness; but at each attempt the bee is further covered with the viscid matter from their tongue, and is then easily swallowed.

"Nothing appears more awkward and ludicrous than a frog engaged with a large worm or little snake; for nature seems to have put a restraint upon their voracity, by forming them very inapt to seize and hold their larger prey. One of my largest frogs, whether the *rana temporaria*, or *esculenta*, I forget, swallowed in my presence an *anguis fragilis* near a span long, which in its struggles, frequently got half its body out again; when completely swallowed, its contortions were very visible in the flaccid sides of the conqueror *."

Very feeble.

SENSE OF TASTE.—If the perception of taste is to be taken in proportion to the sensibility of the organ which is the seat of it, this sense in reptiles must be considered as the feeblest of the whole. The tongue of most reptiles is rather to be considered as an instrument for seizing its prey, than as an organ destined for the perception of taste; and for the former purpose it is remarkably fitted, both from its structure and mechanism, by which means the animal can project it instantaneously from its mouth, and also from the viscid fluid which is secreted on its surface. We have already described, in speaking of the anatomy of reptiles, this peculiarity of structure in the tongue of the chameleon.

SENSE OF TOUCH.—This sense cannot be supposed to be very acute in this order of animals. Most of them have the body covered with hard scales, with large tubercles, or with a strong bony substance. In a great number belonging to this order, the extremities of the feet even are furnished with scales; and the toes are so united together, that they can only be applied with difficulty to the surface of bodies. And if in some lizards it is found that the toes are long, and distinctly separated from each other, the inferior surface is covered, either with a hard skin or with very thick scales, which must undoubtedly deprive this part of all sensibility. The sense of touch, therefore, in reptiles, may, in general, be considered as dull and imperfect.

CIRCULATION OF THE BLOOD.—In animals which have been usually dignified with the name of *perfect*, and which are furnished with a double heart, the blood which has been collected from all parts of the body, returns to the right side of the heart; is thence conveyed to the lungs; from the lungs it passes to the left side of the heart, and thence is again distributed through the body. But this course of the blood can only go on when the function of respiration continues without interruption; because on the cessation of the action of the lungs, the circulation through them is interrupted; and therefore, without some other structure of the heart, the circulation through the body must stop, and the death of the animal ensue.

Peculiarity of the circulation.

Many of the animals included under the order of reptiles are distinguished by a peculiarity of structure, which allows the circulation to go on during the necessary interruption of the function of respiration to which they are subjected. The blood therefore, instead of passing through the lungs, is conveyed through an oblong opening called *foramen ovale*, situated between the two auricles, and is discharged directly from the pulmonary artery into the aorta. Hence it is that these animals come under the denomination of cold-blooded. This diminished temperature of the blood is ascribed to the less complicated circulation which goes on in their system. For the blood in the course of the circulation being less exposed to the action of the air in the lungs, undergoes fewer of these changes, on which, according to the present chemical theory of respiration, the temperature of the body, or animal heat, depends.

Respiration different from that of other animals.

RESPIRATION.—The function of respiration exhibits one of the greatest peculiarities in the animals belonging to the order of reptiles. For, as in these animals the structure of the thorax, and the other parts necessary to the process of respiration in other animals, are quite different, the means also by which it is conducted in them must also be different. It is to Dr Townson that we are indebted for the elucidation of this part of the physiology of reptiles. This naturalist, as he himself observes, at least revived a doctrine which had been acknowledged by former physiologists, to whom it seems to have been distinctly known. Among these he mentions Laurenti, who, in his *Synopsis Reptilium*, has derived the character of his class from the peculiar mode of respiration of these animals, of which he says that they are furnished with lungs, but are destitute of diaphragm and ribs, but by means of the gular pouch the air is alternately drawn into this reservoir, and by its contractions propelled to the lungs.

Process of inspiration.

In quadrupeds, Dr Townson observes, there are no perceptible motions in the throat, excepting those which accompany the process of deglutition; but in the frog tribe, whether they are awake or asleep, if they are not excluded from the air, there are some remarkable motions of the throat which are quick and constant; these are the motions which are subservient to inspiration. The bony and muscular parts, which in hot-blooded animals are the mechanical instruments of respiration, are entirely wanting in this order of amphibia. It must then be by means of some other contrivance, that they are enabled to fill the lungs with air. In the hot-blooded

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* Tracts on Nat. Hist. p. 113.

blooded animals the alternate contraction and dilatation of the thorax effects this, but in this tribe the same purpose is accomplished by the dilatations and contractions of the throat. When the cavity of the throat is enlarged, the air rushes through the nostrils and fills it; the nostrils being closed by their proper muscles, the glottis is opened; the muscles designed for this office contract, diminish the cavity of the throat, and impel the air which is contained in it into the lungs; and in this way, he adds, is inspiration performed in these animals.

"When the lungs, says he, were laid bare, I have observed that these did not inflate, if the frog, exhausted with pain and loss of blood, or when the nostrils were covered with it, opened its mouth to take in a greater supply of air, till the throat contracted; this, then, was the immediate consequence. Likewise, if I put a tube down the throat, the glottis and mouth being by this kept open, the lungs collapsed, and in this state remained; but as soon as the tube was removed, respiration immediately recommenced; nothing similar to this is to be observed in hot-blooded animals.

Of expiration.

"Expiration is very easily accomplished; for, the glottis and the nostrils being open, the lungs by their own contraction from a state of distention, and by their own weight, aided by that of superincumbent parts, will gradually expel the air; but the muscles which cover the sides act also on this occasion, and in their croakings, (which, in the time of their amours, are heard to a great distance), with great force. But in the ordinary expirations of these animals, no more than in quadrupeds, do the lungs wholly collapse; if not viewed with attention, no motion is ever perceived in their sides, though there is a regular contraction and distention. They likewise have the faculty of compressing one lobe of the lungs singly, by the contraction of the muscles of that side; this is easily induced by touching them gently on the side with a pin or other sharp body.

"As these animals are known to be able to live a much longer time without air than those with hot blood, it has been said by many that they respire slower. But although probably they do not vitiate so much air, they respire very rapidly. Man respires about twenty times in a minute: and, according to Forgaro, birds, which breathe the quickest of all hot-blooded animals, from 25 to 50; but the esculent frog (*rana esculenta*), respires about 70 times in a minute; the *rana variabilis* (a species of toad), about 100, and the tree frog (*rana arborea*), so rapidly that I could not reckon the number of the motions of its throat. The contractions of the throat I have considered as inspirations; yet, as the nostrils do not close with each contraction, I cannot venture to affirm that at each the whole contents of the throat are driven into the lungs. As there is frequently one contraction in four or five greater than the rest, it may be then that the greatest quantity of air is driven into them. When these animals sleep, and in cold weather, these motions are slower and more feeble.

"According then to the doctrine which I have advanced on the mechanism of respiration in the frog tribe, which may easily be subjected to experiment, and then thrown aside, if it bears not this test, but candidly received if it does, their lungs possess no secret power of dilatation, any more than those of hot-blooded animals. In both, this organ is inactive in respiration, which process principally differs in this, that, whilst in the *hot-blooded the air is sucked into the lungs by the expansion of the thorax; it is driven into them, in the frog tribe, by the motions of the throat.*

Mechanism of respiration.

"Let us now proceed to examine anatomically the mechanism subservient to respiration; and when, for the sake of brevity, in speaking of the throat, I make use of the terms of muscles of inspiration and expiration, I mean by the former those muscles which serve for forming a vacuum in the throat, and by the latter those which serve to diminish it.'

"Instruments of Respiration.—When the skin is stripped off from the throat, a broad muscle comes into view, which is the mylo-hyoideus. It covers the whole throat, being extended from the end of the maxilla to the condyles; its fibres run transversely, and are inserted into the maxilla through its whole length. In the middle, from the point of this bone, it becomes thin and membranous, but at the condyles thicker; it is not united with the os hyoides, as in man, but slightly connected with the skin. When the cavity of the throat is diminished, its muscular fibres are seen evidently to contract, but chiefly at the condyles, where the muscle is thickest. Thus, this muscle seems well adapted to assist in driving the air from the throat into the lungs; nevertheless, if it be cut away, respiration continues.

"The mylo-hyoideus being cut away, the genio-hyoidei appear; and, under these, in the middle, is the muscle of the tongue; the muscle at the point of the maxilla, the sterno-hyoidei and the coraco-hyoidei are likewise seen. The genio-hyoidei, which are slit where the sterno-hyoidei are inserted in the os hyoides, from their direction and connection, ought, one would think, greatly to assist in drawing the os hyoides forwards, and by this means diminish the cavity of the throat; yet these being cut away, respiration continues.

"The sterno-hyoidei are strong and powerful; they rise from the whole length of the last bone of the sternum, and are inserted all along the os hyoides. As the os hyoides is not in the same direction as the sternum, but higher, and its cornua, which are fastened by the stylo-hyoidei, likewise higher and oblique, these muscles in their contractions draw this bone downwards and backwards, and thus form a cavity in the throat. These are the principal muscles used in forming this cavity, and when they are cut respiration ceases.

"The coraco-hyoidei rise from the inferior side of the neck of the scapula, and are inserted into the os hyoides near the insertions of the sterno-hyoidei. They direct the movements of the os hyoides, and draw it downwards; one being cut, this bone loses its natural direction and inclines to the other side.

"If we search deeper, we find the stylo-hyoidei muscles, otherwise the *constrictores medii pharyngis*, (B) of which there are three pairs (C). One pair, which is stronger

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(B) Either the stylo-hyoidei or these constrictors are wanting.

(C) In the common toad (*Rana Bufo*), and in the *Rana variabilis*, I only found two pairs.

stronger than the rest, rises from the posterior region of the ear, and is inserted into the points of the cornua of the os hyoides. The other two pairs have the same origin, and are likewise inserted into the cornua of the same bone, but more forward. These muscles are likewise of great moment in contracting the cavity of the throat, by elevating the os hyoides, and drawing it forward. I have observed some muscular fibres in the vicinity of the stylo-hyoidei, upon the membrane which lies immediately under the muscles now described, and which forms the interior part of the throat: these may assist likewise as constrictors.

“ If we take away the muscles and the membrane of the throat, leaving only the sterno-hyoidei muscles, although respiration is now totally destroyed, the motions used in respiration continue. The os hyoides is still drawn backwards and forwards, and the glottis opens and shuts, but the lungs remain collapsed; if even all the muscles which move the os hyoides, are cut away, the glottis, whose muscles remain untouched, continues to open and shut, just as in hot-blooded animals, whose respiration is destroyed by a large wound in the thorax, and efforts to respire continue, though ineffectual to remove the painful sensation of incipient suffocation.

“ On expiration little is to be said; I have always found the lungs of these animals, whether alive or dead, to collapse as soon as the glottis is open; yet, as I have already observed, the oblique muscles, which extend from the glottis to the os pubis, and thus envelope the lungs through their whole extent, have a great power to compress them, and thus produce expiration. Whether I have properly applied the name of obliques to these muscles I will not contend, as I have not examined them with particular care; they may probably be composed of several muscles, but thus much I have observed that their fibres run more or less transversely, and are therefore well adapted to produce this effect [*].”

**Propagation of Reptiles.**—Although reptiles, from their senses being less acute than those of other animals, seem in general dull and stupid; on the return of spring, they exhibit a very different character. As the warm season advances, they become lively and active, and thus shew that they are actuated by a new set of desires. It is at this time that the frog tribe, which at no other season of the year emits the smallest sound, become remarkable for the croaking and disagreeable noise, by means of which they express these new or once dormant feelings. When these feelings acquire force, even some of the external parts of some of the frog tribe undergo a change. The fore feet of the male are then furnished with a kind of wart, which is supplied with papillæ, that it may more firmly attach itself to the female. The male then places itself on the back of the female, and embraces her so strongly with the fore feet, that it can only be separated by a considerable force. In this situation the two remain together for about a month. About the end of this time, or sooner or later, according to the temperature of the season, the female begins to exclude the ova. The eggs form a kind of string, and are united together by a viscid matter, and included in a thick glairy substance. At the moment that the ova are excluded by the female, the male ejects a fluid with which they are impregnated, at the same time giving a peculiar cry during the course of this process. So strongly is the male attached to the female, that nothing can disturb or interrupt his operations. Nay, what will appear still more surprising, in an experiment by Spallanzani, in which the head of a male frog was cut off in this situation, the animal continued for some time to impregnate the ova as they were excluded, and died only at the end of four hours.

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Ova of the frog.

When the ovum of the frog is examined with the microscope, a small point is distinguished, black on the one side and white on the other, placed in the centre of a globule, whose glutinous and transparent substance is surrounded with two concentric membranes, which are analogous to the shell of the egg. At the end of a certain time, which is longer or shorter, according to the temperature of the season, the embryo begins to be developed, and is afterwards known by the name of tadpole. Spallanzani has observed, that the process of incubation or hatching in the ova of the toad goes on, although the temperature of the atmosphere does not exceed 6° above zero of Reaumur's thermometer, which is equal to about 39° of Fahrenheit.

It is unnecessary to mention, that the ova of the frog are deposited and hatched in water. It may be observed also that this process is interrupted in the ova of the toad, which happen to be dropt on the earth, unless they are supplied with moisture.

Progress of the tadpole.

The tadpole, as the process of incubation proceeds, and the organs which are destined to perform the functions of life are developed, exhausts the glutinous matter with which it is surrounded; this gradually dilates; and the more it increases in volume, the less is the quantity of its mass. It becomes at length only a light and almost invisible substance, from which the tadpole makes a short occasional excursion in the water, in making its first efforts in swimming; but returns again, finding itself either unable to procure its food, or to support itself long in the water on account of the shortness of the fins, which have not yet attained their full size. But as the little animal advances in its growth, the glutinous matter, its former habitation, being entirely dissipated, it roams at large in the waters.

According to the observations of Swammerdam, a tadpole is about six lines in length at the end of 15 days after it has been deposited by the female. The first traces of the hind feet may then be seen; and the place of the toes is marked with so many small protuberances. In this stage of its progress the little animal exhibits a very different appearance from that which it assumes after the change it is to undergo. The mouth is not placed at the anterior part of the head, but on the lower surface; and when it wishes to seize any object for its prey, or to expel the air from its lungs by expiration, its motion in turning its body is so rapid and instantaneous, that the eye can scarcely follow it.

In a tadpole of 36 days old the hind legs are protruded; but the fore legs are some days later, so that to see them at the same period the animal must be opened, at least the external covering which veils in some measure, or disguises its future form. At last, at the end of about two months of confinement, which is about the middle of June, the young frog having reached its perfect form, and acquired sufficient strength, bursts from its prison. It contrives at first to contract its

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[*] *Tracts on Nat. Hist.* . 17.

covering by elevating its back; by this the skin is torn near the head of the animal, which passes through the opening. That part of the membrane which formed the mouth of the tadpole is retracted over the body; the fore legs are successively unfolded; and the skin pushed to the posterior extremity of the body, leaves the whole of it, as well as the hind legs and the tail, uncovered. The tail then gradually diminishing in volume, at last entirely disappears, so that the smallest trace of it no longer remains in the perfect animal.

Time of the turtle breeding varies.

According to the situation of the countries in which they are found, the temperature of the climate, and the period and duration of the rainy seasons in tropical regions, the time of the turtle depositing its eggs is regulated. At this season the female quits the ocean, and often, it is said, makes a voyage of 300 leagues to find a safe and convenient spot for the reception of the embryons of her future offspring. The male, according to the accounts of some naturalists, accompanies the female in this expedition, with the view of reconducting her to their former haunts. We are informed that they arrive in such multitudes on the banks of the Oroonoko about the beginning of March, that there is not sufficient space on the shore to contain them, so that vast numbers are seen with their heads above water, waiting the departure of those on land, that they may occupy their place. When the turtle has reached the shore, she fixes on a spot covered with sand or gravel, digs with her fins, in a place beyond the reach of the tide, one or more holes of about a foot broad and two feet deep; and there deposits her eggs to the number of more than a hundred. She then covers them with a little sand, but so lightly, that the action of the rays of the sun may not be interrupted hatching them. The turtle deposits her eggs commonly at three different times, a period of fourteen days intervening between each time. The danger to which these animals are exposed, when the light of day favours the pursuit of their enemies, and perhaps also, it has been conjectured, the fear of suffering from the burning rays of the sun, make them almost always prefer the darkness and temperate coolness of night to come on shore for this purpose.

The period of hatching is longer or shorter according to the temperature of the climate. In more temperate regions, it continues about 20 or 25 days. At the island of St Vincent, (one of the Cape de Verd islands), this process is completed in 17 days; and Gumilla the historian of the river Oroonoko asserts, that three days only are required for hatching on the banks of this river. He placed, he says, a stick near the place where the turtle deposited her eggs, and at the end of three days, so great is the influence of the sun upon the sand, the small turtles had made their appearance.

Travellers who have had opportunities of observing the small turtles soon after they are hatched, when they are only about an inch long, inform us, that in this state they do not quit their holes during the day, being instinctively warned to protect themselves in this manner from the heat of the sun, and the voracity of birds of prey, but they wait till night to make their way to the ocean. "I have been often astonished, (says Gumilla), when I have observed that the place where they have been hatched, being sometimes half a league distant from the river, they direct their course towards it without any deviation by the shortest possible way. I have sometimes carried the young turtle to a great distance from the water. I have covered them up and made several holes for them that they might wander. But I no sooner left them at liberty, than they took the direct course to the river, without turning either to the right hand or to the left. "The instinct with which these little animals are impressed, conducts them towards the nearest waters, where they find safety and proper food. They move on very slowly, and as yet too feeble to resist the force of the waves, great numbers are thrown back by the surge on the sea shore, where sea fowl, crocodiles, tigers, and other animals are in waiting to devour them, so that but a small number escapes the numerous dangers to which they are constantly exposed.

Of the alligator.

It is also at the return of the spring season that the alligator deposits its eggs. It lays about 100 in the space of one or two days; and in the same way as the turtle covers them with sand, and, it is said, rolls itself round the place, that it might be the better concealed from its enemies. Having thus secured its future offspring, it returns to the water, when the process of hatching goes on by the heat of the sun. About the time that the necessary period has elapsed for the evolution of the young animal, it is said that the female returns, accompanied by the male, scrapes up the sand, and uncovering the eggs, breaks the shell, to allow the young animal to escape. It is said that the young alligator, before it leaves the egg, is at least six inches long, and that it is rolled up, having its head placed in the centre. When the shell is broken with a stick, they bite it furiously, and sink their teeth in this substance. This seems not improbable, since it is recorded by different naturalists, that the teeth of the young alligator are completely formed before it leaves the egg.

The mode of propagation, so far as it has been observed among the tribe of lizards, is similar to that of the frog. The male remains for some time on the back of the female, embracing her closely. This does not prevent them from running about, or leaping from branch to branch. When the female is about to deposit her eggs, she makes a hole in the earth of about two inches deep, at the foot of a tree or wall; in that the egg is dropped and covered with earth, and, as in the other tribes, the process of incubation is accomplished by the heat of the sun.

But some species of lizards are viviparous. This is considered by naturalists as exactly the same mode of propagation as in the others which are produced from eggs, with this difference only, that the process of incubation goes on in the former within the body of the female, and the young are excluded completely formed.

Size of the eggs.

The Eggs of Reptiles.—The size of the eggs of this order of animals is always proportioned to that of the female by whom they are produced. From the smallest species of lizard to the huge crocodile, they may be found of every size. The smallest are scarcely more than two lines in diameter, while the largest are three inches long.

The covering of these eggs is different in the different tribes. In the greatest number, but especially in the eggs of the turtle, it is flexible, soft, and similar to moistened parchment. The eggs of the crocodile, and of some large lizards, are covered with a shell of a hard, calcareous

calcareous substance, like that of the eggs of birds. It is, however, considerably thicker, and consequently less brittle.

Used as food.

In India and America, these eggs are very much sought after, and are esteemed by the natives a very rich and delicate food. About the time that the turtle deposits its eggs on the banks of the Oreonoko, the neighbouring inhabitants repair to the banks of that river with their families, for the purpose of collecting them; and they not only live upon them at this time of the year, but dry them, that they may carry them home to be laid up in store for their future sustenance.

It is said that the Indians are extremely fond of the eggs of the alligator, which they search out with great industry, and rejoice when they discover the place where they have been deposited. They bake them when they prepare them for food, and although the young animal has begun to be evolved, or is nearly formed, they are not less scrupulous in eating them.

Reptiles feed voraciously.

FOOD OF REPTILES.—It is only in extraordinary cases that reptiles abstain from food for any length of time. When they are at perfect liberty, and find that kind of food which is suited to their nature, they in general indulge in it voraciously. Frogs and lizards feed on leeches, worms, snails, beetles, and different species of winged insects. Some of the toads live on aquatic plants; the turtles find in the water or on the land, vegetables and shell-fish; the crocodile is carnivorous, and devours, greedily, fishes, sea-fowl, and turtles; and when pressed by hunger, attacks men, but especially, it is said, the negro race, whom he prefers to others. This latter fact has probably no foundation whatever. The very largest crocodiles, which are more easily seen and avoided, it is said, employ some artifice in seizing their prey. They watch about the margin of stagnant waters, and lie there covered with mud, like a fallen tree, remain immoveable, and patiently wait the favourable moment to seize some unsuspecting animal. Sometimes, when they swim down any large river, they stop at the most frequented places, and raise only the upper part of their head above the surface of the water. In this attitude, which leaves the eyes at liberty, they surprise the animals which come to cool themselves, or to drink in the river. As soon as they perceive any one, they plunge under the water, swim towards it, and seize it by the limbs, drag it along to drown it, and afterwards make it their prey.

Different character of reptiles in different situations.

ABODE OF REPTILES.—Reptiles, like plants, are profusely distributed over the whole surface of the globe; but from their nature and habits are more abundant and numerous in some places than in others. Some tribes live entirely on dry land, while others are confined to the bottom of the water. Others may be considered as intermediate tribes, living on the confines of the two elements, exhibiting in them the degrees and shades of different habits, which result from the diversity of forms. Among those which have their abode on dry land, as many of the tortoises, most of the lizards, the chameleons, some prefer dry and elevated situations, while others dwell in caverns or in the holes of rocks; and as these are different in their economy and habits, so we find that they are different in their motions; while the one is sluggish and inactive, moving slowly, the others spring or creep rapidly among the branches of trees. Almost all of them, however, take the water, and swim with great facility; but they are obliged, as well as the reptiles which remain constantly in the water, to come to the surface from time to time to respire the air of the atmosphere. The intermediate tribes, or such as have their usual haunts on the limits of the land and water, can only exist in climates which correspond to their temperament. And thus they are found in innumerable multitudes in the immense extent of morass in the deluged savannahs of the new continent, where the moisture of the atmosphere and the temperature of the climate are favourable to their reproduction.

In Kamtschatka, where the cold of winter is so rigorour, no species of toad, of frog, or even of serpent, is ever seen. Lizards, however, are very numerous, which are regarded by the inhabitants with a superstitious horror. They suppose that they are sent by some evil deity, as spies on their actions, or to predict their death; and hence it is that they use every precaution to secure themselves against their mischievous effects. Wherever they find them they cut them to pieces, that they may not be able to return to the malignant being by whom they have been sent to witness against them. Should the animal accidentally make its escape, they are seized with the most violent grief and despair. They expect every moment the approach of death, and sometimes bring on, by their fears and terror, what they so much dread. All this contributes still more to increase and strengthen this ridiculous and groundless superstition.

REPRODUCTIVE POWER OF REPTILES.—Many of the animals belonging to the order of reptiles undergo very considerable changes, in the reproduction of different parts of the body, either in the ordinary processes of nature, or when they are deprived of them by accident. The casting of the skin, and its reproduction in different reptiles, as in the toad and newt, may be regarded as a natural operation in some way necessary to the economy of these animals. It is observed, that the water-newts frequently cast their skins; and these are occasionally seen floating in the waters which they inhabit. The skin is sometimes so perfect, that it exhibits the whole form of the complete animal.

Casting the skin.

The following account of this process by Bonnet will, we doubt not, be interesting to the reader.

"When, says he, the period of change approaches, the fine skin is observed detaching from the body. The head first loses it; then the rest of the anterior part; next the middle, and the posterior part. Sometimes the spoil, cast by the head, forms like a gauze collar or cravat around the neck; or it is adjusted on the head, like a capuchin or head-dress.

"The commencement of separation, from the back and belly, is discovered by viewing the newt obliquely from one side, in a strong light. The skin of the belly is further detached, because it falls down by its own weight.

"Approaching spoliation is recognised by conspicuous and unequivocal symptoms. The back, viewed obliquely, appears whitish, and as if covered with a spider's web. This is the effect of the spoil beginning to separate. If closely examined with the naked eye, or a magnifier of small power, it seems composed of minute scales covering the callosities or tubercles, which shagreen the body of the newt. But, when examined with

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with more attention, and in a favourable light, this epidermis is discovered to be a beautiful reticulation, the meshes of which are visible to the naked eye.

"Many observations could be made on the texture of this delicate membrane; and these might greatly tend to elucidate the nature and origin of the epidermis, which, notwithstanding all the researches of physiologists, are so little known; and newts would afford frequent opportunities for deeply investigating the point.

"From particular attention to the newts in my possession, I have observed, that there is not the smallest resemblance between this operation and what is exhibited by caterpillars, and many other insects. The skin is detached here and there, and often in different sized plates; and the change is slow, for it occupies one or two days, and I have even known it take three. During spoliation, the newt continues moving about in the water, with all the usual motions of newts that undergo none; therefore it is no disease, and it does not affect them as it does insects. While the change is going on, the animal darts on its prey, holds and devours it.

"Sometimes spoliation is difficult to be accomplished; but in these cases the newt knows to practise certain manœuvres, to facilitate the operation, which I have often beheld with pleasure. It alternately raises and depresses the right arm and left leg at the same time, with gentle vibrations of the whole body. It frequently darts suddenly towards the surface of the water, and the next moment precipitates itself to the bottom; and these manœuvres I have seen continued above half an hour. But the sudden exertion, in all its motions, indicated that the newt was impatient at the tediousness of the change.

"When most of the spoil is thrown off, and the animal, to disengage itself from the rest, rapidly rises to the surface, it seems carried along in a cloud; for the whiteness, firmness, and semitransparency of the spoil, floating around it, is no imperfect representation of a cloud.

"I never observed the fingers employed in detaching the spoil. Both young newts and those full grown cast several successive skins: some of large size are in my possession, that have done so before me. Reproducing limbs throw off the epidermis as well as the original.

"I have seen the skin of the head, which formed like a collar or cravat round the neck, gradually come down the belly of a large newt that had lost the arms, and fasten like a tight girdle.

"Nothing can accurately be said of the number and interval of mutations. Between the 14th of July and the 7th of September, a newt has changed its skin 11 times.

| | | | |
|---|---|---|---|
| 1st change | 14th July. | 6th change, | 9th August. |
| 2d | 17th | 7th | ——. |
| 3d | 20th | 8th | 19th |
| 4th | 25th | 9th | 24th |
| 5th | 30th | 10th | 26th |
| | | 11th | 6th Sept. |

"Spoliation sometimes makes a slight change in the colour *."

The manner in which toads throw off the old cuticle is quoted by Dr Shaw, as related by Mr Schneider, from Grignon, who was an eye witness of it. "The skin splits or cracks in a longitudinal direction, both above and below, and the animal pulls off that of the left side with its left foot, and, delivering it into the right foot, applies it to its mouth and swallows it. It then performs the same process on the right side, and, delivering the cuticle into the left foot, swallows it like the former.

Phisiology.

But the most remarkable circumstance in the economy of these animals is the reproduction of mutilated limbs, such as the legs, the tail, and even the eyes. The completest set of experiments to ascertain these curious facts, were made by Spallanzani and Bonnet. The following is an account of some of these experiments in the words of the author.

"EXPERIMENT. *The right arm and left leg of a newt amputated.*—On the 6th of June, I cut the right arm and left leg off a large newt, very near the body. A stream of florid blood spouted a minute and a half from each wound; however, the vessels soon closed, and the newt was apparently as well as those unmutilated. But it will easily occur that it did not swim with equal facility.

"When about a month had elapsed, I began to perceive a papilla, of a violet gray colour, near the edge of the trunk or section. This was the origin of a new arm and leg, which gradually increased; and, from the 14th of July, the two papillæ continued growing on the subsequent days, but more in length than thickness. They became minute stumps; and, on the first of August, were about two lines long. A kind of cleft, hardly perceptible, announces the appearance of two toes which nature labours to produce, or rather to expand, on the new foot. No cleft appears on the originating arm.

"The two toes were easily recognised on the 7th. They were real miniatures, and truly most minute. The stump of the arm continued nearly as it was on the first of the month, but is now somewhat larger; but as yet there is no indication of fingers.

"It is pleasing to observe the little hand fully unfolding, while only three fingers of unequal length are visible: the middle one is the longest. The arm has made no sensible progress. The new foot had four toes also of unequal length, the first and second of which are longest; other two only begin to appear; the fourth is scarcely perceptible. One can never tire contemplating these miniatures, and admiring the wonders of the organic kingdom.

Leg and arm reproduced.

"Evolution advanced every day. On the 22d of August, the regenerated members began to deepen in colour, so that the line, discriminating the old parts from the new, was no longer so conspicuous; but the black specks on the toes of unmutilated newts were still imperceptible.

"I continued my observations on the daily evolution of the members; and the following were their dimensions of length on the 20th of September.

| *Old Members.* | | *New Members* | |
|---|---|---|---|
| Arm, | 4 lines. | Arm, | $2\frac{1}{6}$ |
| Cubit, | $3\frac{1}{2}$ | Cubit, | $2\frac{1}{8}$ |
| Thigh, | 3, | Thigh, | $2\frac{2}{3}$ |

Leg,

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* Spallanzani's Tracts, ii. 368. Dalyell's Trav.

| | | | |
|---|---|---|---|
| Leg, | 4 lines, | Leg, | 2¼ |
| Longest finger, | 3⅔ | Longest finger, | 1⅕ |
| Longest toe, | 4½ | Longest toe, | 1⅓ |

Even in the beginning of October, the fifth toe of the new foot was not visible.

"EXPERIMENT.—*A newt deprived of the right arm and left hand.* On the 12th of June, I cut the left hand and right arm off a newt: my chief object in this experiment was to verify Sig. Spallanzani's assertion, that nature reproduces exactly the portion amputated, which was a fact of the utmost importance in the theory of animal reproductions, and could not be too well established.

"Towards one side of the section, a little conical nipple began to appear about the 7th or 8th of July, of a violet gray colour. An incipient cleft, indistinctly seen with the naked eye, was perceptible near the middle of July: the papilla seemed ready to divide in two; and the cleft was the origin of two fingers.

"In two or three days, I remarked a new cleft at the upper extremity of the papilla, which was the beginning of a new finger: the third, in its turn, appeared on the 19th. The conical papilla had then disappeared; and in its place was seen a small open hand with four fingers, still very minute, but quite well shaped.

"On the 3d of August, the cone began to divide, that is, two fingers became evident.

"On the 9th, a hand extremely minute, but the most beautiful object imaginable, was observed at the extremity of the arm. The fingers, all of unequal length, were distinguished, the smallest being just perceptible. The trunk, or part of the original arm, connected to the body, may be recognised by the brown colour, and from being covered with white points. The new arm is of a lighter and uniform colour. Four fingers of the hand are visible: the largest not above half a line in length.

"The hand of the left arm had made considerable progress on the 21st: it had expanded, and nearly acquired the figure peculiar to the newt's hand. The fingers also had extended, and become thicker in proportion. The whole hand began to colour, and brown specks were distinguishable on different parts; they were more evident on the back of the hand than on the fingers.

"On the 21st, the hand has already assumed its natural shape, and the rapid progress of evolution is suspended. Colouring of the arm begins near the trunk: but all the rest is of a mixed gray and violet colour.

"Though I have not hitherto expressly said so, it will obviously be presumed, that there is a kind of semitransparency in the reproduced parts, which the original members have not. This continues long, and changes slowly as the reproductions colour. The transparency is evidently greater on the edges of the fingers than elsewhere; if examined with a magnifier, they seem inclosed in a fine diaphanous envelope: but nothing of this is evident in the old fingers. Parts beginning to unfold naturally have a degree of transparency wanting in those further advanced, or fully expanded, because, with the progress of evolution, the calibre of the vessels increases, which allows admission to more gross and colouring particles. Whiteness and transparence apparently constitute the primitive state of organic bodies. It is this primitive state which we design by the word *germ*; and which we can comprehend, when the organic whole is expanded to a certain extent. But there is here a term beyond which we cannot ascend; for the organic whole either becomes so minute or so transparent, that it escapes all research and our most perfect instruments.

"The dimensions of the old and new members, in length, were as follows, on the 2d of September.

| *Old Members.* | | *New Members.* | |
|---|---|---|---|
| Arm, | 3¼ lines, | Arm, | 2⅓ |
| Cubit, | 3½ | Cubit, | 2¾ |
| Longest finger, | 1⅖ | Longest finger, | 1⅕ |

*Ib.* ii. 372.

"EXPERIMENT.—*The tail of a newt amputated transversely.* Something important would have been wanting, had I neglected amputation of the tail, which is a very intricate great organic substance. It is formed of a series of minute vertebræ, with arteries, veins, and nerves; and it is covered with muscles and flesh.

"The tail of a large newt is more than two inches long, and about half an inch thick, formed like an oar, and terminated by a soft point. Much might be said of the figure, proportions, and position of this organ, and with respect to the functions it has to exercise; but these would be details foreign to my purpose: I only mean to confirm what Sig. Spallanzani has advanced concerning the admirable reproduction of the members.

"When the tails of large newts were amputated near the origin, I never succeeded in obtaining reproduction; the whole died in a certain time; and for several weeks preceding death, a kind of whitish cotton mould grew on the wounds, the filaments of which were several lines in length. Nevertheless, I cannot think that this affected the animal's life, for I had seen similar mould, or cottony filaments, on wounds occasioned by amputating the arms and legs. These filaments gradually disappeared, and unequivocal signs of reproduction soon became visible. Thus a good observation was never obtained, unless the tail was divided about the middle, and by a section perpendicular to the axis. A stream of blood, as thick as a hog's bristle, always spouted from the wound. The large vessel, from which it flows, is situated near the vertebræ, and its orifice is visible by the naked eye; it immediately closes; and the orifice is distinguished by a reddish or brownish point.

"The tail of newts is very sensible, which is particularly evident in the slenderest part. A portion cut off will retain life, and move whole hours; and when life seems entirely extinct, we have only to prick the pointed extremity, that motion may be renewed; it rises and falls alternately, and with greater force, according to the period that has elapsed since the operation. The motion of this separated part bears great resemblance to that which is peculiar to certain apodal worms; it is undulatory, and evidently depends on irritability, which is extremely active in so muscular an organ.

"Immediately after the operation, the area of the cut exhibits a very long ellipse; the two extremities almost terminating in a point. The smallest diameter is about a line across, and the largest five or six. In the centre are the vertebræ, or blood-vessels; the rest of the area seems full of small oblong clear white substances,

stances, which one would suppose pieces of fat, or glands. The surface slowly contracts; the opposite sides approach; the colour of the substances becomes fainter, and in a certain time, which is according to the season, new flesh appears, and it daily increases. Then we observe one or two cross brown lines, occupying the middle of the new tail, which indicate the site of the vertebræ and the vessels. In a tail which had been divided on the 11th of July; on the 14th August the reproduced part was about three lines and a half long, and four and a half in diameter, at the base.

Tail regenerated.

"The new portion was ten lines in length, 20th September, and shaped exactly like the tail of a newt. I could observe no difference between the motions of this regenerated tail, and those of tails unmutilated. Those of the regenerated part only had a peculiar transparency, wanting in the rest of the tail*.

"Experiment.—*Whether reproduced members possess the same sources of reproduction as those amputated.* I cut the left arm and right thigh off a large newt, 2d June 1778. In the beginning of July, a new arm and thigh began to reproduce. They were still in miniature, but the fingers and toes sufficiently formed, and very distinct.

"On the 11th of July, I made an experiment, which was most important in the theory of animal reproductions. The object was to discover whether the members now reproducing, which in reality were miniatures, contained the same sources of reparation as the original; that is, whether there were, in new limbs, germs containing members in miniature, similar to those amputated. With this view, I cut off the regenerated hand and foot.

"At the extremity of the reproduced leg, on the 21st, appeared two new toes extremely minute, but easily recognisable by the naked eye: and, on the 24th, an originating hand, with three well-shaped fingers, appeared at the extremity of the new arm.

"The foot, now reproduced, exhibited four very distinct toes. Both these and the fingers were yet only one-fourth, or one-third, of a line long.

"Therefore it is proved, by this first experiment, that the reproduced limbs of a newt can make new productions, in the same manner as the old ones can, and give birth to members which, in their essential parts, resemble those amputated, and are different only in size, consistence, and colour: for, as was remarked in my former memoir, the new members are of more delicate texture, and of a much lighter colour than the old.

"It was undoubtedly most interesting to ascertain how far the resources of nature extended; and whether, after several successive mutilations of the reproduced member, a new one would still regenerate.

"On the 31st of July, for the second time, I cut off the reproduced hand and foot of my newt; the fingers and toes being then about a line long.

"Two new fingers and toes appeared at the extremity of the limbs, 13th August, therefore a hand and foot had begun to regenerate. On the 15th, there were three fingers and toes already well formed, though very small.

Reproduced members also regenerated.

"Both the hand and foot seemed quite repaired on the 24th, though still of extreme minuteness. All the fingers had grown, but only four toes. And it may now be observed, that the appearance of the fifth toe is constantly later; often it does not unfold.

"On the same day, 24th August, I amputated the reproduced hand and arm the third time; and on the 13th October, performed the fourth operation: the limbs being then in the same state as those mutilated by the third amputation.

"Thus it is fully established, that every member, successively reproduced, contains new sources of reparation; and that they are actually existing, though the member is extremely minute.

"From these successive mutilations of reproduced members, I have thought the extremity of the leg and arm became a little thicker than usual, as if from a reflux of the nutritive fluids into the extremity, by such repeated amputations.

"This season was particularly favourable to my experiments, being always dry and warm. A mercurial thermometer, in the shade, completely isolated, on a large terrace, stood at 90° and 93°, on the 14th and 15th of August. Most of summer it stood between 79° and 81°; and the temperature of the apartment, where the newt was kept, differed very little from that of the open air.

"Experiment.—When a large newt was treated as has just been related, I made another experiment on one of similar size, to obtain comparative results.

"The left arm and thigh were severed 2d June 1778. Reproduction of new members commenced in the beginning of July: two well-shaped toes were then on the foot. On the 11th, new limbs had replaced the old; they seemed completely repaired: still they were only miniatures of most delicate texture. This day I amputated the reproduced hand and foot.

"A new foot, with two distinct toes, was perceptible on the 22d; and three were visible on the 24th. But the new hand had not appeared; at least there was no evidence of originating fingers. The thermometer now stood about 84°. However, a new hand, with three perfect fingers, was seen on the 29th.

"The reproduced hand and foot being a full line long on the 31st, I then cut them off. Both appeared again, August 15th, with three well shaped fingers and toes. On the 24th, the hand had acquired its four fingers, and the foot five toes, all visible, though excessively small.

"I then cut off the hand and foot for the third time. The fingers and toes were a full line long 13th October; four of which appeared, but the fifth toe was yet imperceptible.

"Next I performed a fourth amputation: it also was followed by reproductions. Various occupations having interrupted me, a fifth amputation was not made before 26th August 1779.

"The longest finger was then about one line and a third, the longest toe one and a half in length, deep coloured, and very slender. The hand had four fingers; the first and fourth imperfect. The foot had only three toes, more distant from each other than usual. Both the fingers were as imperfect 30th October 1780: the fourth scarcely visible, and consisting only of a sharp point; and no more than three toes on the foot. The newt had then diminished greatly in size, and was very brown. It ate little, and seldom: it remained long at the surface, unable to get to the bottom of the water; and its belly was almost always very much inflated.

"These are two experiments, therefore, which concur

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* Ibid. ii. 331.

in establishing the same fact, viz. that the reproduced members of a newt, though still in miniature, are equally provided with reparatory germs as the old limbs; and that they begin to unfold after the new members are cut off *."

To these curious experiments we shall only add the account of another, concerning the reproduction of the eyes of newts.

"EXPERIMENT.—*On the eyes of newts.* This is a cruel experiment; and sensible minds will hardly pardon the observer's cruelty, though it arises from an evident desire to discover new facts and enlarge our knowledge of the animal economy. Therefore, I fear the compassionate reader will revolt further still at what is yet to be related. But I beg he will consider, that animals, which, after losing one, or even several limbs, continue greedily devouring the prey presented, undoubtedly cannot experience the sensation of pain to the excess which our own sensations lead us to imagine. We are very insufficient judges of what passes within an animal so remote from us in the scale of living beings. Let it not be thought, that by these reflections, I mean to lessen the natural repugnance of every humane mind to make animals suffer. The benignity of nature itself will inspire man with this precious sentiment to prevent the enormous abuse that his power might exert over the animals which she has subjected to his dominion. Yet let me ask, whether a rational person abuses his empire over animals, by making them suffer only for his own instruction, or that of his fellow creatures.

"With a scalpel, I extracted the right eye of a large newt, September 13. 1779; but I did not obtain the globe without much injury to the tunics. It was the first time of performing the operation, and before I had acquired the peculiar dexterity necessary for success, and afterwards learned by experience. Thus the utmost disorder ensued in the eye, and the crystalline lens started out on my nail. This is a beautiful object; no larger than a millet seed, and quite transparent. I thought that I beheld one of the spherical lenses with which Leeuwenhoeck discovered so many wonders. But contact of the air soon tarnished the minute lens; it dried and became disfigured.

"A deep bloody wound in the socket of the eye was the consequence of this cruel operation. And the reader will not be surprised if I hardly expected any thing from it, and that the newt would probably remain blind for ever. How great was my astonishment, therefore, when, on the 31st of May 1780, I saw a new eye formed by nature. The iris and cornea were already well shaped, but the latter wanted its peculiar transparency, which is very considerable in these animals. Impatience to arrive at the most important part of the prodigy has induced me to omit the progress of it; and observe that nature certainly began with closing the wound.

Eyes regenerated.

"The eye was completely repaired 1st September. The cornea was nearly as transparent as that of the other eye, with which it was frequently compared. The iris had also acquired the yellow gilded colour, which characterises this species of newt. In short, the eye was so perfectly renewed, that no vestige existed of the uncommon operation that the animal had undergone. During the remainder of this and the following month, the cornea always became more transparent; and now, when I write these remarks, 8th November 1780, it is equally perfect as the other; but the reproduced eye seems a little smaller than the entire one; and the iris, or golden circle, goes only half round the ball.

"It would still be necessary to extract the reproduced eye, to ascertain, by dissection, whether it contains a crystalline lens similar to the original. But I confess, that, as yet, I have not had resolution to subject the newt to the most barbarous of all operations; and I shall probably await its death for satisfying my curiosity †."

HYBERNATION OR TORPIDITY OF REPTILES.—The heat of the atmosphere is so necessary to animals, that when the periodical return of the seasons reduces the heat of the countries in the neighbourhood of the equator to the cool temperatures of places situated in higher latitudes, reptiles lose their activity; the heat of their blood diminishes; their strength decreases; they retire into obscure retreats, in holes of rocks, in the mud at the bottom of lakes, or else they seek shelter among the roots of plants which grow on the banks of rivers: but the cold increasing, they fall into a state like that of profound sleep; and this torpor is so great, that no noise disturbs or awakens them. They seem alike insensible to violent blows or severe wounds. Reptiles are subject to this state of torpidity only in those countries where the variations of temperature at different seasons of the year is considerable; and indeed it seems to be a wise regulation of nature, that some of the animals functions should be suspended during that period of the year when the supply of food is cut off. This is the case with reptiles which inhabit countries distant from the equator, whose food consisting of insects, worms, &c. can only be obtained in the warmer season of the year. Accordingly, about the end of autumn, the reptiles, which have been vigorous and active in the summer, conceal themselves in the earth, or under the water, where they remain in the torpid state till the return of the genial warmth of spring. In Britain, frogs are found at the bottom of stagnant water, or in marshy places, where the water of springs issues from the earth, the temperature of which continues uniform through the whole year.

Places to which they retire in winter.

In this state of torpor and inaction, nothing of the animal remains but the form, and those functions only go on, which are essentially necessary to existence during this long period of torpidity, which sometimes continues more than six months. The total mass of the body of reptiles sustains only small loss of substance, but the external parts, such as are exposed to the action of the cold, and more distant from the centre of heat, undergo in the most of animals a considerable change.

But even in countries where the change of seasons is so great, and the diminution of temperature such as to oblige the animals belonging to this order to retire during that season, there are in particular circumstances some remarkable exceptions. One of these is mentioned by Townson in his travels in Hungary: "The town of Gran (he says) is favoured with a fine spring of tepid water, of more use, I believe, to the frogs than to its other inhabitants. My Ciceroni assured me that this animal is not torpid here during the winter, but is then seen in numbers in the pond in the town which receives its water from this spring. This is uncommon (continues the same author), but not surprising. For these three

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* Ibid. ii. 394.

† Ibid. ii. 431.

Hybernation different from sleep.

three years, I have kept a favourite tree frog, which is as gay in winter as in summer, provided she has warmth and enough to eat. The German stoves, which keep the room warm all night, have been very favourable to her. In this, hybernation differs from sleep, that, whereas the latter admits of little variation, and can never be laid aside, or through art receive a substitute; the former greatly varies, and may be supplied by warmth and food. The Alpine marmot, in some high valleys in Savoy, hybernates, I am told, eight or ten months in the year. In other parts of the Alps, it does not hybernate half that time; and when kept warm, and well fed, its annual sleep entirely forsakes it, but not its diurnal. The same warmth that keeps alive the frog, keeps alive the insects on which it feeds, which in their turn will find food from the vegetable world, the mediate or immediate support of every living being, kept in vegetation by the same cause [*]."

Abstinence of the crocodile and the turtle.

ABSTINENCE OF REPTILES.—The singular instances of abstinence which have been recorded of many of the animals belonging to this order, are not the least of the peculiarities by which they are distinguished. It is conjectured by some physiologists, that the texture of the skin, which has few pores, and from which consequently the waste by perspiration is very small, enables them to endure long abstinence. The turtle and the crocodile can live two months without any kind of nourishment. It is no unusual circumstance to keep turtle on the decks of ships, during a passage of seven or eight weeks, from the West Indies, without any food whatever, only occasionally moistening the eyes with salt water.

Of the toad.

The toad has lived eighteen months entirely deprived of food, and excluded from the air; so that the functions of digestion and respiration, so necessary and essential to animal existence in general, must have been totally suspended. We have already mentioned, in the natural history of the toad, Herissant's experiments on this subject before the French academy; and it would be superfluous to repeat the account of them here.

In the same place we have also given our opinion of the extreme improbability of toads, or indeed, it may be added, any animal whatever, having existed for any length of time inclosed in wood or stone, according to the vague stories which have been propagated of such having been discovered. The experiments of Herissant, above alluded to, afford a direct proof of the contrary.

TENACITY OF LIFE.—Many of the tribes of reptiles are not less remarkable for being extremely tenacious of life. They not only live when deprived of their limbs and are otherwise mutilated, but absolutely seem to be little injured when some of the organs essential to life in other animals, and without which they could not exist for a moment, have been removed. The experiments of Redi on the land tortoise, which we have related in the natural history of that animal, in p. 271. are a proof of this fact.

AGE OF REPTILES.—Of the age of reptiles not much is known. But, from the few well authenticated instances which are recorded, it may be fairly presumed, that the period of the life of many tribes is very long. This, indeed, might have been concluded to be the case with cold-blooded animals, which can sustain total abstinence for such a length of time, are so extremely tenacious of life, and repair so easily the loss of different parts of the body: but, on the other hand, when it is considered that they have no fixed haunts where they can remain always undisturbed, that from their amphibious nature they live alternately on the land and in the water, and that they are constantly exposed to the vicissitudes of the seasons, it is not possible to conceive but these changes from wet to dry, and from hot to cold, must greatly affect the animal frame, and limit the period of existence.

Age of the tortoise and the toad.

But without entering into any train of reasoning on the subject, the facts which have been recorded, and some of which we have related, clearly shew, that individuals among reptiles arrive at a very great age. The age of the land tortoise which was kept in Lambeth gardens, and which we have mentioned in p. 271. was at least 120 years. The common toad, of which the history of one kept by Mr Ascot in Devonshire, that lived to the age of 40 years, is given in p. 286. is an instance of the remarkable length of life of so small an animal.

The turtle.

Some species of the turtle do not reach their full size till they are 20 years old; and it is said that they live more than a century.

Of the crocodile.

The age of the crocodile can only be conjectured. It is supposed that this animal, which does not reach its full size of 25 feet long in less time than 32 years, may live seven times this period, so that the age of the crocodile has been calculated at 200 years.

MANNERS, &c. OF REPTILES.—There are probably few animals which discover so much tranquillity and composure in their manners and habits, in general, as reptiles. Less agitated within by violent passions, and less affected from external objects than other animals, they are calm, mild, and peaceable. And if the crocodile, which of all the animals belonging to this order is the most voracious and destructive, is to be regarded as an exception, the ferocious habits for which he is distinguished, are owing to the great size of body which he must support; and, besides, how many tribes may be opposed to this sanguinary family, whose character is quite the reverse. Let us only compare the character of the crocodile with the gentle habits of the small gray lizard, or with the manners of the frog.

But notwithstanding this favourable character of reptiles, which may be considered in some measure as negative, it is to be observed, that, in their manners and habits, they never discover that choice of means, that series of combinations, or that kind of foresight, which in many other animals we behold with wonder and admiration. If sometimes they assemble together in great numbers, this by no means exhibits the character of that social union which takes place among gregarious animals, for it discovers no foresight or order. This bond of union is founded on no connection with each other, on providing no means for their mutual safety or protection. They produce no common work; they do not join together in search of prey, nor are they united in making any general attack on their enemies. Like the beaver, birds, or bees, they construct no permanent asylum; but when they fix on any particular place of abode on the shores, in the clefts of rocks, or in the hollow of trees, it is not a commodious habitation which they prepare for a certain number of individuals, and which they endeavour to appropriate to different purposes,

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[*] P. 60.

purposes, it is rather a retreat for concealment on which they make no change, and which they occupy equally, whether it be only sufficient for a single individual, or contain an extent of space to admit many. If they associate together, it has been observed, for the purpose of pursuing their prey either on the land or in the water, it is because they are equally attracted by the same object; if they make a joint attack, it is because they have the same prey in view. If they seem to unite for the common defence, it is because they are attacked at the same time; and if any individual among them has ever saved the whole party by warning it by its cries, it is not, as has been said of monkeys and some other quadrupeds, that they have been left to watch for the common safety, but only proceeds from the impressions of fear which every animal possesses, and which renders it constantly attentive to its own preservation.

It has been commonly supposed that reptiles have none of those tender affections, with which the care for the preservation of their offspring inspires other animals. Their whole concern about their progeny, it is thought, extends no farther than depositing their eggs in proper places, and covering them with sand and leaves. The offspring is not indebted to the parent for its food, for any of its habits, or for assistance or protection of any kind. It is true, that in general, the moral affections owe much of their force to their repeated impressions on the senses, and that these impressions, recurring distinctly to the memory, and modified by the imagination, cherish these feelings; whence it follows, that the females of reptiles, which do not hatch their young, and which never see them till after the process of incubation is completed, must have very feeble impressions of maternal tenderness, or perhaps none at all. The few observations, however, which have been made with regard to the attachment of the crocodile to its offspring, shew that some of them are not entirely destitute of that feeling, which almost universally pervades the animated creation. "At Surinam (says M. de la Borde) the female of the crocodile remains always at a certain distance from her eggs, which she watches and protects with a kind of fury when any animal approaches them. On the banks of the Oroonoko, when the alligators are hatched, the mother places them on her back and returns to the river. "But, adds Gumilla, the male eats as many as he can, and the female herself devours all those which separate from her, or which are unable to follow her; so that scarcely five or six, of the whole number, remain." This fact, which is by no means probable, even in so voracious an animal as the crocodile, is not incompatible with what is certainly known of many other animals devouring their own offspring. But it seems extremely doubtful, that what is mentioned above of the crocodile watching its eggs, as recorded by de la Borde, is an observation founded in truth.

Enemies of Reptiles.—The earth would soon be covered with immense swarms of reptiles, if nature had not made some provision to retard their increase, and raised up a crowd of enemies which destroy their eggs and their offspring, and preserve the proper balance which is established among the different orders of animals. Fortunately, a great number of frogs, toads, lizards, and crocodiles, are destroyed before they are hatched. Many quadrupeds, as several species of monkeys, the ichneumon, and other animals, as well as several species of aquatic birds, search for their eggs on the shores, and feed on them with avidity. All the small reptiles which live in the water, which crawl in the mud of marshes, or creep on the earth, become the prey of fishes, of serpents, of birds, and of quadrupeds.

The tiger attacks the crocodile; and is sometimes successful in seizing its prey. The hippopotamus is a terrible enemy to the same animal; and is the more to be dreaded, as from his habits, he is enabled to pursue it to the bottom of the water. The cougar, although a less ferocious animal than the tiger, destroys many alligators. He waits in ambush on the banks of the great rivers for the approach of the young ones, and at the moment they raise their head above the water, he seizes them and tears them to pieces. But when he attacks those that are large and vigorous, he often meets with a bold and effectual resistance. It is in vain that he fastens his talons in their eyes; these huge reptiles drag him to the bottom of the water and devour him.

But man is perhaps the most dangerous enemy of the crocodile; sometimes he attacks him by open force, and sometimes by means of stratagem. The Africans, as soon as they perceive one of these animals on the bank of a river, advance towards him, having only in their hand a stick of very hard wood, or an iron rod about eight or ten inches long, and well sharpened at the ends; they hold this feeble instrument by the middle, and when the reptile, which advances towards them, opens his wide mouth, they introduce the rod of iron, which they turn with dexterity, so that the monster finds that he is unable to close his jaws. The pain from the wound, and instinct to reach a place of safety, make him retreat into the water, where he soon perishes by suffocation and the loss of blood. It is said, that some negroes are so bold and dexterous, as to swim under the body of the crocodile, and to pierce him in the skin of the belly; which is almost the only place on which a wound can be inflicted.

In some countries the natives employ stratagem to take this dreadful animal. In Egypt, they dig a deep ditch in the path which he follows in proceeding from the river. This is covered with branches of trees, and with a small quantity of earth; they then set up loud shouts, at which the crocodile is terrified, and returning the same way to the water, he passes over the ditch, falls into it, and is either killed or taken in snares.

The Indians successfully employ another mode of destroying the crocodile. They introduce into the body of a small animal, newly killed, a quantity of arsenic or quicklime, so secured, that the moisture cannot reach it; and this animal is exposed to the view of the crocodile. This is undoubtedly the most certain, and the least dangerous expedient.

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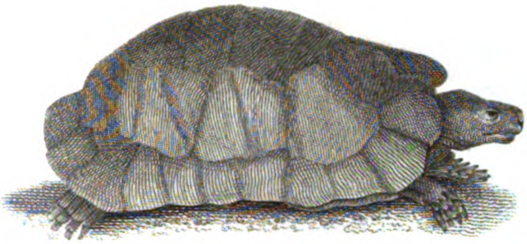
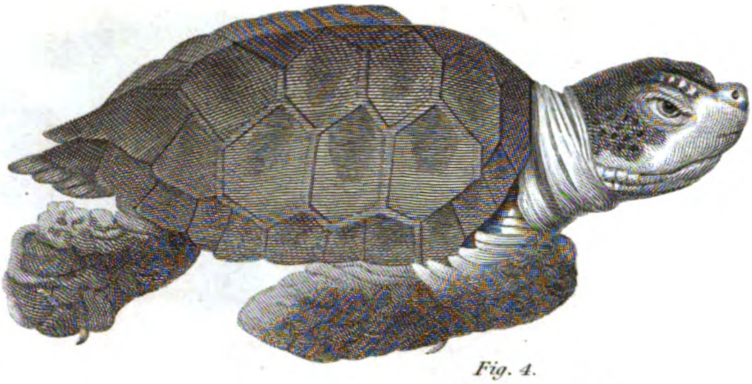


*Fig. 2.*



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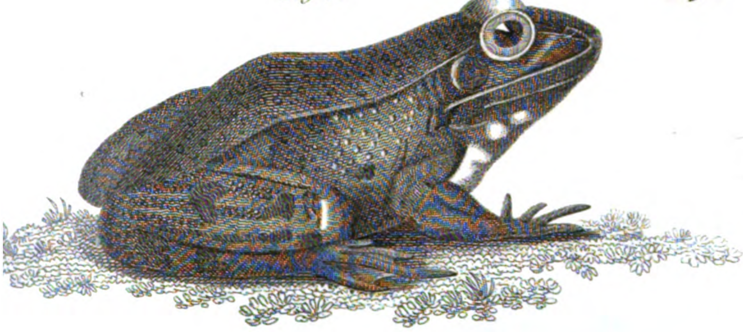

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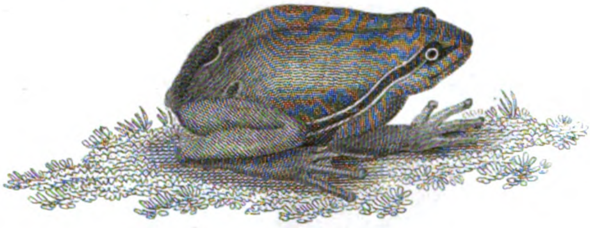

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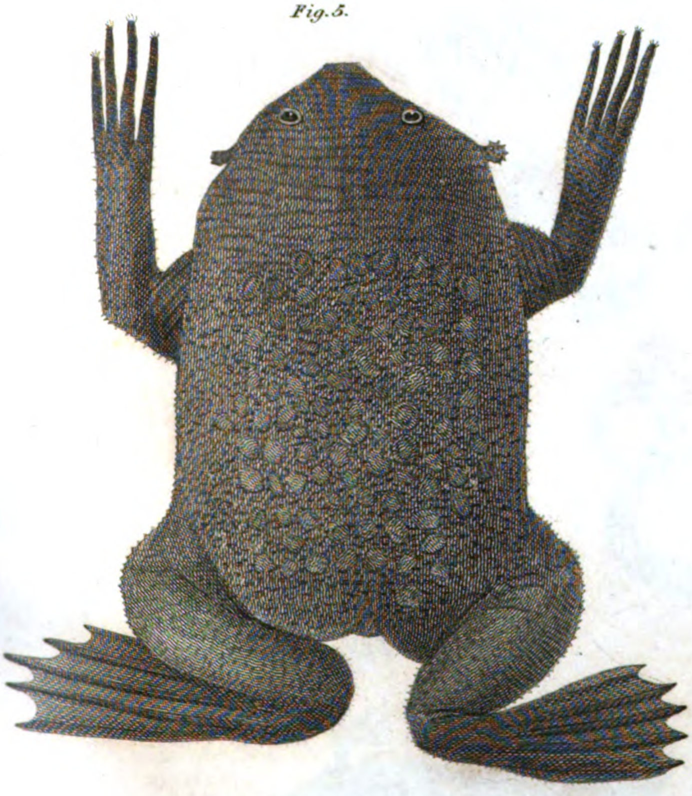
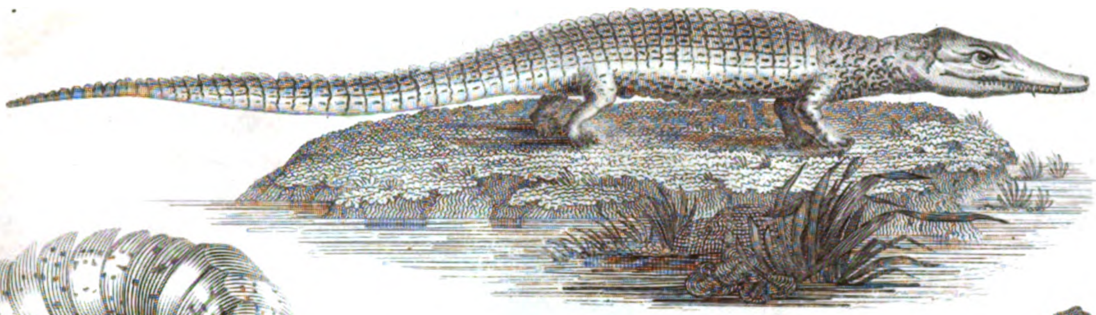


*Fig. 6.*

*A. Wilson Sculp!*

# ERPETOLOGY. PLATE CCVIII.

Fig. 7.



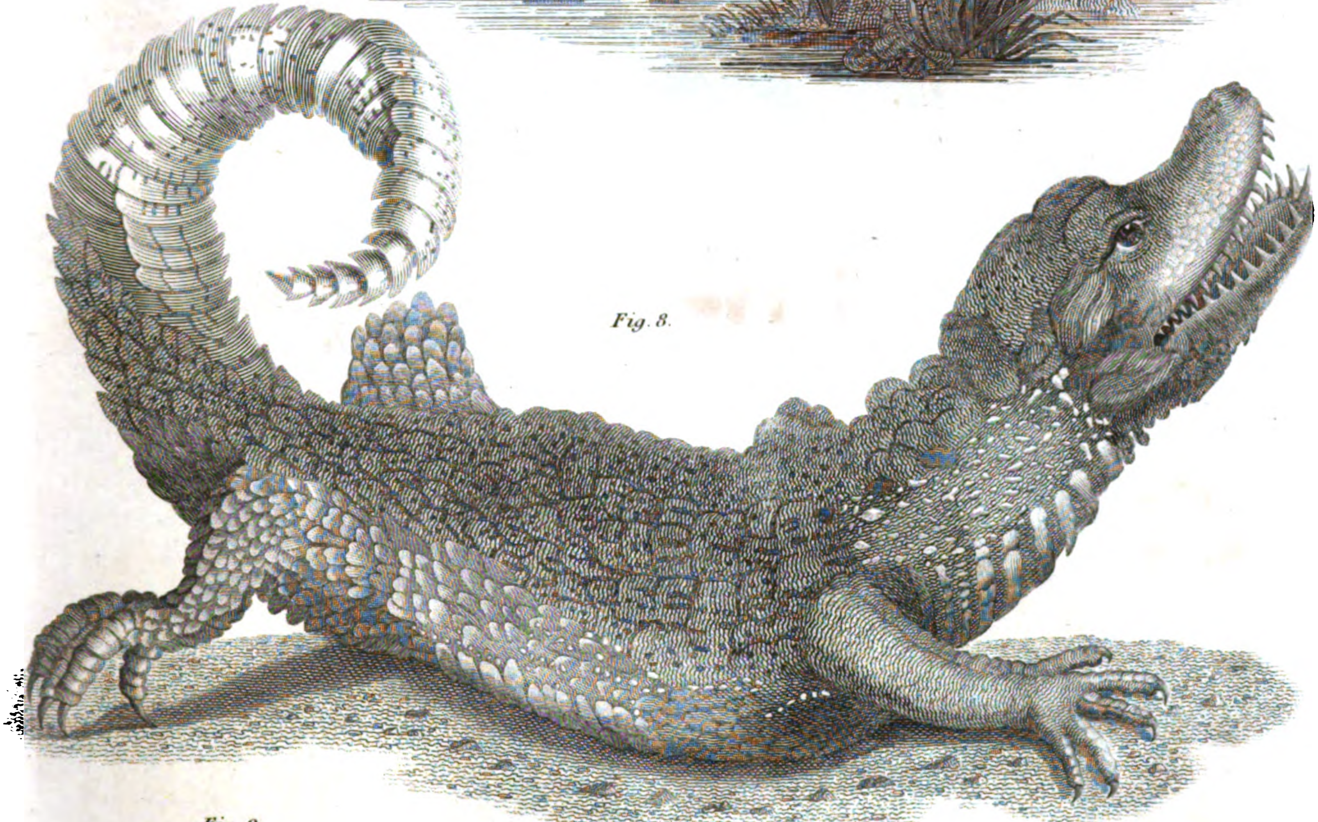


Fig. 8.

Fig. 9.

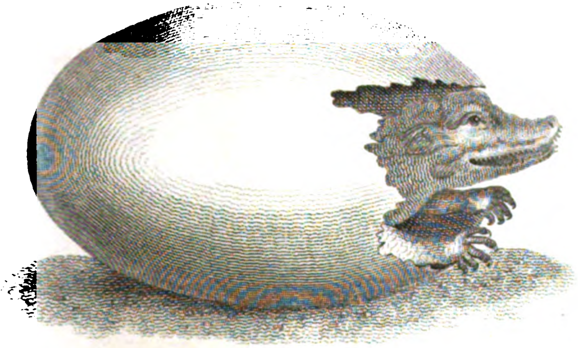


Fig. 10.

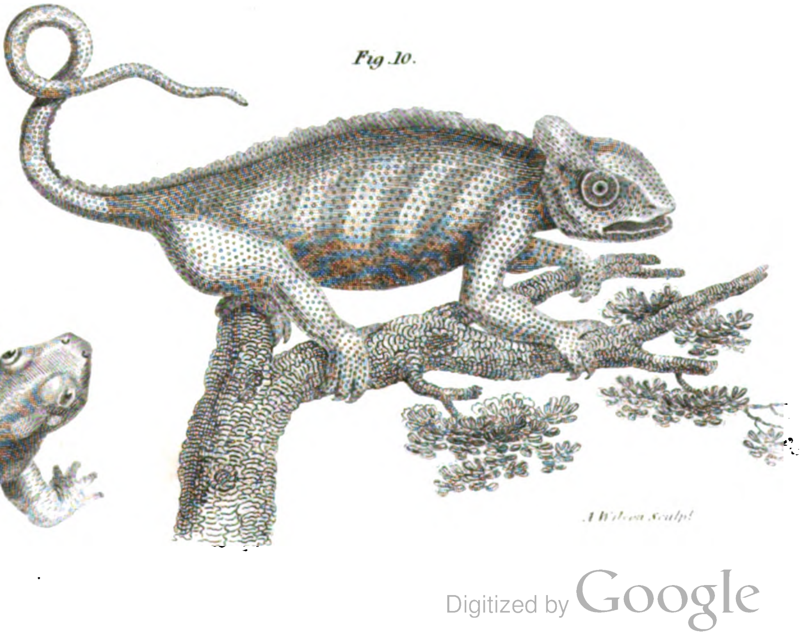
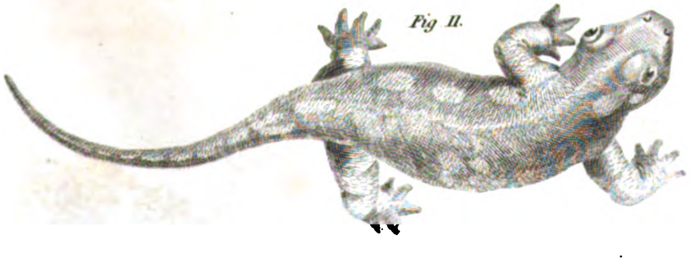


Fig. 11.



A Wilson Sculpt

# ERPETOLOGY. PLATE CCIX.

Fig. 12.

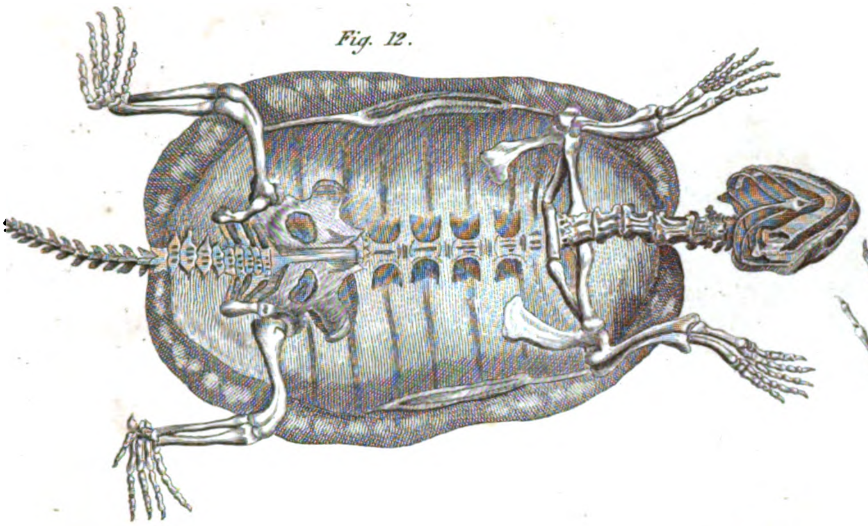


Fig. 13.

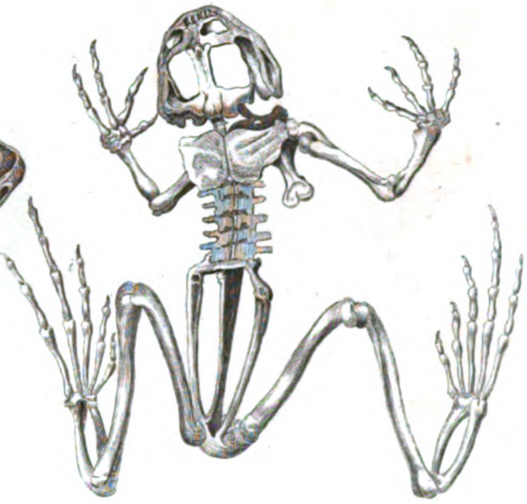


Fig. 14.

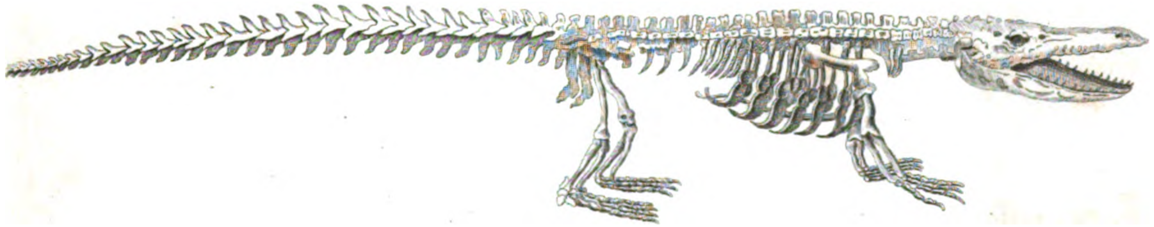


Fig. 15.

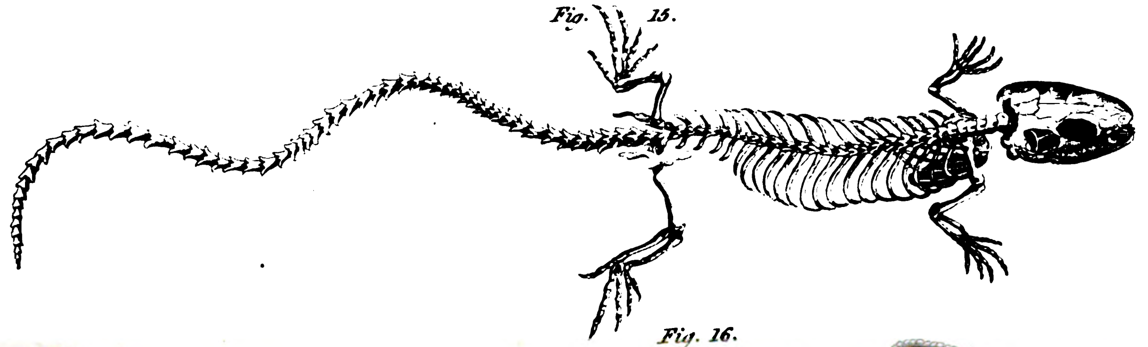
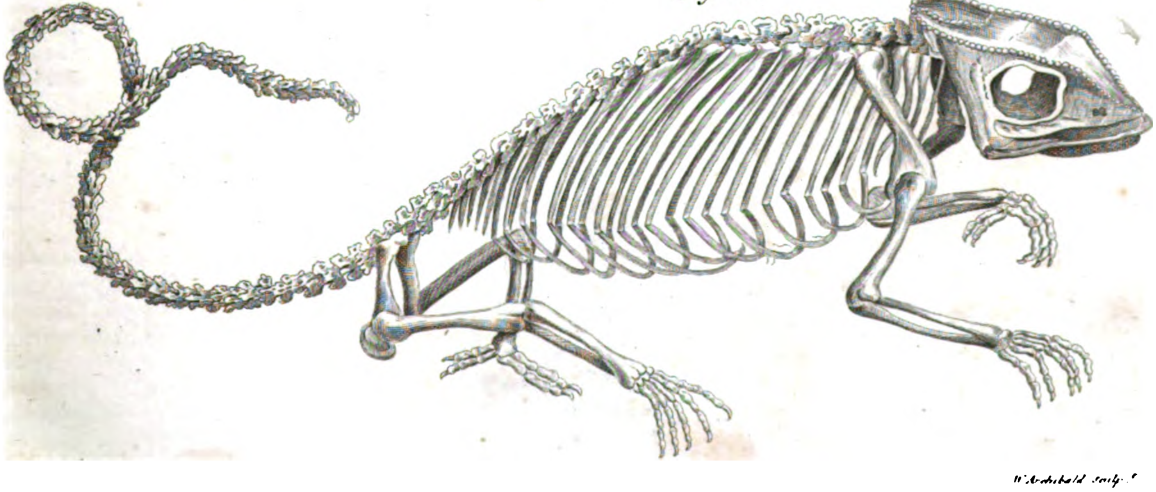


Fig. 16.



W. Archibald sculpt.

**ERRATIC**, in general, something that wanders, or is not regular: hence it is the planets are called *erratic stars*.

**ERRHINES**, in *Pharmacy*, medicines which when snuffed up the nose promote a discharge of mucus from that part. See MATERIA MEDICA *Index*.

Errhines prepared of cephalic herbs are of singular service in oppressive pains of the head, a hemicrania, lethargic disorders, weakness of memory, stuffings of the head, and coryza, mucous defluxions of the eyes, drowsiness, vertigoes, and in cases where the malignant humours generated by the lues venerea are lodged in the membranes of the nostrils.

**ERROR**, in *Philosophy*, a mistake of our judgment, giving assent to that which is not true.

Mr Locke reduces the causes of error to these four; first, want of proofs; secondly, want of ability to use them; thirdly, want of will to use them; and, fourthly, wrong measures of probability.

He obverves upon the first of these causes of error, that the greatest part of mankind want conveniences and opportunities of making experiments and observations themselves, or of collecting the testimony of others, being prevented by the necessity of their condition. Upon the second of these causes, he observes, that there are many, who, from the state of their condition, might bestow time in collecting proofs, but yet are not able to carry a train of consequences in their heads, nor weigh exactly the preponderancy of contrary proofs and testimonies, merely from the difference in men's understandings, apprehensions, and reasonings. Thirdly, he remarks, that though some have opportunities and leisure enough, and want neither parts, learning, nor other helps, that they never come to the knowledge of several truths within their reach, either upon account of their attachment to pleasure or business; or otherwise because of their laziness or aversion to study. The fourth cause of error, viz. wrong measures of probability, he imputes, 1. To the practice of taking for principles propositions that are not in themselves certain and evident, but, on the contrary, doubtful and false. 2. To received hypotheses. 3. To predominant passions or inclinations. And, 4. To authority, or the giving up our assent to the common received opinions either of our friends or party, neighbours or country.

The causes of error in philosophy, or the reasons why all former philosophers have through so many ages erred, according to Lord Bacon, are these following. 1. Want of time suited to learning. 2. The little labour bestowed upon natural philosophy. 3. Few entirely addicted to natural philosophy. 4. The end of the sciences wrong fixed. 5. A wrong way chosen. 6. The neglect of experiments. 7. Regard to antiquity and authority. 8. Admiration of the works in use. 9. The artifices of teachers and writers in the sciences. 10. Ostentatious promises of the moderns. 11. Want of proposing worthy tasks. 12. Superstition and zeal being opposite to natural philosophy, as thinking philosophy dangerous, on account of the school theology; from the opinion that deep natural inquiries should subvert religion. 13. Schools and academies proving unfavourable to philosophy. 14. Want of rewards. And, 15. Despair, and the supposition of impossibility.

*ERROR Loci.* Boerhaave is said to have introduced the term, from the opinion that the vessels were of different sizes for the circulation of blood, serum, and lymph; and that when the larger-sized globules were forced into the lesser vessels by an error of place, they were obstructed. But this opinion does not seem well grounded.

**ERUCA**, in general, denotes caterpillars of all kinds. The caterpillar state is that through which insects pass before they arrive at perfection. See LARVA, ENTOMOLOGY *Index*.

**ERUDITION**, denotes learning or knowledge; and chiefly that of history and antiquity, of languages and of books, which is the result of hard study and extensive reading. The Scaligers were men of deep erudition: the writings of M. Launoy, a priest of the Oratory, are full of erudition.

Mr Locke says, it is of more use to fill the head with reflections than with points of erudition. If the mind be not just and right, ignorance is better than erudition, which only produces confusion and obscurity. M. Balzac calls a heap of ill chosen erudition the luggage of antiquity.

**ERUPTION**, in *Medicine*, a sudden and copious excretion of humours, as pus or blood: it signifies also the same with exanthema, any breaking out, as the pustules of the plague, small-pox, measles, &c.

ERUPTION *of Volcanoes*. See ÆTNA, VESUVIUS, and VOLCANO, GEOLOGY *Index*.

**ERVUM**, the LENTIL: A genus of plants, belonging to the diadelphia class; and in the natural method ranking under the 32d order, *Papilionaceæ*. See BOTANY *Index*.

ERYMANTHUS, a mountain, river, and town of Arcadia, where Hercules killed a prodigious bear, which he carried on his shoulders to Eurystheus; who was so terrified at the sight, that he hid himself in a brazen vessel.

ERYNGIUM, Sea-Holly, or *Eryngo;* a genus of plants belonging to the pentandria class, and in the natural method ranking under the 45th order, *Umbellatæ.* See Botany *Index.*

ERYSIMUM, Hedge-Mustard; a genus of plants, belonging to the tetradynamia class, and in the natural method ranking under the 29th order, *Siliquosæ.* See Botany *Index.*

ERYSIPELAS, in *Medicine*, an eruption of a fiery or acrid humour, from which no part of the body is exempted, though it chiefly attacks the face. See Medicine *Index.*

ERYTHEA, or Erythia, an island adjoining, according to the ancients, either to or a part of Gades; nowhere now to be found by the description given of it by ancient authors. The poets feign this to be the habitation of the fabulous Geryon, disarmed by Hercules, who drove away his cattle.

ERYTHRÆ, in *Ancient Geography*, a port-town of Ætolia, on the Corinthian bay. Another Erythræ of Bœotia, near Platæa and Mount Cithæron. A third Erythræ, a town of Ionia in the Hither Asia, situated in the peninsula, at its extremity, with a cognominal port. The Erythræans laid claim to the Sibyl Herophile, as their countrywoman, surnamed thence *Erythræa.* Erythræ was famous for an ancient temple of Hercules.

ERYTHRÆA, a town of Crete, situated in the south-east of the island, at the promontory Erythræum.

ERYTHRÆUM mare, erroneously called *Rubrum* by the Romans. Thus the ocean that washes Arabia and Persia, and extends a great way farther, is denominated. Hence it is, Herodotus says, that the Euphrates and Tigris fall into the Mare Erythræum. He also calls it the *South Sea*, on which the Persians dwell. It takes its name, not from its colour, the error of the Romans, who translated *Erythræum* "Rubrum;" but from *Erythras*, son of Perseus and Andromeda, whose kingdom lay on the confines of that sea; whence its name *Erythræum.*

ERYTHRINA, Coral Tree; a genus of plants belonging to the diadelphia class; and in the natural method ranking under the 32d order, *Papilionaceæ.* See Botany *Index.*

ERYTHRINUS, in *Ichthyology*, a species of Sparus. See Ichthyology *Index.*

ERYTHROIDES, in *Anatomy*, the first of the proper tunics or coats which cover the testicles.

ERYTHRONIUM, Dog's-tooth Violet; a genus of plants belonging to the hexandria class; and in the natural method ranking under the 11th order, *Sarmentaceæ.* See Botany *Index.*

ERYTHROXYLON, a genus of plants, belonging to the decandria class. See Botany *Index.*

ERYX, a son of Butes and Venus, who relying upon his strength, challenged all strangers to fight with him in the combat of the cestus. Hercules accepted his challenge after many had yielded to his superior dexterity; and Eryx was killed in the combat, and buried on the mountain, where he had built a temple to Venus. Virg. Æn. 5. v. 402. A mountain of Sicily near Drepanum, which received its name from Eryx, who was buried there. This mountain was so steep, that the houses which were built upon it seemed every moment ready to fall. Dædalus had enlarged the top, and inclosed it with a strong wall. He also consecrated there to Venus Erycina a golden heifer, which resembled life so much, that it seemed to exceed the power of art.

ERZERUM, or Erzeron, a city of Turkey in Asia, and capital of Armenia, or Turcomania. It is a pretty large town, five days journey from the Black sea, and ten from the frontiers of Persia. It stands in a delightful plain, at the foot of a chain of mountains, which hinder the Frat, or Euphrates, from falling into the Black sea. A neighbouring hill supplies very fine springs, which not only water the fields, but the streets of the town. Erzerum is surrounded with double walls, defended by pentagonal towers; but the ditches are neither deep nor well kept up. The beglerbeg, or bashaw of the province, lives in the seraglio, which is very ill built. They reckon that there are 18,000 Turks at Erzerum, 6000 Armenians, and 10,000 Greeks. The Armenians have a bishop and two churches; and the Greeks have also a bishop, but the church is a miserable place. The last are mostly braziers, inhabiting the suburbs, who work the copper brought from the neighbouring mountain. They drive a great trade in copper utensils and furs, particularly martens skins. Five or six days journey from the town there are oaks that produce plenty of gall-nuts, which are brought hither. This place is the thoroughfare and resting place of all the merchants trading to the Indies, especially when the Arabs are watching for their prey round Aleppo and Bagdad. E. Long. 40. 50. N. Lat. 39. 46.

ESARHADDON, the son of Sennacherib, and his successor in the kingdom of Assyria. He is said to have reigned 29 years at Nineveh, from the year 3294 to 3322; besides which he reigned 13 years at Babylon, in all 42 years. He died in the year of the world 3336, and was succeeded by Saosduchinus. Esarhaddon, in the opinion of Sir Isaac Newton, seems to be the Sardanapalus who died, as Clectarchus says, of old age, after the revolt of Syria; the name *Sardanapalus* being derived from *Asserhadon Pul.*

ESCALADE, or Scalade, a furious attack of a wall or a rampart, carried on with ladders, to pass the ditch, or mount the rampart; without proceeding in form, breaking ground, or carrying on regular works to secure the men.

When the troops are prepared to pass the ditch, either with the assistance of boards, hurdles, and fascines, when it is muddy, or with small boats of tin, or baskets covered with skins or oil cloth, when it is deep and filled with water, a party must be placed on the counterscarp, opposite to the landing-place, ready to fire at the garrison if they are alarmed, and oppose the mounting on the rampart. If the ditch is dry, the ladders are fixed in some place farthest distant from the centry; and as soon as they get upon the rampart, they put themselves in order to receive the enemy; if the centry should be surprised and silently overcome, the detachment hastens to break open the gate, and to let in the rest of the party. If the ditch is wet, the rampart high, and provided with a revetement, it will be be difficult to surprise the town in this way; but if there is no revetement, the troops may hide themselves along the outside of the rampart till all are over. Since the invention and use of gunpowder, and the walls of cities have been flanked, they are seldom taken by escalade.

ESCALLONIA, a genus of plants belonging to the pentandria class. See BOTANY *Index*.

ESCAPE, in *Law*; a violent or privy evasion out of some lawful restraint, without being delivered by due course of law. There are two sorts of escapes, voluntary and negligent. Voluntary, when a man arrests another for felony or other crime, and afterwards lets him go freely by consent; in which case, the party that permits such escape is held guilty, committed, and must answer for it. Negligent escape, on the contrary, is where one is arrested, and afterwards escapes against the will of the person that arrested him, and is not pursued with fresh suit, and retaken before the person pursuing hath lost sight in him. By stat. 8 and 9 Will. III. c. 26. the keepers of prisons conniving at escapes shall forfeit 500l.; and in civil cases the sheriff is answerable for the debt.

ESCHALOT, or SHALLOT. See ALLIUM.

ESCHAR, in *Surgery*, the crust or scab occasioned by burns or caustic medicines.

ESCHARA, in *Natural History*, the name of a species of coralline, &c. the characters of which are these: they are of a stony or coral-like hardness, and resemble a woven cloth in their texture; and the microscope informs us, that they consist of arrangements of very small cells, whose surfaces appear much in that form. Linnæus makes it a species of millepora, in the class of lithophytes.

ESCHEAT, in *Law*, signifies any land or tenements that casually fall to a lord within the manor. It is one of the consequences of tenure in chivalry: (See *FEODAL System*, *KNIGHT-Service*, and TENURE). It is the determination of the tenure or dissolution of the mutual bond between the lord and tenant, from the extinction of the blood of the latter by either natural or civil means: if he died without heirs of his blood, or if his blood was corrupted and stained by commission of treason or felony; whereby every inheritable quality was entirely blotted out and abolished. In such cases the land escheated or fell back to the lord of the fee; that is, the tenure was determined by breach of the original condition, expressed or implied in the feodal donation. In the one case, there were no heirs subsisting of the blood of the first feudatory or purchaser, to which heirs alone the grant of the feud extended: in the other, the tenant, by perpetrating an atrocious crime, showed that he was no longer to be trusted as a vassal, having forgotten his duty as a subject; and therefore forfeited his feud, which he held under the implied condition that he should not be a traitor or a felon. The consequence of which in both cases was, that the gift being determined, resulted back to the lord who gave it.

The word *escheat* is sometimes used for the place or circuit within which the king or other lord is intitled to escheats; also for a writ to recover the same from the person in possession after the tenant's death.

ESCHEAT, in *Scots Law*, is that forfeiture which is incurred upon a person's being denounced a rebel. See LAW, Part III. N° clxvi. 12.

ESCHEVIN, or ECHEVIN (*Scabinus*), in the French and Dutch polity, a magistrate elected by the inhabitants of a city, to take care of their common concerns, the good order, conveniency, and decoration of the city, &c.

At Paris there were formerly a prevôt and four *eschevins*; in most other cities a mayor and *eschevins*. In Languedoc, Provence, and Dauphiné, they were called *consuls*; at Toulouse, *capitouls*; and *jurats* at Bourdeaux.

Anciently the *eschevins* were the assessors and counsellors of the comites or judges of cities; on which account they were called in some places *pairs*, *pares*; they even took cognizance of petty causes themselves.

Du Cange observes, that the judges and their assessors, who were chosen by the inhabitants, were called *scabini*, "eschevins," and their college *scabinagium* or "eschevinage."

"In Holland, the *scabins* or *eschevins* judge of all civil affairs at first hand. They also take cognizance of criminal matters: and if the criminal confess himself guilty, they can see their sentence executed without appeal. They can even give torture. The number is not the same in all cities; at Amsterdam there are nine, at Rotterdam seven, &c.

ESCHRAKITES, or ESRAKITES, a sect of philosophers, among the Mahometans, who adhere to the doctrines and opinions of Plato. The word is derived from the Arabic שרק *schraca*, which in the fourth conjugation אשרק *aschraca*, signifies "to shine, glitter like the sun," so that *Eschrakite* seems to import "illumined."

The *Eschrakites*, or Mahometan Platonists, place their highest good and happiness in the contemplation of the Divine Majesty; despising the gross imaginations of the Alcoran touching paradise. They are very careful in avoiding all vice; they preserve an equal and easy temper, love music, and divert themselves with composing little poems or spiritual songs. The shaeicks or priests, and the chief among the preachers of the imperial mosques, are Eschrakites.

ESCLAIRCISSEMENT, a French term adopted into our language, signifying the explaining or clearing up of some difficulty or obscurity.

ESCORT, a French term, sometimes used in English authors to denote a convoy or company of armed men, attending some person or thing, in a journey or voyage, to defend or secure it from insults. Some derive the word from the Latin *cohors*.

ESCOUADE, or SQUAD, is usually the third or fourth part of a company of foot; so divided for mounting guards, and for the more convenient relieving of one another. It is equivalent to brigade of a troop of horse. See BRIGADE.

ESCUAGE, in our old customs, a kind of knight-service, called *service of the shield*, by which the tenant was bound to follow his lord to the wars on his own charge. See the articles CHIVALRY, *FEODAL System*, and *KNIGHT-Service*.

ESCULAPIUS. See ÆSCULAPIUS.

ESCULENT, an appellation given to such plants, or the roots of them, as may be eaten: such are beets, carrots, artichokes, leeks, onions, parsnips, potatoes, radishes, scorzonera, &c.

Escurial.

**ESCURIAL**, a royal residence of Spain, situated about 15 miles north-west of Madrid. It is the largest and most superb structure in the whole kingdom, and perhaps one of the finest in Europe. The word is Arabic, meaning "a place full of rocks." It is built in a dry barren spot, surrounded with rugged mountains, insomuch that every thing which grows there is owing to art. This place was chosen, it is said, for the sake of the stone wherewith the fabric was built, which is got from a mountain just by, and is very durable; and the design of erecting it was to commemorate a victory which Philip II. obtained over the French (but by the assistance of the English forces) at St Quintin, on St Laurence's day, in the year 1557. The Spanish description of this structure forms a sizeable quarto volume, and it is said that its founder expended upon it six millions of ducats. The apartments are decorated with an astonishing variety of paintings, sculpture, tapestry, ornaments of gold and silver, marble, jasper, gems, and other curious stones, surpassing all imagination. This building, besides its palace, contains a church, large and richly ornamented; a mausoleum; cloisters; a convent; a college; and a library, containing about 30,000 volumes; besides large apartments for all kinds of artists and mechanics, noble walks, with extensive parks and gardens, beautified with fountains and costly ornaments. The fathers that live in the convent are 200, and they have an annual revenue of 12,000l. It was begun by Philip in 1562, five years after the battle; and completed in 22 years. It consists of several courts and quadrangles, which altogether are disposed in the shape of a gridiron, the instrument of the martyrdom of St Laurence: the apartments where the king resides form the handle. The building is a long square of 640 by 580, and the height up to the roof is all round 60 feet, except on the garden side, where the ground is more taken away. At each angle is a square tower 200 feet high. The number of windows in the west front is 200; in the east front 366. The orders employed are Doric and Ionic. There are three doors in the principal front. Over the grand entrance are the arms of Spain, carved in stone; and a little higher in a niche, a statue of St Laurence in a deacon's habit, with a gilt gridiron in his right hand, and a book in his left. Directly over the door is a basso-relievo of two enormous gridirons in stone. This vast structure, however, with its narrow high towers, small windows, and steep sloping roof, exhibits a very uncouth style of architecture; at the same times that the domes, and the immense extent of its fronts, render it a wonderfully grand object from every point of view. The church, which is in the centre of all, is large, awful, and richly but not affectedly ornamented. The cupola is bold and light. The high altar is composed of rich marbles, agates, and jaspers of great rarity, the produce of this kingdom. Two magnificent *catafalquas* fill up the side arcades of this sanctuary: on one the emperor Charles V. his wife, daughter, and two sisters, are represented in bronze, larger than life, kneeling; opposite are the effigies of Philip II. and of his three wives, of the same materials, and in the same devout attitude. Underneath is the burial-place of the royal family, called the *Pantheon*. Twenty-five steps lead down to this vault, over the door of which is an inscription denoting, that.

Escurial ‖ Esdras.

*Hic locus, sacer mortalitatis exuviis Catholicorum Regum, &c.*

was intended by Charles the emperor; resolved upon by Philip II. begun by Philip III. and completed by Philip IV. The mausoleum is circular, 36 feet diameter, incrusted with fine marbles in an elegant taste. The bodies of the kings and queens lie in tombs of marble, in niches, one above the other. The plan of these sepulchres is grand, and executed with a princely magnificence; but, as a modern traveller observes, in a style rather too gay, too light, and too delicately fitted up for the idea we are apt to form of a chapel destined for the reception of the dead. The collection of pictures dispersed about various parts of the church, sacristy, and convent, has been considered as equal, if not superior, to any gallery in Europe, except that of Dresden. Formed out of the spoils of Italy, and the wasted cabinet of that unfortunate dilettante Charles I. of England, it contains some of the most capital works of the greatest painters that have flourished since the revival of the art. In the sacristy is an altar called *La santa Forma:* this is a kind of tabernacle or *custioda* of gems, marbles, woods, and other precious materials, inlaid in gilt bronze; in which, rather than in the excellence of the workmanship or taste of the design, consists the merit of this rock of riches. Before it hangs a curtain, on which Coello has represented Charles II. and all his court in procession, coming to place this *Forma*. This is esteemed one of the most curious collections of portraits in the world; for all the persons are drawn with the greatest strength of colour and truth of expression, and are said to be perfect resemblances not only of the monarch and grandees, but even of the monks, servants, and guards. The statues, busts, and medallions of the Escurial, are not in any great number, or very remarkable for their excellence: but the library contains a most precious collection of manuscripts, many fine drawings, and other curiosities. Notwithstanding the coldness of the exposure, the late king, for the sake of hunting, used to pass here several months in the year; and to make the place less inconvenient to his attendants and to the nobility, he built an entire new town adjoining to it.

**ESCUTCHEON**, or SCUTCHEON, in *Heraldry*, is derived from the French *escusson*, and that from the Latin *scutum*, and signifies the shield whereon coats of arms are represented.

Most nations of the remotest antiquity were wont to have their shields distinguished by certain marks painted on them; and to have such on their shields was a token of honour, none being permitted to have them till they had performed some honourable action.

The escutcheon, as used at present, is square, only rounded off at the bottom.

**ESDRAS**, a Jewish priest, and doctor of the law. Artaxerxes Longimanus sent him with rich presents for the use and ornament of the temple at Jerusalem, rebuilt under Zerobbabel; the king also ordered the neighbouring governors to provide him with what conduced to the pomp of the Jewish religion, and to exempt the priests from paying taxes. He is supposed to be the collector of the Canon of Scripture; and that, by divine inspiration, he added some things which happened

pened after the deaths of the authors. It is guessed he wrote the Chronicles, besides those books which bear his name, the two last of which are exploded even by the church of Rome.

ESK, the name of several rivers both in England and Scotland, particularly of one which forms part of the boundary between the two kingdoms. It runs from north east to south-west, and gives name to the district of Eskdale.

ESKI-HISSAR. See STRATONICEA.

ESKIMAUX. See ESQUIMAUX.

ESNE, or ESNEH, a considerable town of Upper Egypt. It is governed by an Arabian prince and by a cachef, dependent on the bey of Girze. The Mahometans have several mosques here, and the Coptis a church served by two priests. "Esne (says Abulfeda,) remarkable for its public baths and its commerce, is built on the westward of the Nile, between Assouan and Cous, but nearer to this latter. It acknowledges, adds the geographer of Nubia, the Coptis for founders. Its well cultivated territory abounds in grain and palm-trees. It is surrounded by gardens filled with fruit-trees. One admires here several ancient monuments constructed by the Coptis, and superb ruins." This description answers to Esne in our time, which is situated on the edge of a rich country, and shaded by groves of orange trees loaded with fruits and flowers. This town, formerly called *Latopolis*, revered Minerva and the fish *Latus* (Strabo). It contains within its boundary an antique temple. Thick walls inclose it on three sides. Six large fluted columns, crowned by a capital ornamented with the palm leaf, form the façade of it; 18 others support the roof, which is composed of large squares of marble; the building is surrounded by a frieze, and innumerable hieroglyphics cover its exterior aspects.

A little to the south of the town are seen the ruins of a monastery founded by St Helena, and near it the burying-place of the martyrs, adorned with tombs crowned by cupolas, supported by arcades. The inhabitants of Esne having revolted against the persecution of Dioclesian, that emperor destroyed this town and put them to the sword. This place, consecrated by religion, is become a celebrated pilgrimage among the Coptis. They repair thither from the most distant provinces of the kingdom. In the chain of mountains which stretches to the eastward of the Nile, and nearly opposite Esne, are quarries of a soft stone, called *Baram*. It is made use of for kitchen utensils. It hardens in the fire, and forms excellent kettles and pans, which give no bad taste to the victuals. This stone is probably the *lapis ollaris*, or *pot-stone*.

"Esne (says Denon*) is the ancient Latopolis. Some remains are still visible of its port or quay on the bank of the Nile, which has been often repaired: but, notwithstanding all that has been done for it, still remains in a very miserable condition. This town also contains the portico of a temple, which appears to me to be the most perfect monument of ancient architecture. It is situated near the bazar in the great square, and would make an incomparable ornament to this spot, if the inhabitants had any idea of its merit; but instead of this they have deformed it by the most miserable ruined hovels, and have devoted it to the vilest purposes. The portico is very well preserved, and possesses a great richness of sculpture: it is composed of eighteen columns with broad capitals; these columns are noble and elegant, though they now appear in the most disadvantageous light: the rubbish should be cleared to find if any part of the *cella* remains.

"The hieroglyphics in relief, with which it is covered within and without, are executed with great care; they contain, among other subjects, a zodiac, and large figures of men with crocodiles heads: the capitals, though all different, have a very fine effect; and as an additional proof that the Egyptians borrowed nothing from other people, we may remark, that they have taken all the ornaments, of which these capitals are composed, from the productions of their own country, such as the lotus, the palm-tree, the vine, the rush, &c. &c."

ESOX, a genus of fishes belonging to the order of abdominales. See ICHTHYOLOGY *Index*.

ESPALIERS, in *Gardening*, are rows of trees planted about a whole garden or plantation, or in hedges, in such a manner as to enclose quarters or separate parts of a garden; and are trained up regularly to a lattice of wood-work in a close hedge, for the defence of tender plants against the injuries of wind and weather. They are of admirable use and beauty in a kitchen-garden, serving not only to shelter the tender plants, but screen them from the sight of persons in the walks.

The trees chiefly planted for espaliers, are apples, pears, and some plums: some plant apples grafted upon paradise stocks; but as these are of short duration, it is better to plant those grafted upon crabstock, or upon what the gardeners call *Dutch stocks*; which will both cause them to bear sooner, and prevent their growing too luxuriant. The best kinds of apple for this purpose, are the golden pippen, nonpareil, renette, &c. and the best sorts of pear, are the jargonelle, blanquett, &c. These last, if designed for a strong moist soil, should be grafted upon quince stocks; but if for a dry soil, upon free stocks.

While the trees are young, it will be sufficient to drive a few stakes into the ground on each side of them; fastening the branches to these in a horizontal position, as they are produced. This method will do for the three first years; after which an espalier should be made of ash-poles, whereof there must be two sorts, larger and smaller; the former to be driven upright into the ground a foot asunder, and the latter, or slender poles, to be nailed across these, at about nine inches. Some prefer to this another sort of espalier, made of square timber cut to any size; these are, indeed, more sightly, but withal vastly more expensive.

When the espalier is thus framed, the branches are to be fastened to it with osier twigs; observing to train them in a horizontal position, and at equal distances. Fruit trees thus managed are preferable to any others; not only as bearing better-tasted fruit, but as taking up very little room in a garden, so as to be less hurtful to plants which grow in the quarters.

ESPLANADE, in *Fortification*, the sloping of the parapet of the covered-way towards the champaign.

ESPLEES, in *Law*, the general products which lands yield, or the profit or commodity that is to be taken or made of a thing.

ESPOUSALS, in *Law*, signify a contract or pro-

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* *Trav.* ii. 93.

mise made between a man and a woman to marry each other; and in cases where marriages may be consummated, espousals go before. Marriage is termed an espousal *de presenti*.

The espousals among the Jews were either by writing, or by a piece of silver given and received, or by cohabitation. Amongst the Greeks, after the parents and friends of the young couple had finished their negociation, the couple themselves pledged their faith to each other, the man swearing that he would be constant and true, the woman that she would marry him, and make him master of all she had. Then they ratified their agreement by a kiss and joining right hands.

Amongst the Romans the espousals consisted in an engagement of friends on both sides, whether absent or present, in public or without witnesses. But the common way was by writings drawn up by common consent, and sealed by both parties: besides this, the man sent a ring to the woman, consisting of iron and without a stone.

ESQUILIÆ, in *Ancient Geography*, one of the seven hills of Rome, which Varro will have to be two, viz. Cispias and Oppius; also Mons Esquilinus, softened from Exquilinus; and this again from Excubinus, the watch or guard Romulus kept here, from a jealousy he entertained of his colleague Titus Tatius. On the east side it reached the city walls; on the south, the Via Lavicana; on the west, the wide valley between Mount Coelius and the Palatine; on the north, the Mons Viminalis; on the east side was the Porta Esquilina. This hill by some of the ancients was called *Suburranus*, from the street *Suburra* to the north of it: by the poets, *Esquilius*.

ESQUIMAUX, a people of North America, inhabiting all that vast tract of land known by the name of *Labrador*, or *New Britain*. They differ very considerably, both in aspect and manners, from the other American nations; agreeing in most respects with the inhabitants of West Greenland. See *New* BRITAIN and GREENLAND.

ESQUIRE (from the French *escu*, and the Latin *scutum*, in Greek *σκυτος*, which signifies a hide, of which shields were anciently made, and afterwards covered; for in the time of the Anglo-Saxons the shields had a covering of leather), was originally he who, attending a knight in time of war, did carry his shield; whence he was called *escuier* in French, and *scutifer*, or *armiger*, i. e. armour-bearer, in Latin. Hotoman says, that those whom the French call *esquires*, were a military kind of vassals, having *jus scuti*, viz. liberty to bear a shield, and in it the ensigns of their family, in token of their gentility or dignity. But this addition hath not of long time had any relation to the office or employment of the person to whom it hath been attributed, as to carrying of arms, &c. but hath been merely a title of dignity, and next in degree to a knight. For those to whom this title is now due, see the article COMMONALTY. Officers of the king's courts, and of the king's household, counsellors at law, justices of the peace, are only *esquires* in reputation; and he who is a justice of peace has this title only during the time he is in commission, and no longer, if he is not otherwise qualified to bear. A sheriff of a county being a superior officer, bears the title of *esquire* during his life; in respect of the great trust he has in the commonwealth. The chiefs of some ancient families are esquires by prescription; and in late acts of parliament for poll money, many wealthy persons commonly reputed to be such, were ranked among the esquires of this kingdom.

There is a general opinion, that every gentleman of landed property who has 300l. a-year, is an esquire; which is a vulgar error: for no money whatsoever, or landed property, will give a man properly this title, unless he comes within one of the above rules: and no person can ascribe this title where it is not due, unless he pleases; there being no difficulty in drawing the line by the accounts given above and in the article COMMONALTY: but the meaner ranks of people, who know no better, do often basely prostitute this title; and, to the great confusion of all rank and precedence, every man who makes a decent appearance, far from thinking himself any way ridiculed by finding the superscription of his letters thus decorated, is fully gratified by such an address.

*ESQUIRES of the king*, are such as have that title by creation, wherein there is some formality used, as the putting about their necks a collar of SS. and bestowing on them a pair of silver spurs, &c.

ESRAKITES. See ESCHRAKITES.

ESSAY, a trial or experiment for proving the quality of any thing; or an attempt to learn, whether or not any invention will succeed.

ESSAY, in literature, a peculiar kind of composition, the character whereof is to be free, easy, and natural; not tied to strict order and method, nor worked up and finished like a formal system.

ESSAYING, or ASSAYING, in *Chemistry* and *Metallurgy*, signifies the examination of a small quantity of any ore or mineral by fire, in order to discover the quantity of metal it contains. This is very necessary for those who intend to deal largely in metallurgic operations, in order to avoid unnecessary expence, by becoming previously acquainted with the nature of the ore. See CHEMISTRY *Index*; and ORES, *Reduction of*.

*ESSAY-Hatch*, is the miners term for a little trench or hole, which they dig to search for shoad or ore.

ESSEDARII, a sort of gladiators, mentioned by Seneca, Suetonius, and Tully, who on some occasions engaged one another out of chariots called *esseda*. The *essedum* was a sort of heavy chariot from which the Gauls and Britons engaged the Romans. See GLADIATOR.

ESSENCE, in *Metaphysics*, that which constitutes the particular nature of each genus or kind, and distinguishes it from all others: being nothing but that abstract idea to which this name is affixed, so that every thing contained in it is essential to that particular kind.

This Mr Locke calls the *nominal essence;* in contradistinction to the real essence, or constitution of substances on which this nominal essence depends. Thus the nominal essence of gold is that complex idea the word *gold* stands for; let it be, for instance, a body, yellow, weighty, malleable, fusible, and fixed: but its real essence is the constitution of its insensible parts, on which these qualities and all its other properties depend, which is wholly unknown to us.

ESSENES, or ESSENIANS, in Jewish antiquity, one

one of the three ancient sects among that people. They allowed a future state, but denied a resurrection from the dead. Their way of life was very singular: they did not marry, but adopted the children of others, whom they bred up in the institutions of their sect: they despised riches, and had all things in common, and never changed their clothes till they were entirely worn out. When initiated, they were strictly bound not to communicate the mysteries of their sect to others; and if any of their members were found guilty of enormous crimes, they were expelled.

Pliny tells us, that they dwelt on the west side of the lake of Asphaltites; and that they were a solitary kind of men, living without women or money, and feeding upon the fruit of the palm-tree: he adds, that they were constantly recruited by new-comers, whom the surges of ill fortune had made weary of the world: in which manner the sect was kept up for several thousands of years, without any being born among them. The reason why we find no mention made of them in the New Testament, may be their recluse and retired way of life, no less than their great simplicity and honesty, whereby they lay open to no censure or reproof.

**ESSENTIAL**, something necessarily belonging to a thing, from which it cannot be conceived distinct: thus the primary qualities of bodies, as extension, figure, number, &c. are essential or inseparable from them in all their changes and alterations.

*Essential Oils* are such as are really contained in a plant, and are drawn from it by distillation in an alembic with water; they are thus called, in contradistinction to empyreumatic oils, which are raised by a naked fire without water.

**ESSEX**, a county of England, bounded on the north by the Stour, which separates it from Suffolk and Cambridgeshire; on the east, by the German sea; on the west, by Hertfordshire and Middlesex; and on the south by the river Thames. It extends 46 miles in length from east to west, and about 42 in breadth from north to south, and 200 in circuit. This county is in the diocese of London, and gives the title of earl to the family of Capel. The county of Essex is divided into nineteen hundreds, and contains twenty-seven market-towns, 415 parishes, 125 vicarages, and 1100 villages. It sends eight members to parliament; namely, two for the county, and two for Colchester, Harwich, and Malden. The air in the inland parts is healthy; but in the marshes near the sea it produces agues, particularly in the part called the Hundreds. However, the fertility of the unwholesome part is very great, and even the higher grounds of this county are very fruitful. About Saffron Walden, the earth, after bearing saffron three years, it is said, will produce good barley for 18 years successively without any manure. Its produce, which is very plentiful, consists of corn, most excellent saffron, cattle, fowl, fish, and particularly oysters. The chief manufactures of this county are cloth, stuffs, and particularly baize. The principal rivers, besides the Thames, are the Stour, which falls into the German sea at Harwich; the Lea, its western boundary, falls into the Thames below Stratford; the Blackwater runs through the heart of the county, and passing by Chelmsford is joined by the Chelmer, and from thence runs into the German sea; the Coln runs by Halsted to Colchester, and so into the sea. The Roding which rises northwards, near Dunmow, runs into the Thames near Barking. All these rivers abound in most sorts of fish.

In the year 1801, the total number of inhabitants in the county of Essex amounted to 226,437 persons. Of these 111,356 are males, and 115,081 are females. In 1811 the population was 252,473, of whom 69,590 lived in towns, and 182,883 in the country.

**ESTATE**, in *Law*, signifies the title or interest that a person has in lands, tenements, or other effects; comprehending the whole in which a person hath any property, and will pass the same.

Estates are either real or personal; otherwise distinguished into FREEHOLDS, which descend to heirs; or CHATTELS, that go to executors or administrators.

A fee-simple is the amplest estate our law admits of. See FEE.

Estates are obtained several ways; as, by descent from a father to a son; by conveyance or grant from one person to another; by gift or purchase; by deed or will. See DESCENT, SUCCESSION, TENURE, &c.

ESTATES, in a political sense, is used either to denote the dominions of some prince, or the general classes into which the people are divided.

In Britain, the estates are the king, lords, and commons; or rather the lords and commons, who meet the king in parliament, for reforming abuses, and enacting good and wholesome laws.

**ESTHER**, a canonical book of the Old Testament; containing the history of a Jewish virgin, dwelling with her uncle Mordecai at Shushan, in the reign of Ahasuerus, one of the kings of Persia.

The great beauty of this maid raised her to the throne of Persia; whereby she had an opportunity to save her countrymen, whose destruction was plotted by Haman, a favourite of that prince.

The learned are not agreed who this Ahasuerus was. Archbishop Usher supposes him to be Darius Hystaspes, and Artystona to be Esther. Scaliger makes him the same with Xerxes, and his queen Hanestris to be Esther. Josephus, on the contrary, positively asserts, that the Ahasuerus of the scriptures, is the Artaxerxes Longimanus of profane story; and the Septuagint, throughout the whole book of Esther, translate Ahasuerus by Artaxerxes. Most people subscribe to this last opinion; and indeed the extraordinary kindness showed by Artaxerxes to the Jews, can scarcely be accounted for otherwise than by supposing that they had so powerful an advocate as Esther to solicit for them.

**ESTHONIA**, is a province of the Russian empire, and part of Livonia. It is bounded on the east by the Baltic sea, on the north by the gulf of Finland, on the west by Ingria, and on the south by Lettonia. It is divided into six districts: 1. Harrien; 2. Wireland; 3. Alentakin; 4. Wich; 5. Jerven; and, 6. Odepoa. The principal towns are, Revel, Weisenberg, Borchholm, Narva, Nyslot, Habsal, Derpt, St Elin, Pernau, and Roderswick.

In former times the inhabitants of this country carried

Esthonia ‖ Estremadura.

ried on a good trade in corn, which was dried in stoves: but wars have much depopulated the country, insomuch that not a fourth part of it is inhabited, and a great number of gentlemen's seats lie in ruins.

**ESTOILE'E**, or **Cross Estoille'e**, in *Heraldry*, a star with only four long rays in form of a cross; and, accordingly, broad in the centre, and terminating in sharp points.

**ESTOPPEL** (formed of the French *estouper*, *oppilare*, *obstipare*, "to stop or block up"), in *Law*, an impediment or bar of action, arising from a man's own act or deed; against which a man is forbidden, by law, to speak; though it be to say the truth.

**ESTOVERS**, in *Law*, is used by Bracton, for that sustenance which a man, committed for felony, is to have out of his lands or goods for himself and his family during imprisonment. In stat. 6 Edw. I. it is used for an allowance in meat or clothes. In some manors, the tenants have *common of estovers;* that is, necessary botes or allowances out of the lord's wood: in which last sense, estovers comprehends house-bote, hay-bote, and plow-bote; so that if a man have in his grant these general words, *de rationabili estoverio in boscis*, &c. he may thereby claim all three.

Estovers is also used for alimony, which, if the husband refuses to pay, there is, besides the ordinary process of excommunication, a writ at common law, *de estoveriis habendis*, in order to recover it.

**ESTRAY**, or **Stray**, signifies any tame beast, as sheep; oxen, swine, and horses, or swans, found within a lordship, and not owned by any man; in which case being cried, according to law, in the church, and two market towns adjoining, if it be not be claimed by the owner within a year and a day, it becomes the lord's of the soil where found. If the owner claims it within the year and day, he must pay the charges of finding, keeping, and proclaiming them; and he may seize it, without telling the marks or proving his property, which may be done at the trial if contested. If the beast stray within the year to another lordship, the first lord cannot retake it. An estray must be fed and kept, uninjured, and without labour, till it is reclaimed or the limited time expires.

**ESTREAT**, **Extractum**, in *Law*, is used for the true copy or duplicate of some original writing, especially of amercements or penalties set down in the rolls of a court, to be levied by the bailiff or other officer, on every offender.

**ESTREMADURA**, a province of Spain, has New Castile on the east, Leon on the north, Andalusia on the south, and Portugal on the west. It is 175 miles in length, and 100 in breadth; and its principal towns are Calatrava, Menda, and Badajoz, on the river Guadiana; Alcantara, on the Tajo; and Cona and Placentia, to the north of this river.

This province enjoys a very pure and healthful air, and its mountains are full of wild and tame animals; they having woods and forests for the one sort, and pastures for the other. The fields are planted with fruit-trees, which bear all kinds of delicious fruit. The vineyards produce excellent wines of all colours, and the fields yield plenty of corn.

**Estremadura**, a province of Portugal, near the mouth of the Tagus or Tajo, bounded on the north by Beira, on the east and south by Alentejo, and on

Estremadura, Etching.

the west by the Atlantic ocean. It is about 88 miles in length, and 45 in breadth. This province is divided into six comarcas, viz. Litria, Lisbon, Tomar, Santaren, and Alanquar, to the north of the Tagus; and that of Setubal, to the south of this river. These are likewise the principal towns. Estremadura is equal, if not preferable, to any other province in Spain or Portugal. The district of Santaren produces such plenty of corn, and feeds so many flocks of sheep, that it may enter into competition with Sicily. The fruits and the wines are all excellent; and it was here that the sweet oranges brought from China were first planted, and of which there are large quantities transported to foreign parts, with the wines and other fruits. The fields are covered with flowers almost all the year, from which the bees collect large quantities of fine honey. The olive-trees are numerous, from which they have excellent oil. The rivers abound with good fish, and the mountains have quarries of several kinds.

**ETCHING**, a method of engraving on copper, in which the lines or strokes, instead of being cut with a tool or graver, are eaten in with aquafortis. See Engraving.

Etching is of a later invention, though not very modern, than engraving with the tool; of which it was at first only an imitation, that was practised by painters and other artists, who could much sooner form their hands to, and attain a faculty of, working in this way, than with the graver. But being then nevertheless considered as a counterfeit kind of engraving, and therefore inferior to the other, it was cultivated in a very confined manner; the closeness of the resemblance of the work to that performed by the tool, being made the test of its merit, and consequently the principal object of aim in those who pursued it. This servile confinement of the art of etching to the imitation of the original kind of engraving, was a great cause of retarding its advancement towards perfection, as many of the most able masters cramped their talents with the observance of it: this may be seen in the instances of Sadelers, Swaneberg, Villamena, and particularly Le Bosse; who, in his treatise on engraving, has laid down as a principle, that the perfection of this kind consists in the close similitude of the work with that done by the tool. This absurd prepossession has been since worn out: and the method of working with aquafortis has been so far improved, that instead of being now deemed a spurious kind of engraving, it evidently appears, in many modern works, the foundation of an excellence that could never have been produced without it: since, though the neatness and uniformity of the hatches, which attend the use of the tool, is more advantageous with respect to portraits; yet the liberty and facility of the other manner gives a much greater opportunity to exercise the force of genius and fancy in history-engraving; where the effect of the whole, and not the minute exactness in finishing all the parts, constitutes the principal value.

There are two methods practised of engraving in this way; the one with a hard varnish or ground, the other with a soft. The first was formerly much used, being better accommodated to the intention of imitating the engraving with the tool; as the firmness of the body of the varnish gave more opportunity of retouching the lines,

lines, or enlarging them with the oval-pointed needles, called by the French *echoppes*, as was practised by Le Bosse and others for that purpose. The latter has now almost wholly superseded the use of the other, by the free manner of working it admits of; which affords a power of expression incompatible with the greater inflexibility of the hard varnish, that confines the lines and hatches to such a regularity and sameness, as gives a stiffness of manner and coldness of effect to the work.

The combination of the use of the tool and aquafortis, which are now both employed in many cases, has, however, given that perfection to engraving which it possesses at present. The truth and spirit of the outline that the method of working with aquafortis affords, and the variety of shades which the different kinds of black produce in this way, as well as other means of expressing the peculiar appearance and character of particular subjects, furnish what was defective in the sole use of the tool; while on the other hand, the exactness and regularity of the lines, which are required for finishing many kinds of designs, are supplied by the graver; and by a judicious application of both, that complete finishing is obtained, which either of them alone must necessarily want.

The manner by which this art is performed, is the covering the surface of the plate with a proper varnish or *ground*, as it is called, which is capable of resisting aquafortis; and then scoring or scratching away, by instruments resembling needles, the parts of this varnish or ground, in the places where the strokes or hatches of the engraving are intended to be; then, the plate being covered with aquafortis, the parts that are laid naked and exposed by removing the ground or varnish, are corroded or eaten away by it; while the rest, being secured and defended, remain untouched.

There are two methods of etching, as has been already observed; the difference of which from each other consists, as well in the difference of the varnish or ground, as in that of the aquafortis, adapted to each kind; but the general methods of performing them are alike in both. These varnishes or grounds are distinguished by the names of *hard* and *soft*: for in their consistence, or the resistance they give to the needles, lies their essential variation from each other. The hard varnish, it is with good reason conjectured, was not the first in use: but soon took place of the other; and was, for some time, the most received in practice, on account of its admitting the work to be made more like that of the graver; the soft has, however, since, in its turn, prevailed to the exclusion of it in some degree, except in the case of particular subjects; but not so entirely as to take away the expedience of showing how it is performed. The manner of etching with the soft varnish is now, however, one of the most important objects of the art of engraving; and it is at present in universal use, sometimes alone, but more frequently intermixed with the work of the tool, and in some cases with great advantage, even where the whole is intended to pass for being performed by the graver.

*Preparation of the soft varnish; according to Mr Lawrence, an eminent English engraver at Paris.* "Take of virgin wax and asphaltum, each two ounces; of black pitch and Burgundy pitch, each half an ounce. Melt the wax and pitch in a new earthen-ware glazed pot; and add to them, by degrees, the asphaltum finely powdered. Let the whole boil till such time as that, taking a drop upon a plate, it will break, when it is cold, on bending it double two or three times betwixt the fingers. The varnish being then enough boiled, must be taken off the fire; and letting it cool a little, must be poured into warm water, that it may work the more easily with the hands, so as to be formed into balls; which must be rolled up, and put into a piece of taffety for use."

It must be observed first, that the fire be not too violent, for fear of burning the ingredients; a slight simmering will be sufficient: secondly, that while the asphaltum is putting in, and even after it is mixed with them, the ingredients should be stirred continually with the spatula; and thirdly, that the water, into which this composition is thrown, should be nearly of the same degree of warmth with it, to prevent a kind of cracking that happens when the water is too cold.

The varnish ought always to be harder in summer than in winter; and it will become so if it be suffered to boil longer, or if a greater proportion of the asphaltum or brown resin be used. The experiment above mentioned, of the drop suffered to cool, will determine the degree of hardness or softness that may be suitable to the season when it is used.

*Preparation of the hard varnish used by Callot, commonly called the* Florence varnish. Take four ounces of fat oil very clear, and made of good linseed oil, like that used by painters: heat it in a clean pot of glazed earthen-ware, and afterwards put to it four ounces of mastick well powdered; and stir the mixture briskly till the whole be well melted; then pass the whole mass through a piece of fine linen into a glass bottle with a long neck, that can be stopped very securely; and keep it for the use that will be below explained.

*Method of applying the soft varnish to the plate, and of blackening it.* The plate being well polished and burnished, as also cleansed from all greasiness by chalk or Spanish white, fix a hand-vice on the edge of the plate where no work is intended to be, to serve as a handle for managing it when warm: then put it upon a chafing-dish, in which there is a moderate fire; observing to hold it so that it may melt: then cover the whole plate equally with a thin coat of the varnish; and while the plate is warm, and the varnish upon it in a fluid state, beat every part of the varnish gently with a small ball or dauber made of cotton tied up in taffety; which operation smooths and distributes the varnish equally over the plate.

When the plate is thus uniformly and thinly covered with the varnish, it must be blackened by a piece of flambeau, or of a large candle which affords a copious smoke; sometimes two or even four such candles are used together for the sake of dispatch, that the varnish may not grow cold: which if it does during the operation, the plate must then be heated again, that it may be in a melted state when that operation is performed: but great care must be taken not to burn it; which, when it happens, may be easily perceived by the varnish appearing burnt and losing its gloss. The following expedient is made use of for the more commodiously blackening the varnish, being particularly necessary where the plates are large: Fix a strong hook in the roof of the room, through which pass four pieces of cord of equal length, at the end of which are fixed four iron rings of about four inches in diameter, for supporting the corners of the plate. The plate being thus suspended in the air, with the varnished side downwards, may be blackened with great convenience: but this is not, however, absolutely requisite, except in the case of large plates that could not, without difficulty, be held up, unless this or some other such contrivance were made use of.

It is proper to be very cautious in keeping the flambeau or candle at a due distance from the plate, lest the wick touch the varnish, which would both sully and mark it. If it appear that the smoke has not penetrated the varnish, the plate must be again placed for some little time over the chafing-dish; and it will be found, that, in proportion as the plate grows hot, the varnish will melt and incorporate with the black which lay above it, in such a manner that the whole will be equally pervaded by it.

Above all things, the greatest caution should be used in this operation, to keep all the time a moderate fire; and to move frequently the plate, and change the place of all the parts of it, that the varnish may be alike melted everywhere, and kept from burning. Care must also be taken, that during this time, and even till the varnish be entirely cold, no filth, sparks, or dust, fly on it; for they would then stick fast, and spoil the work.

*Method of applying the hard varnish.* This is precisely the same as for the soft; being spread equally over the warm plate with the taffety-ball, and smoked in the same manner: only after it is smoked, it must be baked, or dried over a gentle fire of charcoal, till the smoke from the varnish begins to decrease; taking care not to overheat the plate, which would both soften it and burn the varnish.

The plate being thus prepared, and an exact drawing of the outlines of the design made upon thin paper, the other side of the paper must be well rubbed with chalk or Spanish whitening, or, which is better, with red chalk scraped to a powder; and the loose chalk is cleared off with a linen rag: then the stained side of the paper is laid upon the varnish, fixing the corners to the plate with wax or wafers, to prevent its shuffling; and with a blunted needle or pointer the drawing is slightly traced, and communicates to the varnish an exact outline of the design to be etched.

A variety of pointers is necessary for the work. Those used for the broad large strokes ought to be very blunt, exceeding round, and well polished at the point; the sole of a shoe answers very well for polishing the points. The finest ought to be as sharp as a needle. If any scratches or false strokes happen in the working, they are to be stopped up with a hair-pencil dipped in Venetian varnish, mixed with lamp black, by which means these places will be defended from the action of the aquafortis.

The next operation is that of eating or corroding the plate with aquafortis; in order to which, a border of soft wax (being a composition of bees wax melted and tempered with a little Venice turpentine and tallow) must be fastened round the plate about an inch high, in the form of a little wall or rampart, to contain the aquafortis. At one of the corners of this border a gutter is usually made, which serves for pouring commodiously the aquafortis off the plate. The plate being thus bordered, take a due quantity of the refiners aquafortis; mix it with half its quantity of common water, and pour it gently on, till it rise above a finger's breadth above the surface of the plate; when, if all things have been rightly conducted, it will be seen that the aquafortis will soon exert its action in the hatches which have been strongly touched; but those more weakly engraved will appear at first clear, and of the colour of the copper. The menstruum must therefore be suffered to continue on the plate till its effects become visible on the more tender parts: then the aquafortis should be poured off, the plate washed with clean water, and dried before the fire: then take a small pencil dipped into the Venetian varnish, and cover with it the lighter parts of the plate. This being done, the aquafortis must again be poured on, and suffered to continue a longer or a shorter time, according to the strength of the menstruum, or the nature of the engraving; when it must be again poured off as before, and the plate immediately washed with water.

It may not be improper to observe, that, when the aquafortis is on the plate, a feather should be used to cleanse away the foulness of the verdegris that gathers in the hatches when the aquafortis operates on them, and to give it more room to exert its action; for by moving the aquafortis to and fro on the plate by the feather, and brushing away the black saline matter where it appears to be formed, the hatches will be cleansed, and the aquafortis exert its whole force equally on every part.

The plate being thus sufficiently corroded by the aquafortis, and well washed with water, it must be warmed at the fire, and the border of wax removed; after which it must be made hotter till the varnish melt; then it must be well wiped with a linen cloth, and afterwards rubbed well with oil of olives; when it will be ready to be retouched and finished by the graver. See the article ENGRAVING.

ETEOCLES, in fabulous history, a son of Oedipus and Jocasta. After his father's death, it was agreed between him and his brother Polynices, that they should both share the royalty, and reign alternately each a year. Eteocles by right of seniority first ascended the throne; but after the first year of his reign had expired he refused to give up the crown to his brother, according to their mutual agreement. Polynices, resolved to punish such an open violation of a solemn engagement, went to implore the assistance of Adrastus king of Argos. He received that king's daughter in marriage, and was soon after assisted with a strong army headed by seven famous generals. These hostile preparations were seen by Eteocles, who on his part did not remain inactive. He chose seven brave chiefs to oppose the seven leaders of the Argives, and stationed them at the seven gates of the city. He placed himself against his brother Polynices, and he opposed Menalippus to Tydeus, Polyphontes to Capaneus, Megareus to Eteocles, Hyperbius to Parthenopæus, and Lasthenes to Amphiaraus. Much blood was shed in light and unavailing skirmishes, and it was at last agreed between the two brothers

brothers that the war should be decided by single combat. They both fell in an engagement conducted with the most inveterate fury on either side; and it is even said that the ashes of these two brothers, who had been so inimical one to the other, separated themselves on the burning pile, as if sensible of resentment, and hostile to reconciliation.

ETERNITY, an attribute of God, expressing his infinite or endless duration. See LOGIC and METAPHYSICS.

ETERNITY, in *Mythology*, a divinity among the Romans, who had neither temples nor altars. They represented it under the figure of a woman, who held the sun in one hand and the moon in the other: her symbols were a phœnix, globe, and elephant.

ETESIÆ, or ETESIAN *winds*, are such as blow at stated times of the year, from what part soever of the compass they come. They are so called from the Greek word ἔτος, "year," being yearly or anniversary winds, such as our seamen call *monsoons* and *trade-winds*, which in some parts of the world continue constantly blowing for certain stated seasons of the year. Thus, the north winds, which, during the dog-days, constantly blow upon the coasts of Egypt, and hinder all ships from sailing out of Alexandria for that season, are called *etesiæ* in Cæsar's Commentaries. In other authors, the west and east winds are called *etesiæ*, when they continue blowing for certain seasons of the year.

Cellarius endeavours to prove that those winds are properly etesian which blow from that part of the horizon which is between the north and west about the time of the solstice. In ancient writers, they are represented as of a very mild and gentle nature; and were called by mariners *somniculosi* and *delicati*, from their sleeping or ceasing to blow in the night.

ETFU, a town of Upper Egypt, celebrated on account of the sublime temple of Apollinopolis, which, Denon observes,* is "the most beautiful of all Egypt, and next to those of Thebes, the largest. Being built (he adds) at a period when the arts and sciences had acquired all their splendour, the workmanship of every part is equally beautiful, the hieroglyphics are admirably executed, the figures more varied, and the architecture of a higher order than in the Theban edifices, the building of which must be referred to an earlier age. My first care was to take a general plan of the building.

"Nothing can be more simply beautiful than these outlines; nothing more picturesque than the effect produced in the elevation, by the various dimensions belonging to each member of the harmonious whole. This superb edifice is seated on a rising ground, so as to overlook not only its immediate vicinity, but the whole valley; and at the foot of this greater temple, but on a considerably lower level, is a smaller one, at present almost buried. The only part still visible is in a hollow surrounded with rubbish, where may be seen a little portico of two columns, and as many pilasters, a peristyle, and the sanctuary of the temple inclosed within a pilastered gallery. A single column, with its capital rising from the ruins, to the height of forty feet above the portico, and the angle of a wall 100 feet beyond, shew that there formerly existed a court in the front of the temple. It is remarkable of this monument, notwithstanding the skill displayed in its construction, that the gates are not exactly in the middle of the sides. It seems to have been dedicated to the evil genius, for the figure of Typhon is seen in relief on the four sides of the plinth, which surmounts each of the capitals. The whole frieze, and all the paintings within, appear descriptive of Isis defending herself against the attacks of this monster."

ETHELBALD, }
ETHELBERT, } kings of England. } See (History of) ENGLAND.
ETHELRED, }
ETHELWOLF, }

ETHER, }
ETHERIAL, } See ÆTHER.

ETHERIDGE, SIR GEORGE, a celebrated wit and comic genius in the reign of Charles II. and James II. descended from an ancient family in Oxfordshire, and born in 1636. He travelled in his youth; and, not being able to confine himself to the study of the law, devoted himself to the gayer accomplishments. His first dramatic performance, the Comical Revenge, or Love in a Tub, appeared in 1664, and introduced him to the leading wits of the time: in 1668, he produced a comedy called She would if she could; and, in 1676, he published his last comedy, called the Man of Mode, or Sir Fopling Flutter; which is perhaps the most elegant comedy, and contains more of the real manners of high life than any one the English stage was ever adorned with. This piece he dedicated to the beautiful duchess of York, in whose service he then was; and who had so high a regard for him, that when, on the accession of James II. she came to be queen, she procured his being sent ambassador first to Hamburgh, and afterwards to Ratisbon, where he continued till after his majesty quitted the kingdom. Our author being addicted to certain gay extravagances, had greatly impaired his fortune; to repair which, he paid his addresses to a rich widow; but she, being an ambitious woman, had determined not to condescend to a marriage with any man who could not bestow a title upon her; on which account he was obliged to purchase a knighthood. None of the writers have exactly fixed the period of Sir George's death, though all seem to place it not long after the Revolution. Some say, that on this event he followed his master King James into France, and died there; but the authors of the Biographia Britannica mention a report, that he came to an untimely death by an unlucky accident at Ratisbon; for that after having treated some company with a liberal entertainment at his house there, where he had taken his glass too freely, and being, through his great complaisance, too forward in waiting on his guests at their departure, flushed as he was, he tumbled down stairs and broke his neck, and so fell a martyr to mirth and jollity. As to Sir George's literary character, he certainly was born a poet, and seems to have been possessed of a genius whose vivacity needed no cultivation: for we have no proofs of his having been a scholar. His works, however, have not escaped censure on account of that licentiousness which in general runs through them, which renders them dangerous to young unguarded minds; and the more so, for the lively and genuine wit with which it is gilded over, and which has therefore justly banished them from the purity of the present stage.

ETHICS, the doctrine of manners, or the science of

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* Trav. ii. 277.

of moral philosophy. The word is formed from ηθος, ηθη, *mores*, "manners;" because it is the object of ethics to investigate the manners or conduct of man. See *MORAL Philosophy*.

ETHIOPIA, an extensive region of Africa. See ABYSSINIA.

ETHIOPS, ANTIMONIAL, MARTIAL, and MINERAL. See CHEMISTRY *Index*.

ETHMOIDES, in *Anatomy*, a bone situated in the middle of the basis of the forehead or os frontis, and at the top of the root of the nose, filling almost the whole cavity of the nostrils. It has its name from ηθμος, *cribrum*, "sieve," and ειδος, "form," because all spongy and porous. See ANATOMY *Index*.

ETHNARCHA, ETHNARCH, (formed of εθνος, "nation," and αρχη, "command)," a governor or ruler of a nation.

There are some medals of Herod I. surnamed the *Great*, on one side whereof is found Ηρωδου, and on the other Εθναρχου, q. d. *Herod the Ethnarch*. After the battle of Philippi, we read that Antony, passing over into Syria, constituted Herod and Phasael his brother tetrarchs, and in that quality committed to them the administration of the affairs of Judea, (Jos. Ant. lib. xiv. cap. 23.). Herod therefore had the government of the province before ever the Parthians entered Syria, or before Antigonus's invasion, which did not happen till six or seven years after Herod was commander in Galilee, (Jos. lib. xiv. cap. 24, 25.). Consequently, Herod was then truly ethnarch, for he can be no otherwise denominated; so that it must have been in that space of time that the medals were struck, which only give him this title: which medals are a confirmation of what we read in history of the government which that prince was intrusted with before he was raised to the royalty.

Josephus gives Herod the appellation of *tetrarch* in lieu of that of *ethnarch;* but the two terms come so near to each other, that it is easy to confound them together.

Though Herod the Great left by will to Archelaus all Judea, Samaria, and Idumea, yet Josephus tells us he was then only called *ethnarch*.

ETHNOPHRONES, in antiquity, a sect of heretics in the seventh century, who made a profession of Christianity, but joined thereto all the ceremonies and follies of Paganism, as judicial astrology, sortileges, auguries, and other divinations.

ETIQUETTE, a French term, primarily denoting a ticket or title affixed to a bag or bundle of papers expressing its contents. It is also used, when applied to the Spanish and some other courts, to signify a particular account of what is to be done daily in the king's household, and in the chief ceremonies relating to it. It likewise denotes those forms that regulate the decorum of conduct towards persons of various ranks and stations.

ETMULLER, MICHAEL, a most eminent physician, born at Leipsic in 1646. After having travelled through the greatest part of Europe, he became professor of botany, chemistry, and anatomy, at Leipsic, where he died in 1683. He was a very voluminous writer, his works making no less than 5 vols folio, as printed at Naples in 1728. His son Michael Ernest Etmuller was also an ingenious physician, who published several pieces, and died in 1732.

ETNA, or ÆTNA, a famous burning mountain of Sicily, and the largest in Europe. See ÆTNA.

ETOLIA, a country of ancient Greece, comprehending all that tract now called the *Despotat*, or *Little Greece*. It was parted on the east by the river Evenus, now the Fidari, from the Locrenses Ozolæ; on the west, from Acarnania by the Achelous; on the north, it bordered on the country of the Dorians and part of Epirus; and, on the south, extended to the bay of Corinth.

The Etolians were a restless and turbulent people; seldom at peace among themselves, and ever at war with their neighbours; utter strangers to all sense of friendship or principles of honour; ready to betray their friends upon the least prospect of reaping any advantage from their treachery: in short, they were looked upon by the other states of Greece no otherwise than as outlaws and public robbers. On the other hand, they were bold and enterprising in war; inured to labour and hardships; undaunted in the greatest dangers; jealous defenders of their liberties, for which thay were, on all occasions, willing to venture their lives, and sacrifice all that was most dear to them. They distinguished themselves above all the other nations of Greece, in opposing the ambitious designs of the Macedonian princes; who, after having reduced most of the other states, were forced to grant them a peace upon very honourable terms. The constitution of the Etolian republic was copied from that of the Achæans, and with a view to form, as it were, a counter alliance; for the Etolians bore an irreconcileable hatred to the Achæans, and had conceived no small jealousy at the growing power of that state. The Cleomenic war, and that of the allies, called the *social war*, were kindled by the Etolians in the heart of Peloponnesus, with no other view but to humble their antagonists the Achæans. In the latter, they held out, with the assistance only of the Eleans and Lacedemonians, for the space of three years, against the united forces of Achaia and Macedon; but were obliged at last to purchase a peace, by yielding up to Philip all Acarnania. As they parted with this province much against their will, they watched all opportunities of wresting it again out of the Macedonian's hands; for which reason they entered into an alliance with Rome against him, and proved of great service to the Romans in their war with him: but growing insolent upon account of their services, they made war upon the Romans themselves. By that warlike nation they were overcome, and granted a peace on the following severe terms: 1. The majesty of the Roman people shall be revered in all Etolia. 2. Etolia shall not suffer the armies of such as are at war with Rome to pass through her territories, and the enemies of Rome shall be likewise the enemies of Etolia. 3. She shall, in the space of 100 days, put into the hands of the magistrates of Corcyra all the prisoners and deserters she has, whether of the Romans or their allies, except such as have been taken twice, or during her alliance with Rome. 4. The Etolians shall pay down in ready money, to the Roman general in Etolia, 200 Euboic talents, of the same value as the Athenian talents, and engage to pay 50 talents more within the six years following. 5. They shall put into the hands of the consul

sul 40 such hostages as he shall choose; none of whom shall be under 12, or above 40 years of age; the prætor, the general of the horse, and such as have been already hostages at Rome, are excepted out of this number. 6. Etolia shall renounce all pretensions to the cities and territories which the Romans have conquered, though these cities and territories had formerly belonged to the Etolians. 7. The city of Oenis, and its district, shall be subject to the Acarnanians.

After the conquest of Macedon by Paulus Æmilius, they were reduced to a much worse condition; for not only those among them, who had openly declared for Perseus, but such as were only suspected to have favoured him in their hearts, were sent to Rome, in order to clear themselves before the senate. There they were detained, and never afterwards suffered to return into their native country. Five hundred and fifty of the chief men of the nation were barbarously assassinated by the partizans of Rome, for no other crime but that of being suspected to wish well to Perseus. The Etolians appeared before Paulus Æmilius in mourning habits, and made loud complaints of such inhuman treatment; but could obtain no redress: nay, ten commissioners, who had been sent by the senate to settle the affairs of Greece, enacted a decree, declaring, that those who were killed had suffered justly, since it appeared to them that they had favoured the Macedonian party. From this time those only were raised to the chief honours and employments in the Etolian republic who were known to prefer the interest of Rome to that of their country; and as these alone were countenanced of Rome, all the magistrates of Etolia were the creatures and mere tools of the Roman senate. In this state of servile subjection they continued till the destruction of Corinth, and the dissolution of the Achæan league; when Etolia, with the other free states of Greece, was reduced to a Roman province, commonly called the *province of Achaia.* Nevertheless, each state and city was governed by its own laws, under the superintendency of the prætor whom Rome sent annually into Achaia. The whole nation paid a certain tribute, and the rich were forbidden to possess lands anywhere but in their own country.

In this state, with little alteration, Etolia continued under the emperors, till the reign of Constantine the Great, who, in his new partition of the provinces of the empire, divided the western parts of Greece from the rest, calling them *New Epirus*, and subjecting the whole country to the *præfectus prætorii* for Illyricum. Under the successors of Constantine, Greece was parcelled out into several principalities, especially after the taking of Constantinople by the Western princes. At that time, Theodorus Angelus, a noble Grecian, of the imperial family, seized on Etolia and Epirus. The former he left to Michael his son; who maintained it against Michael Paleologus, the first emperor of the Greeks, after the expulsion of the Latins. Charles, the last prince of this family, dying in 1430 without lawful issue, bequeathed Etolia to his brother's son, named also *Charles*; and Acarnania to his natural sons, Memnon, Turnus, and Hercules. But, great disputes arising about this division, Amurath II. after the reduction of Thessalonica, laid hold of so favourable an opportunity, and drove them all out in 1432. The Mahometans were afterwards dispossessed of this country by the famous prince of Epirus, George Castriot, commonly called *Scanderbeg*; who, with a small army, opposed the whole power of the Ottoman empire, and defeated those barbarians in 22 pitched battles. That hero, at his death, left great part of Etolia to the Venetians; but, they not being able to make head against such a mighty power, the whole country was soon reduced by Mahomet II. whose successors hold it to this day.

ETON, a town of Bucks, situated on the river Thames, across which there is a bridge leading to Windsor. Eton has been long celebrated for its school and college, which were founded by Henry VI.; and King's college in the university of Cambridge admits none into the number of its fellows, who have not been brought up at Eton. It lies west from London, at the distance of about 20 miles.

The scholars of Eton school have a festival which has been celebrated from time immemorial, called the *Montem*, the observance of which was at first biennial, but is now triennial, on the *Whit Tuesday in every third year*. It commences by a number of the older boys taking post on the bridges, and guarding every other avenue around Windsor and Eton, as soon as the day begins to dawn.

They are generally selected on account of their fine figures and superior activity. Their dresses are all fanciful, composed of silks, satins, &c. some of them very richly embroidered, and chiefly in the appearance of running footmen, having poles in their hands, and denominated *salt-bearers*, who demand salt of every passenger they meet, by which they mean a contribution, and peremptorily insist on receiving it. The contribution being given, which consists of whatever the person pleases to bestow, a printed paper is delivered, containing their motto, together with the date of the year; and this being produced to any other salt-bearer, exempts the passenger from the payment of any farther contributions during that day. The motto is,

> " *Pro more et monte.*
> *Vivant rex et regina.*"

They continue levying contributions in this manner from the dawn of day till about three o'clock in the afternoon, at which time the procession closes. It commences at noon, and consists of the queen's and other bands of music;—several standards carried by different students;—all the boys of Eton, two and two, dressed in the uniform of officers; those belonging to the king's foundation, wear blue, the rest scarlet uniform, swords, &c.—the grand standard bearer;—the captain or head boy of Eton school;—the lieutenant, or second boy;—his majesty, attended by the prince of Wales, and other male branches of the royal family on horseback, with their suite;—the queen and princesses in coaches, attended by their suite;—band of music, followed by a great concourse of the nobility and gentry in their carriages, and on horseback.

The procession begins in the great square at Eton, proceeding through Eton to Slough, and round to Salt-hill, where the whole of the boys pass in review before the king and queen, and ascend the montem, where an oration is delivered, and the grand standard is displayed with much activity and grace by the standard-bearer, who is commonly selected from among the elder boys. The two extraordinary salt-bearers are chosen to wait upon their majesties, dressed in fanciful habits, and decorated in the most superb manner, carrying an embroidered bag, not only for the purpose of receiving what is denominated the *royal salt*, but also what may be collected by the other salt-bearers, in different quarters. The donation of the king is 50 guineas, the queen's is the same sum; that of the prince of Wales is 30, and that of the other princes and princesses is 20 guineas each. This ceremony being over, the royal family return to Windsor. A sumptuous entertainment is provided for the boys at the tavern at Salt-hill, and the beautiful gardens are laid out for ladies and gentlemen to take refreshments, where bands of music are constantly performing.

At six o'clock in the evening, the boys return in the same order of procession as in the morning (but without the royal family), and after marching round the great square, are dismissed. After this the captain pays his respects to the royal family at the queen's lodge, Windsor, prior to his departure for King's college, Cambridge; to defray the expences of which, he is presented with the produce of the montem, which in the year 1796 amounted to more than 1000 guineas.

This joyful day is terminated by a brilliant exhibition of beauty, rank, and fashion; a promenade on the terrace of Windsor; bands of music performing, &c.: and the scene is rendered still more interesting and delightful by the humble, affable deportment of the royal family, who readily mingle with the company, and walk on the terrace till it is almost dark.

ETRURIA. See Hetruria.

ETYMOLOGY, that part of grammar which considers and explains the origin and derivation of words, in order to arrive at their first and primary signification, whence Quintilian calls it *originatio*.—The word is formed of the Greek, *ετυμος*, *verus*, "true," and *λεγω*, *dico*, "I speak;" whence *λογος*, *discourse*, &c. and thence Cicero calls the etymology *notatio* and *veriloquium*; though Quintilian chooses rather to call it *originatio*.

A judicious inquiry into etymologies is thought by some of considerable use; because nations, who value themselves upon their antiquity, have always looked on the antiquity of their language as one of the best titles they could plead; and the etymologists, by seeking the true and original reason of the notions and ideas fixed to each word and expression, may often furnish an argument of antiquity, from the traces remaining thereof, compared with the ancient uses. Add, that etymologies are necessary for the thorough understanding of a language. For, to explain a term precisely, there seems a necessity for recurring to its first imposition, in order to speak justly and satisfactorily thereof. The force and extent of a word is generally better conceived when a person knows its origin and etymology.

It is objected, however, that the art is arbitrary, and built altogether on conjectures and appearances; and the etymologists are charged with deriving their words from where they please. And indeed it is no easy matter to go back into the ancient British and Gaulish ages, and to follow, as it were, by the track, the various imperceptible alterations a language has undergone from age to age; and as these alterations have sometimes been merely owing to caprice, it is easy to take a mere imagination or conjecture for a regular analogy: so that it is no wonder the public should be prejudiced against a science which seems to stand on so precarious a footing. It must certainly be owned, that etymologies are frequently so far fetched, that one can scarcely see any resemblance or correspondence therein. Quintilian has shown, that the ancient etymologists, notwithstanding all their learning, fell into very ridiculous derivations.

The etymologies of our English words have been derived from the Saxon, Welch, Walloon, Danish, Latin, Greek, &c.

In the present work the etymologies of terms are generally noted, where their obviousness does not render it unnecessary, or their dubiety or unimportance useless.

EVACUANTS, in *Pharmacy*, are properly such medicines as diminish the animal fluids, by throwing out some morbid or redundant humour; or such as thin, attenuate, and promote the motion and circulation thereof.

EVACUATION, in *Medicine*, the art of diminishing, emptying, or attenuating, the humours of the body.

EVAGRIUS Scholasticus, a famous historian, born at Epiphania, about the year 536. He practised the profession of an advocate, from which he was called *Scholasticus*, which name was then given to the pleaders at the bar. He was also tribune and keeper of the prefect's dispatches. He wrote an ecclesiastical history, which begins where Socrates and Theodoret ended theirs; and other works, for which he was rewarded by the emperors Tiberius and Mauricius. M. de Valois published at Paris a good edition of Evagrius's ecclesiastical history, in folio; and it was republished at Cambridge in 1620, in folio, by William Reading, with additional notes of various authors.

EVANDER, a famous Arcadian chief, called the son of Mercury, on account of his eloquence, brought a colony of his people into Italy, about 60 years before the taking of Troy; when Faunus, who then reigned over the Aborigines, gave him a large extent of country, in which he settled with his friends. He is said to have taught the Latins the use of letters, and the art of husbandry. He kindly received Hercules when he returned from the conquest of Geryon, and he was the first who raised him altars. He gave Æneas assistance against the Rutuli, and distinguished himself by his hospitality. It is said that he first brought the Greek alphabet into Italy, and introduced there the worship of the Greek deities. He was honoured as a god after death, and his subjects raised him an altar on Mount Aventine.

EVANGELISTS, the inspired authors of the gospels. The word is derived from the Greek *ευαγγελιον*, formed of *ευ*, *bene*, "well," and *αγγελος*, "angel or messenger."

The denomination *evangelists* was likewise given in the ancient church to such as preached the gospel up and down, without being attached to any particular church, being either commissioned by the apostles to instruct the nations, or of their own accord abandoning every worldly attachment, and consecrating themselves to the sacred office of preaching the gospel. In which sense some interpreters think it is that St Philip, who was one of the seven deacons, is called the *evangelist*, in the 21st chapter of the Acts of the Apostles, verse 8. Again, St Paul writing to Timothy, ep. ii. cap. iv. ver. 5. bids him do the work of an evangelist. The same apostle, Eph. iv. 11. ranks the evangelists after the apostles and prophets.

**EVANID**, a name given by some authors to such colours as are of no long duration, as those in the rainbow, in clouds before and after sunset, &c.

Evanid colours are also called *fantastical* and *emphatical* colours.

**EVANTES**, in antiquity, the priestesses of Bacchus, thus called, because in celebrating the orgia they ran about as if distracted, crying, *Evan, evan, ohé evan*. See BACCHANALIA.

**EVAPORATION**, in *Natural Philosophy*, signifies the conversion of fluids into vapour, so that it becomes specifically lighter than the atmosphere. See CHEMISTRY and METEOROLOGY *Index*.

**EVASION**, in *Law*, is used for any subtle endeavour to set aside truth, or to escape the punishment of the law, which will not be endured. Thus, if a person says to another that he will not strike him, but will give him a pot of ale to strike him first, and accordingly he strikes, the returning of it is punishable; for no man shall evade the justice of the law by such a pretence to cover his malice.

**EVATES**, a branch or division of the druids, or ancient Celtic philosophers. Strabo divides the British and Gaulish philosophers into three sects; bards, evates, and druids. He adds, that the bards were the poets and musicians; the evates, the priests and naturalists; and the druids were moralists as well as naturalists: But Marcellus and Hornius reduce them all to two sects, viz. the BARDS and DRUIDS.

**EUBAGES**, an order of priests or philosophers among the ancient Celtæ or Gauls: some will have the eubages to be the same with the druids and saronidæ of Diodorus; and others, that they were the same with what Strabo calls EVATES.

**EUBOEA**, in *Ancient Geography*, an oblong island, stretching out between Attica and Thessaly, opposite to Bœotia; from which it is separated by a narrow strait called *Euripus*. This island, never exceeding 40, nor ever falling short of two miles in breadth, is in length 150 miles, and in compass 365, according to Pliny. Now NEGROPONT, from its principal town, which was anciently called *Chalcis*.

**EUCHARIST**, the sacrament of the Lord's supper, properly signifies *giving thanks*.—The word in its original Greek, Ευχαριστια, literally imports *thanksgiving*; being formed of ευ, *bene*, "well," and χαριν, *gratia*, "thanks."

This sacrament was instituted by Christ himself; and the participation of it is called *communion*.

As to the manner of celebrating the eucharist among the ancient Christians, after the customary oblations were made, the deacon brought water to the bishops and presbyters, standing round the table, to wash their hands; according to that of the psalmist, "I will wash my hands in innocency, and so will I compass thy altar, O Lord." Then the deacon cried out aloud, "Mutually embrace and kiss each other;" which being done, the whole congregation prayed for the universal peace and welfare of the church, for the tranquillity and repose of the world, for the prosperity of the age, for wholesome weather, and for all ranks and degrees of men. After this followed mutual salutations of the minister and people; and then the bishop or presbyter having sanctified the elements by a solemn benediction, he brake the bread, and delivered it to the deacon, who delivered it to the communicants, and after that the cup. Their sacramental wine was usually diluted or mixed with water. During the time of administration, they sang hymns and psalms; and having concluded with prayer and thanksgiving, the people saluted each other with a kiss of peace, and so the assembly broke up.

**EUCHITES**, or EUCHITÆ, a sect of ancient heretics, who were first formed into a religious body towards the end of the fourth century, though their doctrine and discipline subsisted in Syria, Egypt, and other eastern countries, before the birth of Christ; they were thus called because they prayed without ceasing, imagining that prayer alone was sufficient to save them. Their great foundation were those words of St Paul, (Thessalonians, v. 17.) *Pray without ceasing*. The word is formed of the Greek, ευχη, *prayer*, whence ευχιται, the same with the Latin *precatores*, "prayers." They were also called *Enthusiasts* and *Messalians*; a term of Hebrew origin, denoting the same as Euchites.

The Euchites were a sort of mystics, who imagined, according to the oriental notion, that two souls resided in man, the one good and the other evil; and who were zealous in expelling the evil soul or demon, and hastening the return of the good spirit of God, by contemplation, prayer, and singing of hymns. They also embraced the opinions nearly resembling the Manichean doctrine, and which they derived from the tenets of the oriental philosophy. The same denomination was used in the 12th century, to denote certain fanatics who infested the Greek and eastern churches, and who were charged with believing a double Trinity, rejecting wedlock, abstaining from flesh, treating with contempt the sacraments of baptism and the Lord's supper, and the various branches of external worship, and placing the essence of religion solely in external prayer, and maintaining the efficacy of perpetual supplications to the Supreme Being for expelling an evil being or genius, which dwelt in the breast of every mortal. This sect is said to have been founded by a person called *Lucopetrus*, whose chief disciple was named *Tychicus*. By degrees it became a general and invidious appellation for persons of eminent piety and zeal for genuine Christianity, who opposed the vicious practices and insolent tyranny of the priesthood; much in the same manner as the Latins comprehended all the adversaries of the Roman pontiff under the general terms of WALDENSES and ALBIGENSES.

St Cyril of Alexandria, in one of his letters, takes occasion to censure several monks in Egypt, who, under pretence of resigning themselves wholly to prayer, led a lazy, scandalous life. A censure likewise applicable to monasteries in general.

**EUCHOLOGIUM**, Ευχολογιον, a Greek term, signifying literally *a discourse on prayer*. The word is formed of ευχη, *prayer*, and λογος, *discourse*.

The Euchologium is properly the Greek ritual, wherein are prescribed the order and manner of every thing relating to the order and administration of their ceremonies, sacraments, ordinations, &c.

F. Goar has given us an edition of the Greek Euchologium in Greek and Latin, with notes, at Paris.

**EUCLID** *of* **Megara**, a celebrated philosopher and logician, flourished about 400 B. C. The Athenians having prohibited the Megareans from entering their city on pain of death, this philosopher disguised himself in women's clothes to attend the lectures of Socrates. After the death of Socrates, Plato and other philosophers went to Euclid at Megara, to shelter themselves from the tyrants who governed Athens. Euclid admitted but one chief good: which he sometimes called *God*, sometimes *Spirit*, and sometimes *Providence*.

**Euclid** *of Alexandria*, the celebrated mathematician, flourished in the reign of Ptolemy Lagus, about 277 B. C. He reduced all the fundamental principles of pure mathematics, which had been delivered down by Thales, Pythagoras, Eudoxus, and other mathematicians before him, into regularity and order, and added many others of his own discovering: on which account he is said to be the first who reduced arithmetic and geometry into the form of a science. He likewise applied himself to the study of mixed mathematics, and especially to astronomy, in which he also excelled. The most celebrated of his works is his Elements of Geometry, of which there have been a great number of editions in all languages; and a fine edition of all his works was printed in 1703, by David Gregory, Savilian professor of astronomy at Oxford.

**EUCRASY**, (of *ευ*, *well*, and *κρασις*, *temperature*), in *Medicine*, an agreeable well proportioned mixture of qualities, whereby a body is said to be in good order, and disposed for a good state of health.

**EUDIOMETER**, an instrument for ascertaining the purity of the atmospherical air, or the quantity of pure oxygen or vital air contained in it, chiefly by means of its diminution, or the absorption of it by exposing certain substances to its action. Several kinds of eudiometers have been invented. See Chemistry *Index*.

**EUDOSIA**, (Athenia, before her conversion to Christianity), a celebrated lady, the daughter of Leontius, a philosopher of Athens; who gave her such a learned education, that at his death, he left her only a small legacy, saying she was capable to make her own fortune: but pleading at Athens without success against her two brothers, for a share in her father's estate, she carried her cause personally by appeal to Constantinople; recommended herself to Pulcheria, the sister of the emperor Theodosius the younger; embraced Christianity, was baptized by the name of *Eudosia*, and soon after married to the emperor. Their union lasted a considerable time: but a difference at last taking place, on account of the emperor's jealousy, excited by Chrysapius the eunuch, she retired to Jerusalem, where she spent many years in building and adorning churches and in relieving the poor. Dupin says, that she did not return thence till after the emperor's death: but Cave tells us, that she was reconciled to him, returned to Constantinople, and continued with him till his death; after which she again went to Palestine, where she spent the remainder of her life in pious works. She died in the year 460, according to Dupin; or 459, according to Cave: the latter observes, that on her deathbed she took a solemn oath, by which she declared herself entirely free from any stains of unchastity. She was the author of a paraphrase on the eight first books of the Old Testament in heroic verse; and of a great number of poems, which are lost.

**EUDOXIANS**, a party or sect of heretics in the fourth century, so denominated from their leader Eudoxius, patriarch of Antioch and Constantinople, a great defender of the Arian doctrine. The Eudoxians adhered to the errors of the Arians and Eunomians, maintaining, that the Son was created out of nothing; that he had a will distinct and different from that of the Father, &c.

**EVE.** See Vigil.

**Eve**, the mother of all mankind; who being deluded by the serpent, occasioned the fall, and all its dismal consequences. See Adam.

**EVELYN, John**, a most learned and ingenious writer and natural philosopher, was born at Wotton in Surry, the seat of his father, in 1620. After making the tour of Europe, he returned to England about the year 1651, and lived very retired at his rural retreat, Say's Court, near Deptford in Kent; where his disgust at the violence and confusion of the times operated so far upon his studious disposition, that he actually proposed to Mr Boyle the establishing a kind of college for persons of the same turn of mind, where they might associate together without care or interruption. It was owing to Mr Evelyn's gratitude to the place of his education, that Oxford became possessed of the famous Arundelian marbles; which he persuaded the Lord Henry Howard to bestow on that university. He was very assiduous in transmitting to the Royal Society whatever fell within the compass of his inquiries; and used humbly to style himself *a pioneer in the service*. When the number of books he published is considered, the many he left behind him unfinished and unpublished, and the variety of subjects on which he employed his time, his industry and application are astonishing. "His life (says the honourable Mr Walpole) was a course of inquiry, study, curiosity, instruction, and benevolence. The works of the Creator, and the mimic labours of the creature, were all objects of his pursuit. He unfolded the perfections of the one, and assisted the imperfections of the other. He adored from examination; was a courtier that flattered only by informing his prince, and by pointing out what was worthy for him to countenance; and was really the neighbour of the Gospel, for there was no man that might not have been the better for him. He was one of the first promoters of the Royal Society, a patron of the ingenious and indigent, and peculiarly serviceable to the lettered world; for, besides his writings and discoveries, he obtained the Arundelian marbles for the university of Oxford, and the Arundelian library for the Royal Society: nor is it the least part of his praise, that he who proposed to Mr Boyle the erection of a philosophic college for retired and speculative persons, had the honesty to write in defence of active life against Sir George Mackenzie's Essay on Solitude. He knew that retirement in his own hands was industry and benefit to mankind; but in those of others, laziness and inutility." There are five small prints of this gentleman's journey from Rome to Naples, drawn and etched by him; and among his published works are, 1. A Character of England; 2. The State of France; 3. An Essay on the

the first book of Lucretius *De rerum natura*; 4. The French gardener; 5. A Panegyric on King Charles II.'s coronation; 6. *Fumifugum*, or the inconvenience of the air and smoke of London dissipated; 7. The History and Art of Engraving on Copper; 8. A parallel between the ancient architecture and the modern; 9. Sylva, or a discourse of forest trees; and several others. This amiable gentleman died, full of age and honour, in 1706. His son John Evelyn, born in 1654, distinguished himself by his elegant translations and poems: He was one of the commissioners of the revenue in Ireland; but died early in life, in 1698.

**EVERGETES**, a surname signifying *benefactor*, given to Philip of Macedon, and to Antigonus Doson, and Ptolemy of Egypt. It was also commonly given to the kings of Syria and Pontus, and we often see among the former an Alexander Evergetes, and among the latter a Mithridates Evergetes. Some of the Roman emperors also claimed that epithet of Benevolent and Humane.

**EVERGREEN**, in *Gardening*, a species of perennials, which continue their verdure, leaves, &c. all the year: such are hollies, phillyreas, lauristinuses, bays, pines, firs, cedars of Lebanon, &c.

**EVERLASTING PEA**. See LATHYRUS, BOTANY *Index*.

**EVES-DROPPERS**. See *Eaves-Droppers*.

**EVESHAM**, or EVESHOLM, commonly called *Esam*, a town of Worcestershire, seated on a gentle ascent from the river Avon, over which there is a bridge of seven arches. It is 95 miles from London, 14 miles from Worcester, and has a harbour for barges. It is an old borough, reckoned the second in the county; and sends two members to parliament. It had formerly an abbey with a mitred abbot; which abbey when standing was one of the largest and most stately of any in the kingdom. It was governed by a bailiff, till King James I. at the request of his son Prince Henry, gave it a charter for a mayor, 7 aldermen, 12 capital burgesses, a recorder, and chamberlain, who are all of the common council, with 24 other burgesses called assistants. Four of the aldermen, and the mayor for the time being, are justices of the peace; and of oyer and terminer, and of gaol delivery, for all offences in the corporation, except high treason; and the corporation has power to try and execute felons within the borough. Here are two parish-churches; but the bells of both have been removed to a beautiful old tower which was one of the gates of the abbey. The town is noted for the great victory obtained near it by Prince Edward, afterwards King Edward I. over Simon Montfort, the great earl of Leicester, who was killed in the battle. There is an open prospect from hence of the spacious valley called the *vale of Evesham* or *vale of Gloucester*, which so abounds with the best of corn, as well as pasture for sheep, that it is reckoned the granary of all these parts. The vale runs all along the banks of the Avon, from Tewkesbury to Pershore, and Stratford in Warwickshire, and the river is so far navigable. It has a weekly market and four fairs. The market-house, built by Sir Edward Hobby, has its upper apartments used by the corporation for a sessions-house, and formerly for the assizes of the county. There are considerable garden grounds around the place, the produce of which supplies the adjacent towns.

**EUGENE**, FRANCIS, prince of Savoy, descended from Carignan, one of the three branches of the house of Savoy, and son of Eugene Maurice, general of the Swiss and Grisons, governor of Champagne, and earl of Soissons, was born in 1663. Louis XIV. to whom he became afterwards so formidable an enemy, thought him so unpromising a youth, that he refused him preferment both in the church and the state, thinking him too much addicted to pleasure to be useful in either. Prince Eugene, in disgust, quitted France; and, retiring to Vienna, devoted himself to the Imperial service. The war between the emperor and the Turks afforded the first opportunity of exerting his military talents; and every campaign proved a new step in his advancement to the highest offices in the army. He gave the Turks a memorable defeat at Zenta; commanded the German forces in Italy, where he foiled Marshal Villeroy in every engagement, and at length took him prisoner. Our limits do not allow a detail of his campaigns; but Prince Eugene distinguished himself greatly, when the emperor and Queen Anne united against the exorbitant power of Louis XIV. He died at Vienna in the year 1736; and was as remarkable for his modesty and liberality, as for his abilities in the field and the cabinet.

**EUGENIA**, the YAMBOO; a genus of plants, belonging to the icosandria class; and in the natural method ranking under the 19th order, *Hesperideæ*. See BOTANY *Index*.

**EVICTION**, in *Law*, signifies a recovery of lands or tenements by law.

**EVIDENCE**, that perception of truth which arises either from the testimony of the senses or from an induction of reason.

EVIDENCE, in *Law*, signifies some *proof* by testimony of men upon oath, or by writings or records. It is called *evidence*, because thereby the point in issue in a cause to be tried is to be made *evident* to the jury; for *probationes debent esse evidentes et perspicuæ*. The system of evidence, as now established in our courts of common law, is very full, comprehensive, and refined; far different from, and superior to, any thing known in the middle ages;—as far superior in that as in all other improvements and refinements in science, arts, and manners.

The nature of evidence during the ages of ignorance was extremely imperfect, and the people were incapable of making any rational improvement. Thus it was the imperfection of human reason that caused the invention and introduction of the ORDEAL, as an appeal to the Supreme Being. As men are unable to comprehend the manner in which the Deity carries on the government of the universe, by equal, fixed, and general laws, they are apt to imagine, that in every case which their passions or interest render important in their own eyes, the Supreme Ruler of all ought visibly to display his power in vindicating innocence, and punishing vice.

**EVIL**, in *Philosophy*, &c. is either moral or natural. Moral evil is the disagreement between the actions of a moral agent, and the rule of those actions, whatever it is *.—Natural evil is, whatever destroys or any way disturbs the perfection of natural beings: such as blindness, diseases, death, &c.

*King's Evil*, or *Scrophula*. See MEDICINE *Index*.

*Evil-Merodach*, the son and successor of Nebuchadnezzar.

* See *Moral Philosophy*.

Evil-Merodach, Euler.

nezzar the great, king of Babylon, succeeded to the crown in the year of the world 3443; but governed the kingdom during the indisposition of his father, who, after seven years, having recovered his understanding, once more ascended the throne; and, as some believe, imprisoned his son Evil-Merodach. In this confinement it is supposed that Evil-Merodach made an acquaintance and friendship with Jehoiachim king of Judah, who had been carried to Babylon by Nebuchadnezzar. However that was, it is certain, that soon after his succession to the throne, he delivered the king of Judah out of prison, after a confinement of 37 years, heaped many favours on him, and placed him above all the other kings who were at the court of Babylon, (2 Kings xxv. 27. Jer. lii. 31.). Evil-Merodach reigned but one year, according to the chronology of Archbishop Usher; but Dr Prideaux will have him to have reigned two years; and was succeeded by Neriglissar his sister's husband, who having been at the head of a conspiracy that put him to death, reigned in his stead. Others will have it, that this prince was immediately succeeded by his son BELSHAZZAR.

**EULER, LEONARD**, professor of mathematics, member of the imperial academy of Petersburgh, ancient director of the royal academy of Berlin, and fellow of the royal society of London, as also correspondent member of the royal academy of sciences at Paris, was born at Basil, April 15. 1707, of reputable parents. The years of his infancy were passed in a rural retreat at the village of Richen, of which place his father was minister.—Being sent to the university of Basil, he attended regularly the different professors. As his memory was prodigious, he performed his academical tasks with uncommon rapidity; and all the time he gained by this was consecrated to geometry, which soon became his favourite study. The early progress he made in this science, only added new ardour to his application; and thus he obtained a distinguished place in the attention and esteem of Professor John Bernouilli, who was at that time one of the first mathematicians in Europe. In 1723, M. Euler took his degree as master of arts; and delivered on that occasion a Latin discourse, in which he drew a comparison between the philosophy of Newton and the Cartesian system, which was received with the greatest applause. He afterwards, at his father's desire, applied himself to the study of theology and the oriental languages. Though these studies were foreign to his predominant propensity, his success was considerable even in this line: however, with his father's consent, he returned to geometry as his principal object. He continued to avail himself of the counsels and instructions of M. Bernouilli; he contracted an intimate friendship with his two sons Nicholas and Daniel; and it was in consequence of these connexions that he became afterwards the principal ornament of the academy of Petersburgh. The project of erecting this academy, which had been formed by Peter the Great, was executed by Catherine I.; and the two young Bernouillis being invited to Petersburgh in 1725, promised Euler, who was desirous of following them, that they would use their utmost endeavours to procure for him an advantageous settlement in that city. In the mean time, by their advice, he applied himself with ardour to the study of physiology, to which he made a happy application of his mathematical knowledge; and he attended the medical lectures of the most eminent professors of Basil. This study, however, did not wholly engross his time: it did not even relax the activity of his vast and comprehensive mind in the cultivation of other branches of natural science. For while he was keenly engaged in physiological researches, he composed A Dissertation on the Nature and Propagation of Sound, and an answer to a prize-question concerning the masting of ships; to which the academy of sciences adjudged the *acessit*, or second rank, in the year 1727. From this latter discourse, and other circumstances, it appears that Euler had early embarked in the curious and important study of navigation, which he afterwards enriched with so many valuable discoveries.

Euler.

M. Euler's merit would have given him an easy admission to honourable preferment, either in the magistracy or university of his native city, if both civil and academical honours had not been there distributed by lot. The lot being against him in a certain promotion, he left his country, set out for Petersburgh, and was made joint professor with his countrymen Messrs Hermann and Daniel Bernouilli in the university of that city. At his first setting out in his new career, he enriched the academical collection with many memoirs, which excited a noble emulation between him and the Bernouillis; and this emulation always continued, without either degenerating into a selfish jealousy, or producing the least alteration in their friendship. It was at this time that he carried to new degrees of perfection the integral calculus, invented the calculation of sinuses, reduced analytical operations to a greater simplicity, and was thus enabled to throw new light on all the parts of mathematical science. In 1730, he was promoted to the professorship of natural philosophy; and in 1733 he succeeded his friend D. Bernouilli in the mathematical chair. In 1735, a problem was proposed by the academy which required expedition, and for the solution of which several eminent mathematicians had demanded the space of some months. The problem was solved by Euler in three days, to the great astonishment of the academy: but the violent and laborious efforts it cost him threw him into a fever, which endangered his life, and deprived him of the use of his right eye. The academy of sciences at Paris, which in 1738 had adjudged the prize to his memoir concerning the Nature and Properties of Fire, proposed for the year 1740 the important subject of the sea tides; a problem whose solution required the most arduous calculations, and comprehended the theory of the solar system. Euler's discourse on this question was adjudged a masterpiece of analysis and geometry; and it was more honourable for him to share the academical prize with such illustrious competitors as Colin Maclaurin and Daniel Bernouilli, than to have carried it away from rivals of less magnitude. Rarely, if ever, did such a brilliant competition adorn the annals of the academy; and no subject, perhaps, proposed by that learned body was ever treated with such accuracy of investigation and force of genius, as that which here displayed the philosophical powers of these three extraordinary men.

In the year 1741, M. Euler was invited to Berlin to augment the lustre of the academy, that was there rising into fame. He enriched the last volume of the miscellanies (*melanges*), of Berlin with five memoirs, which make an eminent, perhaps the principal, figure in that collection. These were followed with an astonishing rapidity by a great number of important researches, which are scattered through the memoirs of the Prussian academy; of which a volume has been regularly published every year since its establishment in 1744. The labours of Euler will appear more especially astonishing, when it is considered, that while he was enriching the academy of Berlin with a prodigious number of memoirs, on the deepest parts of mathematical science, containing always some new points of view, often sublime truths, and sometimes discoveries of great importance; he did not discontinue his philosophical contributions to the academy of Petersburgh, which granted him a pension in 1742, and whose memoirs display the marvellous fecundity of Euler's genius. It was with much difficulty that this great man obtained, in 1766, permission from the king of Prussia to return to Petersburgh, where he desired to pass the rest of his days. Soon after his return, which was graciously rewarded by the munificence of Catherine II. he was seized with a violent disorder, which terminated in the total loss of his sight. A cataract, formed in his left eye, which had been essentially damaged by a too ardent application to study, deprived him entirely of the use of that organ. It was in this distressing situation that he dictated to his servant, a taylor's apprentice, who was absolutely devoid of mathematical knowledge, his elements of algebra; which by their intrinsical merit, in point of perspicuity and method, and the unhappy circumstances in which they were composed, have equally excited applause and astonishment. This work, though purely elementary, discovers the palpable characteristics of an inventive genius; and it is here alone that we meet with a complete theory of the analysis of Diophantus.

About this time M. Euler was honoured by the Academy of Sciences at Paris with the place of one of the foreign members of that learned body; and, after this, the academical prize was adjudged to three of his memoirs, Concerning the Inequalities in the Motions of the Planets. The two prize questions proposed by the same academy for 1770 and 1772 were designed to obtain from the labours of astronomers a more perfect theory of the moon. M. Euler, assisted by his eldest son, was a competitor for these prizes, and obtained them both. In this last memoir, he reserved for farther consideration several inequalities of the moon's motion, which he could not determine in his first theory, on account of the complicated calculations in which the method he then employed had engaged him. He had the courage afterward to review his whole theory, with the assistance of his son and Messrs Krafft and Lexell, and to pursue his researches until he had constructed the new tables, which appeared, together with the great work, in 1772. Instead of confining himself as before, to the fruitless integration of three differential equations of the second degree, which are furnished by mathematical principles, he reduced them to the three ordinates, which determine the place of the moon; he divided into classes all the inequalities of that planet, as far as they depend either on the elongation of the sun and moon, or upon the eccentricity, or the parallax, or the inclination of the lunar orbit. All these means of investigation, employed with such art and dexterity as could only be expected from analytical genius of the first order, were attended with the greatest success; and it is impossible to, observe, without admiration, such immense calculations on the one hand, and on the other the ingenious methods employed by this great man to abridge them, and to facilitate their application to the real motion of the moon. But this admiration will become astonishment, when we consider at what period and in what circumstances all this was effectuated by M. Euler. It was when he was totally blind, and consequently obliged to arrange all his computations by the sole powers of his memory and his genius. It was when he was embarrassed in his domestic circumstances by a dreadful fire, that had consumed great part of his substance, and forced him to quit a ruined house, of which every corner was known to him by habit, which, in some measure, supplied the place of sight. It was in these circumstances that Euler composed a work, which, alone, was sufficient to render his name immortal. The heroic patience and tranquillity of mind which he displayed here, need no description: and he derived them not only from the love of science, but from the power of religion. His philosophy was too genuine and sublime to stop its analysis at mechanical causes; it led him to that divine philosophy of religion which ennobles human nature, and can alone form a habit of true magnanimity and patience in suffering.

Some time after this, the famous Wenzell, by couching the cataract, restored M. Euler's sight; but the satisfaction and joy that this successful operation produced, were of short duration. Some instances of negligence on the part of his surgeons, and his own impatience to use an organ, whose cure was not completely finished, deprived him of his sight a second time; and this relapse was accompanied with tormenting pain. He, however, with the assistance of his sons, and of Messrs Krafft and Lexell, continued his labours; neither the loss of his sight, nor the infirmities of an advanced age could damp the ardour of his genius. He had engaged to furnish the academy of Petersburgh with as many memoirs as would be sufficient to complete its acts for 20 years after his death. In the space of seven years he transmitted to the academy by Mr Golswin, above 70 memoirs, and above 200 more, which were revised and completed by the author of this paper. Such of the memoirs as were of ancient date were separated from the rest, and form a collection that was published in the year 1783, under the title of *Analytical Works*.

Euler's knowledge was more universal than could be well expected in one who had pursued with such unremitting ardour mathematics and astronomy as his favourite studies. He had made a very considerable progress in medical, botanical, and chemical science. What was still more extraordinary, he was an excellent scholar, and possessed what is generally called *erudition* in a very high degree. He had read, with attention and taste, the most eminent writers of ancient Rome; the civil and literary history of all ages and all nations were familiar to him; and foreigners, who were only acquainted with his works, were astonished to find in the conversation of a man, whose long life seemed solely occupied in mathematical and physical researches and discoveries, such an extensive acquaintance with the most interesting branches of literature. In this respect, no doubt, he was much indebted to a very uncommon memory, which seemed to retain every idea that was conveyed to it, either from reading or from meditation. He could repeat the Æneid of Virgil, from the beginning to the end, without hesitation, and indicate the first and last line of every page of the edition he used.

Several attacks of a vertigo, in the beginning of September 1783, which did not prevent his calculating the motions of the aerostatical globes, were, nevertheless, the forerunners of his mild and happy passage from this scene to a better. While he was amusing himself at tea with one of his grandchildren, he was struck with an apoplexy, which terminated his illustrious career at the age of 76. His constitution was uncommonly strong and vigorous; his health was good; and the evening of his long life was calm and serene, sweetened by the fame that follows genius, the public esteem and respect that are never withheld from exemplary virtue, and several domestic comforts which he was capable of feeling and therefore deserved to enjoy.

EULOGY, Eulogia, in church history. When the Greeks have cut a loaf or piece of bread to consecrate it, they break the rest into little bits, and distribute it among the persons who have not yet communicated, or send it to persons that are absent; and these pieces of bread are what they call *eulogies*. The word is Greek, ευλογια, formed of ευ, *bene*, "well," and λεγω, *dico*, "I say, speak;" q. d. *benedictum*, "blessed."

The Latin church has had something like eulogies for a great many ages; and thence arose the use of their holy bread.

The name *eulogy* was likewise given to loaves or cakes brought to church by the faithful to have them blessed.

Lastly, The use of the term passed hence to mere presents made to a person without any benediction. See the Jesuit Gretser, in his treatise *de Benedictionibus et Maledictionibus*, lib. ii. cap. 22, 24. &c. where he treats of eulogies thoroughly.

From a passage in Bolandus, on the life of St Melaine, cap. 4. it appears, that eulogies were not only of bread, but any kind of meat blessed and hallowed for that purpose. Add, that almost every body blessed and distributed eulogies; not only bishops and priests, but even hermits, though laymen, made a practice of it. Women also would sometimes send eulogies.

The wine sent as a present was also held an eulogy. Bolandus remarks farther, that the eucharist itself was also called *eulogy*.

Eulogy, likewise means an encomium on any person, on account of some virtue or good quality.

EUMARIDES, of ευμαρης, "easy," among the ancients, a kind of shoes common to men and women.—The enmarides were used for pomp and delicacy, being neat, and painted with various colours.

EUMENES, a Greek officer in the army of Alexander, son of a charioteer. He was the most worthy of all the officers of Alexander to succeed after the death of his master. He conquered Paphlagonia, and Cappadocia, of which he obtained the government, till the power and jealousy of Antigonus obliged him to retire. He joined his forces to those of Perdiccas, and defeated Craterus and Neoptolemus. Neoptolemus perished by the hands of Eumenes. When Craterus had been killed during the war, his remains received an honourable funeral from the hand of the conqueror; and Eumenes, after weeping over the ashes of a man who was once his dearest friend, sent his remains to his relations in Macedonia. Eumenes fought against Antipater and conquered him; and after the death of Perdiccas his ally, his arms were directed against Antigonus, by whom he was conquered A. U. C. 433, chiefly by the treacherous conduct of his officers. This fatal battle obliged him to disband the greatest part of his army to secure himself a retreat; and he fled with only 700 faithful attendants to a fortified place on the confines of Cappadocia, called *Nora*, where he was soon besieged by the conqueror. He supported the siege for a year with courage and resolution, but some disadvantageous skirmishes so reduced him, that his soldiers, grown desperate, and bribed by the offers of the enemy, had the infidelity to betray him into the hands of Antigonus. The conqueror, from shame or remorse, had not the courage to visit Eumenes; but when he was asked by his officers, in what manner he wished him to be kept, he answered, keep him as carefully as you would keep a lion. This severe command was obeyed; but the asperity of Antigonus vanished in a few days, and Eumenes, delivered from the weight of chains, was permitted to enjoy the company of his friends. Even Antigonus hesitated whether he should not restore to his liberty a man with whom he had lived in the greatest intimacy while both subservient to the command of Alexander; and these secret emotions of pity and humanity were not a little increased by the petitions of his son Demetrius for the release of Eumenes. But the calls of ambition prevailed; and when Antigonus recollected what an active enemy he had in his power, he ordered Eumenes to be put to death in the prison. His bloody commands were executed 315 years before the Christian era. Such was the end of a man who raised himself to power by merit alone. His skill in public exercises first recommended him to the notice of Philip; and under Alexander, his attachment and fidelity to the royal person, and particularly his military accomplishments, promoted him to the rank of a general. Even his enemies revered him; and Antigonus, by whose orders he perished, honoured his remains with a splendid funeral, and conveyed his ashes to his wife and family in Cappadocia. It has been observed, that Eumenes had such a universal influence over the successors of Alexander, that none during his lifetime dared to assume the title of king.

Eumenes I. king of Pergamus, who succeeded to his uncle Philetærus about 264 years before Christ. He made war against Antiochus the son of Seleucus, and enlarged his possessions by seizing upon many of the cities of the kings of Syria. He lived in alliance with the Romans, and made war against Prusias king of Bithynia. He was a great patron of learning; but being much given to wine, he died of an excess in drinking, after a reign of 22 years. He was succeeded by Attalus.

Eumenes II. succeeded his father Attalus on the throne of Asia and Pergamus. His kingdom was small and poor, but he rendered it powerful and opulent; and his alliance with the Romans did not a little contribute to the increase of his dominions after the victories obtained over Antiochus the Great. He carried his arms against Prusias and Antigonus; and died 160 years before Christ, after a reign of 40 years, leaving the kingdom to his son Attalus II. He has been admired for his benevolence and magnanimity; and his love of learning greatly enriched the famous library of Pergamus, which had been founded by his predecessors in imitation of the Alexandrian collection of the Ptolemies. His brothers were so attached to him and devoted to his interest, that they enlisted among his body guards to show their fraternal fidelity.

Eumenes, a celebrated orator of Athens about the beginning of the fourth century. Some of his harangues and orations are extant. An historical writer in Alexander's army.

**EUMENIDES**, a name given to the Furies by the ancients. They sprang from the blood of the wound which Cœlus received from his son Saturn. According to others, they were daughters of Earth, and conceived from the blood of Saturn. Some make them daughters of Acheron and Night, or Pluto and Proserpine. According to the more received opinions, they were three in number, Tisiphone, Megara, and Alecto, to which some add Nemesis. Plutarch mentions only one called *Adrasta*, daughter of Jupiter and Necessity. They were supposed to be the ministers of the vengeance of the gods. They were stern and inexorable; and were always employed in punishing the guilty upon earth, as well as in the infernal regions. They inflicted their vengeance upon earth by wars, pestilence, and dissensions, and by the secret stings of conscience; and in hell they punished the guilty by continual flagellation and torments. They were also called *Furiæ* and *Erinnys.* Their worship was almost universal; and people dared not to mention their names or fix their eyes upon their temples. They were honoured with sacrifices and libations; and in Achaia they had a temple, which when entered by any one guilty of a crime, suddenly rendered him furious, and deprived him of the use of his reason. In the sacrifices the votaries used branches of cedar and of alder, hawthorn, saffron, and juniper; and the victims were generally turtle doves and sheep, with libations of wine and honey. They were usually represented with a grim and frightful aspect, with a black and bloody garment, and with serpents writhing round their heads instead of hair. They held a burning torch in one hand, and a whip of scorpions in the other; and were always attended by Terror, Rage, Paleness, and Death. In hell they were seated around Pluto's throne, as the ministers of his vengeance.

**EUMENIDIA**, festivals in honour of the Eumenides, called by the Athenians *σεμναι θεαι*, "venerable goddesses." They were celebrated once every year, with sacrifices of pregnant ewes, with offerings of cakes made by the most eminent youths, and libations of honey and wine. At Athens none but freeborn citizens were admitted, such as had led a life the most virtuous and unsullied.

**EUMOLPIDES**, the priests of Ceres at the celebration of her festivals at Eleusis. They were descended from Eumolpus, a king of Thrace, who was made priest of Ceres by Erechtheus king of Athens. He became so powerful after his appointment to the priesthood, that he maintained a war against Erechtheus. This war proved fatal to both. Erechtheus and Eumolpus were both killed, and peace was re-established among their descendants, on condition that the priesthood ever remained in the house of Eumolpus, and the regal power in the family of Erechtheus. The priesthood remained in the family of Eumolpus for 1200 years; and this is still more remarkable, because he who was once appointed to the holy office was obliged to remain in perpetual celibacy.

**EUMOLPUS**, a king of Thrace, son of Neptune and Chione. He was thrown into the sea by his mother, who wished to conceal her shame from her father. Neptune saved his life, and carried him into Æthiopia, where he was brought up by a woman, one of whose daughters he married. An act of violence to his sister-in-law obliged him to leave Æthiopia, and he fled to Thrace with his son Ismarus, where he married the daughter of Tegyrius the king of the country. This connection to the royal family rendered him ambitious; he conspired against his father-in-law, and fled, when the conspiracy was discovered, to Attica, where he was initiated in the mysteries of Ceres of Eleusis, and made hierophantes or high priest. He was afterwards reconciled to Tegyrius, and inherited his kingdom. He made war against Erechtheus king of Athens, who had appointed him to the office of high priest, and perished in battle about 1380 years before the Christian era. His descendants were also invested with the priesthood, which remained for about 1200 years in that family.

**EUNAPIUS**, a native of Sardis in Lydia, a celebrated sophist, physician, and historian, who flourished in the 4th century, under the emperors Valentinian, Valens, and Gratian. He wrote "The lives of the Philosophers and Sophists," in which he frequently shows himself a bitter enemy to the Christians: also a "History of the Cæsars," which he deduced from the reign of Claudius, where Herodian left off, down to that of Arcadius and Honorius. The history is lost; but we have the substance of it in Zosimus, who is supposed to have done little more than copy it.

**EUNOMIANS**, in church history, Christian heretics in the 4th century. They were a branch of Arians, and took their name from Eunomius bishop of Cyzicus, whose confession of faith here follows, extracted from Cave's *Historia Literaria*, vol. i. p. 223. "There is one God, uncreated and without beginning; who has nothing existing before him, for nothing can exist before what is uncreated; nor with him, for what is uncreated must be one; nor in him, for God is a simple and uncompounded being. This one simple and eternal being is God, the creator and ordainer of all things; first indeed and principally of his only-begotten Son; and then, through him, of all other things. For God begot, created, and made, the Son, only by his direct operation and power, before all things, and every other creature; not producing, however, any being like himself, or imparting any of his own proper substance to the Son: For God is immortal, uniform, indivisible; and therefore cannot communicate any part of his own proper substance to another. He alone is unbegotten; and it is impossible that any other being should be formed of an unbegotten substance. He did not use his own substance in begetting the Son, but his will only: nor did he beget him in the likeness of his substance, but according to his own good pleasure. He then created the Holy Spirit, the first and greatest of all spirits, by his own power indeed and operation mediately, yet by the immediate power and operation of the Son. After the Holy Spirit he created all other things in heaven and in earth, visible and invisible, corporeal and incorporeal, mediately by himself, by the power and operation of the Son," &c.

EUNOMIUS, a famous heresiarch of the 4th century, the disciple of Elius, but abundantly more subtile than his master, as well as more bold in propagating the opinions of his sect, who after him are called *Eunomians.* He was ordained bishop of Cyzicus; but gave so much disturbance by the intemperance of his zeal, that he was deposed more than once. At last, tired with being tossed about, he petitioned to retreat to the place of his birth, Dacora in Cappadocia; where he died very old about the year 374, after experiencing a variety of sufferings. The greatest part of his works are lost. There is, however, besides two or three small pieces, a confession of his faith remaining, which Cave inserted in his *Historia Literaria*, from a manuscript in Archbishop Tennison's library. See the preceding article.

EUNUCH, a castrated person. See the article CASTRATION.—The word is formed from ευνην εχει, q. d. *lecti curam habet*, "guardian or keeper of the bed."

In Britain, France, &c. eunuchs are never made but upon occasion of some disease, which renders such an operation necessary; but in Italy they make great numbers of children, from one to three years of age, eunuchs, every year, to supply the operas and theatres of all Europe with singers. M. de la Lande, in his *Voyage d'Italie*, asserts, that there are public shops at Naples where this cruel operation is performed, and that over the door of these shops is inscribed *Qui si castrano ragazzi*. But Dr Burney informs us, that he was not only utterly unable to see or hear of any such shops during his residence in that city, but was constantly told, both by the natives and English settled there, that the laws against such a practice were so numerous and severe, that it was never performed but with the utmost secrecy.

In the eastern parts of the world, they make eunuchs in order to be guards or attendants on their women. The seraglios of the eastern emperors are chiefly served and guarded by eunuchs; and yet, from good authority, we learn, that the rich eunuchs in Persia and other countries keep seraglios for their own use. Those who, out of an imprudent zeal to guard themselves from sensual pleasures, made themselves eunuchs, were, by the council of Nice, condemned and excluded from holy orders. There are several severe prohibitions in Germany against the making of eunuchs; and in France an eunuch must not marry, not even with the consent of the woman.

Though the practice of castration is detestable in every point of view; yet there appears no real foundation for the injurious opinion generally entertained of eunuchs, viz. that they are all cowards, and devoid of genius for literature or any solid study. "As to genius (says the author last quoted), I never found those of the first class in music deficient in intellectual abilities for more serious studies. Indeed I have seen real genius and dispositions for literary pursuits, in more than one great opera singer; and as for composition, and the theory of music, not only the best singers of the pope's chapel ever since the beginning of the last century, but the best composers, are among the soprani in that service." With respect to the operation affecting the mind so much as to deprive it of all fortitude in times of danger, there is great reason to doubt the fact: most of the generals of eastern monarchs having been at all times of this class; and the bravest stand that ever was made against Alexander the Great was at Gaza, under the command of one of Darius's generals, who was an eunuch. Ammianus Marcellinus gives an account of Menophilus, a eunuch, to whom Mithridates intrusted his daughter; which proves the possibility of such unfortunate persons possessing a heroism equal to that of the most determined Stoic.

It is very certain, that the ancients never supposed eunuchs to have been men of inferior intellects, or that they possessed less vigour of mind than other men. At least the Persians were not of this opinion; for Herodotus* relates, that when they had taken possession of some Ionian cities, παιδας τε τους ευ ειδεστατους εκλεγομενοι εξεταμνον, και εποιευν αντι ειναι ενορχιας ευνουχους. It is certain, however, Herodotus†, in relating the melancholy story of Hermotimus, says, that παρα τοισι βαρβαροισι τιμιωτεροι εισι οι ευνουχοι, πιστιος εινεκα πασης, των ενορχιων, "among the barbarians, the eunuchs are more valued than other men, on account of their universal fidelity." It appears from this passage of Herodotus, that in Persia eunuchs were far from being objects of contempt; and were even frequently promoted to the highest honours. This was indeed the case with Hermotimus. We find in Agathias, who was one of the Byzantine historians, that a general in the Roman army, named *Narses*, was a eunuch. This was in the latter ages. In Plutarch's Life of Aristides, Themistocles is related to have chosen an eunuch, whose name was *Arnaces*, from among his prisoners, to send on a secret embassy to Xerxes. This surely may serve to show, that mental imbecility was not supposed by the Greeks to be the characteristic of eunuchism. The same story of the confidence placed in Arnaces, who was one of the Persian king's eunuchs, is related also in the life of Themistocles. Aristotle paid such high respect to Hermias, who was a eunuch and governor of Atarnea, which is in Mysia, that he even offered sacrifices in honour of him; as Lucian informs us in his Dialogue entitled *Eunuchus*. This regard of Aristotle for Hermias has been often celebrated, and is mentioned by Suidas, Harpocration, and others.

EUNUCHS, in church history, a sect of heretics in the third century, who were mad enough to castrate, not only those of their own persuasion, but even all others they could lay hold of. They took their rise from the example of Origen, who, misunderstanding the following words of our Saviour, "and eunuchs who made themselves eunuchs for the kingdom of heaven," castrated himself.

EVOCATI, soldiers among the Romans, who having served their full time in the army, went afterwards volunteers at the request of some favourite general; on which

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* Lib. vi. 32. p 451. Ed. Wesseling.

† Lib. viii. p. 668.

which account they were called by the honourable names of *Emeriti* and *Beneficiarii*.

EVOCATION (*Evocatio*), among the Romans, a religious ceremony always observed by them at the undertaking a siege, wherein they solemnly called upon the gods and goddesses of the place to forsake it and come over to them. Without the performance of this ceremony, they either thought that the place could not be taken, or that it would be a sacrilege to take the gods prisoners. They always took it for granted that their prayer was heard, and that the gods had deserted the place and come over to them, provided they were able to make themselves masters of it.

EUODIA, a genus of plants, belonging to the tetrandria class. See BOTANY *Index*.

EVOLUTION, in *Algebra*, the unfolding or opening of a curve, and making it describe an evolvent.—The word *evolutio* is formed of the preposition *è*, "out;" and *volvo*, "I roll, or wind;" q. d. an *unwinding* or *unrolling*.

The equable evolution of the periphery of a circle, or other curve, is such a gradual approach of the circumference to rectitude, as that its parts do all concur and equally evolve or unbend; so that the same line becomes successively a less arc of a reciprocally greater circle: till at last they change into a straight line. In the Phil. Trans. N° 260. a new quadratrix to the circle is found by this means, being the curve described by the equable evolution of its periphery.

EVOLUTION, is also used for the extraction of roots out of powers; in which sense it stands opposed to involution. See ALGEBRA.

EVOLUTION, in the art of war, the motion made by a body of troops, when they are obliged to change their form and disposition, in order to preserve a post or occupy another, to attack an enemy with more advantage, or to be in a condition of defending themselves the better.

It consists in doublings, counter-marches, conversions, &c. A battalion doubles the ranks, when attacked in front or rear, to prevent its being flanked or surrounded; for then a battalion fights with a larger front. The files are doubled, either to accommodate themselves to the necessity of a narrow ground, or to resist an enemy that attacks them in flank. But if the ground will allow it, conversion is much preferable; because, after conversion, the battalion is in its first form, and opposes the file-leaders, which are generally the best men, to the enemy; and likewise, because doubling the files in a new or not well-disciplined regiment, they may happen to fall into disorder. See DOUBLING.

EVOLVULUS, a genus of plants belonging to the pentandria class; and in the natural method ranking under the 29th order, *Campanaceæ*. See BOTANY *Index*.

EUONYMUS, the SPINDLE TREE; a genus of plants belonging to the pentandria class; and in the natural method ranking under the 43d order, *Dumosæ*. See BOTANY *Index*.

EUPATORIUM, HEMP AGRIMONY; a genus of plants belonging to the syngenesia class; and in the natural method ranking under the 49th order, *Compositæ*. See BOTANY *Index*.

EUPATRIDÆ, in antiquity, a name given by Theseus to the nobility of Athens, as distinguished from the Geomori and Demiurgi. The Eupatridæ, by Theseus's establishment, had the right of choosing magistrates, teaching and dispensing the laws, and interpreting holy and religious mysteries. The whole city, in all other matters, was reduced to an equality. The Geomori were husbandmen, and inferior to the Eupatridæ in point of fortune; the Demiurgi were artificers, and fell short of the Eupatridæ in number.

EUPHONY, in *Grammar*, an easiness, smoothness, and elegance of pronunciation. The word is formed of *εὖ*, *bene*, "well;" and *φωνὴ*, *vox*, "voice." Quintilian calls *euphonia*, "*vocalitas*;" Scaliger, "*facilis pronunciatio*."

Euphonia is properly a kind of figure whereby we suppress a too harsh letter, or convert it into a smoother, contrary to the ordinary rules. There are examples enough in all languages.

EUPHYMISM. See ORATORY.

EUPHORBIA, SPURGE; a genus of plants belonging to the dodecandria class; and in the natural method ranking under the 38th order, *Tricoccæ*. See BOTANY *Index*.

EUPHORBIUM, in the *Materia Medica*, a gummi-resinous substance, which exudes from a large oriental tree, (EUPHORBIA *officinarum*). See MATERIA MEDICA *Index*.

EUPHORBUS, a famous Trojan, son of Panthöus. He was the first who wounded Patroclus, whom Hector killed. He perished by the hand of Menelaus, who hung his shield in the temple of Juno at Argos. Pythagoras, the founder of the doctrine of the metempsychosis or transmigration of souls, affirmed that he had been once Euphorbus, and that his soul recollected many exploits which had been done while it animated that Trojan's body. As a further proof of his assertion, he showed at first sight the shield of Euphorbus in the temple of Juno.

EUPHORION *of* CHALCIS, a poet and historian, born in the 126th Olympiad. Suetonius says that Tiberius composed verses in imitation of Euphorion, Rianius and Parthenius; with whom he was charmed to such a degree, that he ordered their writings and their pictures to be kept in all the public libraries, among the ancient and celebrated authors.

EUPHRASIA, EYE-BRIGHT; a genus of plants belonging to the didynamia class; and in the natural method ranking under the 40th order, *Personatæ*. See BOTANY *Index*.

EUPHRATES, a river universally allowed to take its rise in Armenia Major; but in what particular spot, or in what direction it afterwards shapes its course, there is the greatest disagreement. Strabo says, that the Euphrates rises in Mount Abus, which he joins with, or accounts a part of, Mount Taurus; that its beginning is on the north side of Mount Taurus; and that running, first westward through Armenia, then striking off to the south, it forces its way through the mountain; and thus it rises in the south of Armenia, Mount Taurus being the boundary on that side; and runs through its south part, quite to Cappadocia, conterminal with Armenia Minor; or quite to this last, or to its south limit; to reach which, it must bend its west course a little north; because Taurus, from which it rose, lies lower, or more to the south, and almost parallel with Melitene: and that then it turns to the south, in order to break through Taurus, and escape to Syria, and then take a new bend to Babylonia. To this account of Strabo, Pliny runs quite counter; adducing eye-witnesses, who carry the Euphrates from north to south in a right line, till it meets Mount Taurus; placing the springs to the east, as Strabo does; whence, he says, it runs in a long course westward, before it bends south; and that it rises not from Mount Taurus, but far to the north of it; and he makes it run straight west from its rise, then turn south spontaneously, without any interposing obstacle, in a manner quite different from Strabo, Mela, and others, who make Taurus the cause of this turn. The Euphrates naturally divides into two channels, one through Babylon, and the other through Seleucia, besides the several artificial cuts made between it and the Tigris about Babylon: and these cuts or trenches are what the Psalmist calls the rivers of Babylon, on the willows of which the captives hung their harps. It is probable, that the Euphrates naturally poured into the sea at one particular mouth, before these cuts were made. A thing appearing so evident to the ancients, that Pliny has set down the distance between the mouths of the Euphrates and the Tigris; and he says, some made it 25, and others 7, miles; but that the Euphrates being for a long time back intercepted in its course by cuts, made for watering the fields, only the branch called the *Pasitigris* fell into the sea, the rest of it into the Tigris, and both together into the Persian gulf. Overflowing the country through which it runs, at stated times of the year, like the Nile, it renders it fertile.

**EUPOLIS**, an Athenian comic poet, flourished about the 85th Olympiad. He took the freedom of the ancient comedy in lashing the vices of the people. He lost his life in a sea fight between the Athenians and Lacedæmonians; and his fate was so much lamented, that after his death it was enacted that no poet should serve in the wars. Some say Alcibiades put him to death for his satirical freedom.

**EVREMOND, Charles de St Denis**, a polite scholar and soldier, was born at St Denis le Guast in Lower Normandy in 1613. He was intended for the profession of the law, and entered on the study; but he soon quitted it, and was made an ensign before he was 16. A military life did not hinder him from cultivating polite literature; and he signalized himself by his politeness and wit as much as by his bravery. The king made him a mareschal de camp, and gave him a pension of 3000 livres per annum. He served under the duke of Candale in the war of Guienne; and in Flanders, till the suspension of arms was agreed on between France and Spain: he afterwards accompanied Cardinal Mazarine when he went to conclude the peace with Don Lewis de Haro, the king of Spain's first minister. He wrote, as he had promised, a long letter to the marquis de Crequi, of this negotiation; in which he showed, that the cardinal had sacrificed the honour of France to his own private interest, and rallied him in a very satirical manner. This letter falling into the hands of the cardinal's creatures some time after his death, was represented as a state crime, and he was obliged to fly to Holland. He had too many friends in England (whither he had taken a tour the year before with the count de Soissons, sent to compliment Charles II. upon his restoration) to make any long stay in Holland; and therefore passed over into England, where he was received with great respect, and admitted into intimate friendship with several persons of distinction. The king gave him a pension of 300l. a-year. He had a great desire to return to his native country; and, after the peace of Nimeguen, wrote a letter in verse to the king of France to ask leave, but in vain. Upon the death of King Charles, he lost his pension. He did not rely much on King James, though that prince had shown himself extremely kind to him. The Revolution was advantageous to him. King William, who had known him in Holland, gave him substantial marks of his favour. He died of a strangury in 1703, aged 90; and was interred in Westminster abbey, where a monument is erected to his memory. His behaviour was engaging, his humour cheerful, and he had a strong disposition to satire: he professed the Roman religion, in which he was born; but at the bottom was certainly a freethinker. He always spoke of his disgrace with the resolution of a gentleman: and whatever strong desire he had to return to his country, he never solicited the favour with meanness; therefore, when this leave was signified to him unexpectedly in the decline of his life, he replied, that the infirmities of age did not permit him to leave a country where he lived agreeably. There have been many editions of his works: but the best is that of Amsterdam in 1726, in 5 vols. 12mo, to which is prefixed his life by Doctor Des Maizeaux; who has also given an accurate English translation of them in 3 vols. 8vo.

**EURIPIDES**, one of the Greek poets who excelled in tragedy, was born about 468 B. C. in the isle of Salamis, whither his father and mother had retired a little before Xerxes entered Attica. He learned rhetoric under Prodicus, morality under Socrates, and natural philosophy under Anaxagoras; but at 18 years of age abandoned philosophy, in order to apply himself to dramatic poetry. He used to shut himself up in a cave to compose his tragedies, which were extremely applauded by the Greeks. The Athenian army, commanded by Nicias, being defeated in Sicily, the soldiers purchased their lives and liberties by reciting the verses of Euripides; such esteem and veneration had the Sicilians for the pieces wrote by this excellent poet. Socrates, the wisest of the philosophers, set such a value upon them, that they were the only tragedies he went to see acted; and yet his performances seldom gained the prize. Euripides frequently intersperses through them moral sentences, and severe reflections on the fair sex; whence he was called the *Woman-hater*. He was, nevertheless, married: but the scandalous lives of his two wives drew upon him the raillery of Aristophanes, and other comic poets; which occasioned his retiring to the court of Archelaus, king of Macedon, where he was well received. That prince was fond of learned men, and drew them to him by his liberality. If we may believe Solinus, he made Euripides his minister of state, and gave him other extraordinary proofs of his esteem. He had, however, passed but a few years there, when an unhappy accident put an end to his life. He was walking in a wood, and, according to his usual manner, in deep meditation; when, unfortunately happening upon Archelaus's hounds, he was by them torn in pieces. It is not certain whether

ther his death happened by chance, or through envy of some of the great courtiers. However, Archelaus buried him with great magnificence; and the Athenians were so much afflicted at his death, that the whole city went into mourning. Of 92 tragedies which he composed, only 19 are remaining: the most valuable editions of which are those of Aldus in 1503, 8vo; of Plantin, in 1570, sexesimo; of Comelin, in 1597, 8vo; of Paul Stevens, in 1604, 4to; and of Joshua Barnes, 1694, folio.

EURIPUS, a canal or strait which divides the island of Eubœa, now Negropont, from the continent of Greece. In one place it is so narrow, that a galley can scarcely pass through it. The agitations of the Euripus were much spoken of by the ancients. Some say that the canal has a flux and reflux six times in 24 hours; others, that it ebbs and flows seven times a day; but Livy does not allow this flux and reflux to be so regular. Father Babin, a Jesuit of great learning, who made many observations on the spot during his long abode in the island of Negropont, tells us, that the Euripus is regular in its ebbing and flowing the first eight days of the moon: the same regularity he observed from the 14th to the 20th day inclusive, and in the three last days: but in the other days of the lunar month, it is not so regular; for it sometimes ebbs and flows 11, 12, 13, and 14 times in the space of a natural day. In this place, as the story commonly goes, Aristotle drowned himself out of chagrin, for not being able to account for so unusual a motion.

Euripus has since become a general name for all straits, where the water is in great motion and agitation.

The ancient circuses had their euripi, which were no other than pits or ditches on each side of the course, into which it was very dangerous falling with their horses and chariots as they ran races. The term *euripus* was more particularly applied by the Romans to three canals or ditches which encompassed the circus on three sides, and which were filled occasionally to represent naumachiæ or sea battles. The same people called their smaller fountains or canals in their gardens *euripuses;* and their largest, as cascades, &c. *niles.*

EUROCLYDON, (of Ευρος, *east wind*, and κλυδων, *wave*), is a species of wind, of which we have an account only in Acts xxvii. 14. and concerning the nature of which critics have been much divided. Bochart, Grotius, Bentley, and others, substitute another reading, supported by the Alexandrian MS. and the Vulgate, viz. Ευρακυλων or *Euro-aquilo;* but Mr Bryant defends the common reading, and considers the *Euroclydon*, i. e. Ευρος κλυζων, as an east wind that causes a deep sea or vast inundation. He maintains, in opposition to Dr Bentley's reasoning, who supposes that the mariners in the ship, the voyage of which is recited in this passage, were Romans, that they were Greeks of Alexandria, and that the ship was an Alexandrian ship employed in the traffic of carrying corn to Italy; and therefore, that the mariners had a name in their own language for the particular typhonic or stormy wind here mentioned. He also shows from the passage itself, that the tempestuous wind called *Euroclydon*, beat (κατ' αυτης) upon the island of Crete; and therefore, as this is a relative expression, referring to the situation of the person who speaks of it, who was at that time to the windward or south of it, the wind blew upon shore, and must have come from the south or south-east; which, he adds, is fully warranted by the point where the ship was, and the direction it ran in afterwards, which was towards the north and north-west.

EUROPA, in fabulous history, a daughter of Agenor king of Phœnicia and Telephassa. She was so beautiful that Jupiter became enamoured of her; and the better to seduce her, he assumed the shape of a bull and mingled with the herds of Agenor, while Europa, with her female attendants, were gathering flowers in the meadows. Europa caressed the beautiful animal; and at last had the courage to sit upon his back. The god took advantage of her situation; and with precipitate steps retired towards the shore, crossed the sea with Europa on his back, and arrived safe in Crete. Here he assumed his original shape, and declared his love. The nymph consented, though she had once made vows of perpetual celibacy; and she became mother of Minos, Sarpedon, and Rhadamanthus. After this distinguished amour with Jupiter, she married Asterius, king of Crete. This monarch seeing himself without children by Europa, adopted the fruit of her amours with Jupiter, and always esteemed Minos, Sarpedon, and Rhadamanthus, as his own children. Some suppose, that Europa lived about 1552 years before the Christian era.

EUROPE, one of the four quarters of the world. This is considerably the smallest of the four grand divisions of the terraqueous globe. Its length, from east to west, according to the most authentic accounts, measures about 3300 miles British measure, and its breadth 2350. The continental part of it is bounded on the south by the Mediterranean sea, on the west by the Atlantic ocean, comprehending the most distant isle of Europe, viz. that of Iceland, for Greenland is now considered as constituting a part of North America. Many geographers of eminence have given the Azores to Europe, from their greater proximity to Portugal than to any other continental country, and have considered the Madeiras as a constituent part of Africa for a similar reason. Europe is bounded on the north by the Arctic ocean and the new land; while its eastern limits appear to be more uncertain in the estimation of geographers. It appears evident, however, that a very natural limit might be ascertained by the river Oufa, the Kama, and the Volga, which would make its division extremely natural to the town of Sarepta; it requiring only an imaginary line of very small extent from that place to the river Don. The superficies of Europe, including the Azores, Iceland, &c. is about 3,432,000 miles.

The western and southern parts of Europe anciently consisted of the people called *Celts;* the Fins occupied the north-east; and the Laplanders, a people equally diminutive with the Samoieds of Asia, possessed its remotest parts toward the north, who rendered their own language less uncouth and barbarous by assimilating it to that of the Fins. The Goths from Asia seem to have driven those ancient inhabitants towards the east and north, whose descendants occupy the greater part of Europe. From the Sclavonic tribes, who also came from Asia, the Poles, Russians, &c. were descended. These were accompanied by the Heruli, who made use of what is now denominated the Lettic speech, to be met with in Courland, Livonia, Lithuania, Prussia, and

Samogitia, and nearly allied to the Sclavonic language, according to the account of Tooke in his view of Russia. At an early period the colony of Iberi and northern Mauritani, came over into Spain; and at a later period both the Hungarians and Turks emigrated from Asia.

Notwithstanding the high character of d'Anville as a geographer, we believe that his opinion respecting the geographical knowledge of the ancients is greatly exaggerated. It appears evident that nothing more of Scandinavia was known to the ancients than the southern part as far as the lakes of Weter and Wener. It is no doubt true that the Romans, by means of their shipping, even in the imperfect state of navigation at that period, traversed the southern shores of the Baltic, as far as to the river Rubo, ascertaining the names of various tribes along that coast; but if the maps of Ptolemy are admitted as decisive proofs in this case, it is certain that they were wholly unacquainted with the interior of Germany; and consequently the tribes of which he makes mention, may rather be considered as having dwelt along the northern shores of the Baltic, or the southern parts on the left of the Danube. They were no doubt acquainted with the Carpathian mountains; but their knowledge of Europe towards the north-east was undoubtedly circumscribed by the 50th or 52d degree of north latitude.

In many barbarous languages, the same word was often used indiscriminately either for a mountain or a forest, the want of attention to which has frequently been the prolific source of error, and placed mountains of the greatest consequence where the hand of nature had planted trees. It has been supposed that the Riphæan mountains were the Uralian chain, of which the ancients knew nothing, instead of a forest of prodigious extent from east to west. It is also well known that the *Venedici Montes* of Ptolemy have no existence upon earth, and therefore must once have been a very extensive forest with which the moderns are unacquainted, and perhaps no traces of it are now anywhere to be met with.

Christianity is the predominant religion all over Europe, except in Turkey; and even there it has been computed, that about one-half of the inhabitants are members of the Greek church. The Christian religion has always been accompanied in its progress with the diffusion of knowledge, the extension of industry, and the civilization of manners, whereas the barbarous tribes in the northern parts of Europe advanced by very slow degrees, and the Scandinavians continued in a state of pagan ignorance till the eleventh century. Some tribes of Sclavonia to the south of the Baltic, were not converted to Christianity till the thirteenth century, and of course were for many ages in a state little superior to brutality; and the people of Lapland were not converted to the Christian faith till about a century ago, by means of missionaries sent from Denmark. The people of Europe, as to matters of religion, are divided into catholics and protestants, the former being chiefly confined to the southern parts of it, where the imagination requires the gratifications arising from external pomp and parade; and the latter in the northern parts of it, the simplicity of which is much better calculated to please the predominant exercise of the judgment. The Christian religion being thus diffused all over Europe, that division of the globe has hence become a kind of republic in respect of literature, every scientific invention and discovery being transmitted from one portion of it to another with the utmost dispatch. For this reason Europe has been sometimes compared to ancient Greece, and it is to be hoped that Russia will never prove another Macedon.

The greater part of this quarter of the globe lies within the northern temperate zone, a distinction which is now nearly annihilated by the interesting discoveries of modern geography. Climate is found to depend very frequently on causes which are purely local, since the Alps, in a southern latitude, exhibit mountains of ice which are not known even in Lapland, while the torrid zone is plentifully supplied with water and habitations, and for any thing which can be determined to the contrary, it may contain mountains which are covered with snow. As it is happily delivered from those intense heats which are peculiar to Asia and Africa, the inhabitants are in general blessed with greater bodily vigour and intellectual strength.

One of the most striking features of Europe in a general point of view is its inland seas, which give it a decided superiority over the other more extensive divisions of the earth, and contribute powerfully to the extension of its industry, commerce, and civilization. If such blessings had been enjoyed by Africa, it is more than probable that the consequences of her industry would have been diffused far and wide. Of these inland seas, the Mediterranean holds the most distinguished place, as the centre of civilization both to the ancient and modern inhabitants of Europe. It is about 2000 miles in length to its farthest extremity in Syria, but the maps of antiquity make it 500 more. The gulfs of Venice and the Archipelago open on its northern side, formerly denominated the Adriatic and Egean seas, from the last of which there is a communication with the sea of Marmora, or the Propontis, by means of the Hellespont; and the strait of Constantinople leads into the Black sea, to the north of which is the sea of Azof, (Palus Mœotis), or utmost maritime boundary of Europe in that direction. This vast expanse of water is beautifully ornamented with numerous islands and an opulent sea coast, exhibiting delightful specimens of almost every thing in nature which is sublime and beautiful. Tides cannot be perceived except in straits of very small dimensions, although naturalists have observed, that a current sets along the shores of Italy from west to east, while its direction is from east to west towards the coast of Africa. In the gulf of Venice the current runs along Dalmatia in a north-west direction, and returns by the opposite shore of Italy. There is abundance of fish to be met with in the Mediterranean, some of which are but rarely to be found in more northern latitudes. This sea in particular abounds with coral, now certainly known to be the production of marine insects. This imaginary plant is tri-coloured, composed of red, vermilion and white, and does not exceed eleven inches in height. It is hard in the sea, and in this respect undergoes not the smallest change by exposure to the air; and the nets made use of for procuring it, measure from 60 to 125 feet. From the colour of its rocks or perilous navigation, the Black sea is said to have derived its name. As the sea of Azof almost always exhibits a muddy appearance, it


EUROPE
British Miles.
50 100 200 300 400
ARCTIC OCEAN
ATLANTIC OCEAN
NORTH SEA
BRITISH ISLES
BAY OF BISCAY
MEDITERRANEAN SEA
AFRICA
ASIA
ASIA MINOR
BLACK SEA
CASPIAN SEA
Sea of Azov
White Sea
BALTIC SEA
Gulf of Bothnia
Gulf of Finland
GULF OF VENICE
ICELAND
LAPLAND
FINLAND
RUSSIA
DENMARK
PRUSSIA
GERMANY
BOHEMIA
HUNGARY
TRANSYLVANIA
FRANCE
SPAIN
PORTUGAL
ITALY
SWITZERLAND
TURKEY
Sardinia
Corsica
Sicily
Candia
Cyprus
Malta
Minorca
Majorca
Shetland Isles
Orkney Isles
Ferroe Isles
English Channel
Carpathian Mountains
Ourals Mts.
London
Paris
Madrid
Lisbon
Stockholm
Petersburg
Moskow
Warsaw
Berlin
Vienna
Constantinople
Athens
Rome
Naples
Astrachan
Orenburg
R. Volga
R. Don
R. Danube

was for that reason denominated *Palus* by the ancients, and it is united to the Euxine or Black sea by the strait of Caffa.

The next inland sea of Europe is the Baltic, to which the Germans have given the name of the Eastern sea, which accounts for the people denominated *Easterlings* in the history of England, who undoubtedly came from the shores of the Baltic. It opens from the German sea by a gulf trending north-east, known by the name of the *Skager Rack*, from whence it passes southward in the Cattegat, to the south-east of which we meet with the sound of Elsinore, where vessels become in some degree tributary to the king of Denmark. It is afterwards divided into two branches of great extent, called the gulfs of Bothnia and Finland, both of which are covered with ice for nearly five months in the year. The greatest depth of the Baltic is said not to exceed 50 fathoms; and according to the opinion of naturalists its extent suffers a diminution of four feet every century. It has been affirmed that its waters do not contain above one-thirtieth of salt, while other sea-waters frequently contain one-tenth, which has been ascribed to the vast quantity of ice; and when the north wind blows, these waters, it is also said, may be employed for the purposes of domestic economy. There are no tides in the Baltic, and but very few fish.

The White sea, in the northern parts of Russia, is the last inland sea of Europe, which was well known to the English in particular, before the commerce of Archangel was transferred to Petersburgh. It went by the name of *Quen sea* in the reign of Alfred the Great; and the writers of Iceland called it the sea of *Ganviick*, on the shores of which stood their Biarmia. There are a number of islands in the White sea, but the accounts which geographers have hitherto given us, are neither circumstantial nor satisfactory.

The German sea deserves to be mentioned among the other maritime divisions of Europe, which has received the appellation because it waters the western shores of ancient Germany, from the Rhine to the farthest boundary of Jutland. It may properly be regarded as constituting a part of the Atlantic ocean, ending at the straits of Dover, from whence the British channel extends to the west. Another extensive inlet of the Atlantic is the bay of Biscay; for the British channel is rather to be considered as the wide frith of the Severn. St George's channel lies on the south between Great Britain and Ireland, and the Irish sea leading to the North channel, is situated in the centre. What the ancients called the Deucaledonian sea lies to the north of Scotland, which was likewise denominated the Sarmatian, as extending throughout the Baltic.

The Arctic ocean lies to the north of Europe, the dismal receptacle of countless miles of ice, piled up in mountains, the hoary majesty of which, while it captivates the eye, can scarcely fail to strike terror into the heart of the mariner. Yet from those dreary regions, which at first appear only as a prodigious waste in the works of creation, the benevolent Parent of the universe diffuses innumerable millions of herrings for the use of man. This is worthy of the divine being whose goodness is whispered to us in every breeze, which glows in the starry firmament of heaven, and is diffused through the whole creation.

The Goodwin sands in the vicinity of the Kentish coast, are as dangerous to the mariner as uninviting to the fisher; but excellent fish are to be found on many banks on the coast of Holland, among which may be ranked the cod, the soal, and the plaice. What are called the Silverpits of the mariners, lying between the Dogger and Well bank, supply the London market with cod, which discovers a predilection for the deep waters in the vicinity of the banks. The Hornriff, a narrow strip extending to Jutland, is situated towards the north east of the Dogger bank. The Juttsriff extends from the mouth of the Baltic to the German sea, in the form of a crescent.

The Mar bank takes its rise opposite to Berwick, which is little more than 15 miles in length. To the eastward of this lies the Long Forties, extending from Buchanness to Newcastle, and from between 40 and 100 miles from the shore; and a bank reaches across the German sea towards Juttsriff, from the coast of Buchan. It was thought necessary, in this concise account of Europe, to mention some of the most considerable banks or comparative shoals, which have often been regarded as the summits of lofty mountains beneath the surface of the deep; and which, as the haunts of fishes of different species, have arrested the attention of national industry.

A description of the principal rivers of Europe will be given in our account of the countries through which they respectively flow. The greater part of the Wolga is considered as belonging to Europe; the next highly celebrated river is the Danube, after which we may rank the Nieper, the Rhine, and the Elbe. The Alps are the loftiest mountains; next the Pyrenees; and that vast ridge by which Norway is divided from Sweden. The Carpathian mountains, the chain called Emineh, and the Apennines, are of inferior magnitude.

The European states and kingdoms may properly be divided into three classes. 1. Despotic monarchies, of which Russia and Turkey may serve as specimens. 2. Absolute monarchies, such as Spain and Denmark. And 3. Those of a limited nature, as the Germanic empire, and the kingdom of Great Britain. Since the peace in in 1815, constitutions formed on the model of that of England have been adopted by Bavaria, Wirtemberg, Baden, Hesse Darmstadt, and some other of the smaller states. Spain and Portugal have established governments on a more democratic plan. The two old commercial aristocracies of Venice and Genoa have been suppressed.

It is customary with some geographers to divide the constituent parts of Europe into first, second, and third orders, according to their political importance; the first order including the united kingdoms of Great Britain and Ireland, France, Russia, the Austrian dominions, Prussia, Spain, Turkey. In the second order stand the United Provinces, Denmark, Sweden, Portugal, and Switzerland; and the chief states of Germany and Italy constitute the third, a detailed account of which our readers will find in this work under their proper names. For a detailed account of the recent changes in this quarter of the globe, see the article EUROPE in the SUPPLEMENT.

**EURYALE**, in *Mythology*, one of the Gorgons, daughters of Phorcys, and sister of Medusa; she was subject neither to old age nor death.

EURYANDRA, a genus of plants belonging to the polyandria class. See BOTANY *Index*.

EURYDICE, in fabulous history, the wife of Orpheus, who flying from Aristæus that endeavoured to ravish her, was slain by a serpent. Her husband went down to the shades, and by the force of his music persuaded Pluto and Proserpine to give him leave to carry back his wife; which they granted, provided he did not look on her till he came to the light: but he breaking the condition, was forced to leave her behind him. See ORPHEUS.

EURYMEDON, in *Ancient Geography*, a noble river running through the middle of Pamphylia; famous for a sea and land fight on the same day, in which the Athenians under Cimon the son of Miltiades, defeated the Persians. The sea fight happened first in the sea of Pamphylia, towards Cyprus; the land engagement, the following night on the Eurymedon. Cimon, after defeating the Persian fleet, armed his men with the armour of the captives, and set sail for the enemy, who lay on the banks of the Eurymedon, in the ships taken from the Persians; who on seeing their own ships and their own people in appearance, were off their guard, and thus became an easy conquest.

EURYSTHEUS, a king of Argos and Mycenæ, son of Sthenelus and Nicippe the daughter of Pelops. Juno hastened his birth by two months, that he might come into the world before Hercules the son of Alcmena, as the younger of the two was doomed by order of Jupiter to be subservient to the will of the other. (See ALCMENA). This natural right was cruelly exercised by Eurystheus, who was jealous of the fame of Hercules; and who, to destroy so powerful a relation, imposed upon him the most dangerous and uncommon enterprises, well known by the name of the *twelve labours of Hercules*. The success of Hercules in achieving those perilous labours alarmed Eurystheus in a greater degree, and he furnished himself with a brazen vessel, where he might secure himself a safe retreat in case of danger. After the death of Hercules, Eurystheus renewed his cruelties against his children, and made war against Ceyx king of Trachinia, because he had given them support, and treated them with hospitality. He was killed in the prosecution of this war by Hyllus the son of Hercules. His head was sent to Alcmena the mother of Hercules; who, mindful of the cruelties which her son had suffered, insulted it, and tore out the eyes with the most inveterate fury. Eurystheus was succeeded on the throne of Argos by Atreus his nephew. The death of Eurystheus happened about 30 years before the Trojan war.

EURYTHMY, in *Architecture*, *Painting*, and *Sculpture*, is a certain majesty, elegance, and easiness, appearing in the composition of divers members or parts of a body, painting, or sculpture, and resulting from the fine proportion of it.

EUSDEN, LAURENCE, an Irish clergyman, rector of Conesby in Lincolnshire, and poet laureat after the death of Mr Rowe. His first patron was the eminent Lord Halifax; whose poem, on the battle of the Boyne, he translated into Latin, and dedicated to his lordship. He was esteemed by the duke of Newcastle, who rewarded an epithalamium he wrote on his marriage with the place of poet laureat. He was the author of many poetical pieces, though but little known before his preferment: he died in 1730.

EUSEBIANS, a denomination given to the sect of Arians, on account of the favour and countenance which Eusebius, bishop of Cæsaria, showed and procured for them at their first rise. See ARIANS and EUSEBIUS.

EUSEBIUS, surnamed PAMPHILIUS, a celebrated bishop of Cæsarea in Palestine, and one of the most learned men of his time, was born in Palestine about the latter end of the reign of Gallienus. He was the intimate friend of Pamphilus the Martyr; and, after his death, took his name in honour to his memory. He was ordained bishop of Cæsarea in 313. He had a considerable share in the contest relating to Arius; whose cause he, as well as several other bishops of Palestine, defended, being persuaded that Arius had been unjustly persecuted by Alexander bishop of Alexandria. He assisted at the council of Nice in 325; when he made a speech to the emperor Constantine on his coming to the council, and was placed next him on his right hand. He was present at the council of Antioch, in which Eustathius bishop of that city was deposed; but though he was chosen by the bishop and people of Antioch to succeed him, he absolutely refused it. In 335, he assisted at the council of Tyre held against Athanasius; and at the assembly of bishops at Jerusalem, at the time of the dedication of the church there. By these bishops he was sent to the emperor Constantine to defend what they had done against Athanasius; when he pronounced the panegyric made on that emperor during the public rejoicings in the beginning of the 30th year of his reign, which was the last of his life. Eusebius survived the emperor but a short time, for he died in 338. He wrote, 1. An Ecclesiastical History, of which Valetius has given a good edition in Greek and Latin; 2. The life of Constantine; 3. A treatise against Hierocles; 4. *Chronicon*; 5. *Preparationes Evangelicæ*; 6. *De demonstratione Evangelica*, of which there are but 10 books extant out of 20; and several other works, some of which are lost.

EUSTACHIUS, BARTHOLOMEW, physician and anatomist at Rome, flourished about the year 1550. His anatomical plates were discovered there in 1712, and published in 1714.

EUSTATHIANS, a name given to the Catholics of Antioch in the 4th century, on occasion of their refusal to acknowledge any other bishop beside St Eustathius, deposed by the Arians.

The denomination was given them during the episcopate of Paulinus, whom the Arians substituted to St Eustathius, about the year 330, when they began to hold their assemblies apart. About the year 350, Leontius of Phrygia, called the *eunuch*, who was an Arian, and was put in the see of Antioch, desired the Eustathians to perform their service in his church; which they accepting, the church of Antioch served indifferently both the Arians and Catholics.

This, we are told, gave occasion to two institutions, which have subsisted in the church ever since. The first was psalmody in two choirs; though M. Baillet thinks, that if they instituted an alternate psalmody between two choirs, it was between two Catholic choirs, aud not by way of response to an Arian choir. The second was the doxology, *Glory be to the Father, and the Son, and the Holy Ghost*. See DOXOLOGY.

This conduct, which seemed to imply a kind of communion with the Arians, gave great offence to abundance

dance of Catholics, who began to hold separate meetings; and this formed the schism of Antioch. Upon this, the rest, who continued to meet in the church, ceased to be called *Eustathians*, and that appellation became restrained to the dissenting party. St Flavianus, bishop of Antioch in 381, and one of his successors, Alexander, in 481, brought to pass a coalition, or reunion, between the Eustathians and the body of the church of Antioch, described with much solemnity by Theodoret, *Eccl.* lib. iii. c. 2.

EUSTATHIANS were also a sect of heretics in the fourth century, denominated from their founder Eustathius, a monk so foolishly fond of his own profession, that he condemned all other conditions of life. Whether this Eustathius was the same with the bishop of Sebastia and chief of the Semi-Arians, is not easy to determine.

He excluded married people from salvation; prohibited his followers from praying in their houses; and obliged them to quit all they had, as incompatible with the hopes of heaven. He drew them out of the other assemblies of Christians to hold secret ones with him, and made them wear a particular habit; he appointed them to fast on Sundays; and taught them, that the ordinary fasts of the church were needless, after they had attained to a certain degree of purity which he pretended to. He showed great horror for chapels built in honour of martyrs, and the assemblies held therein. Several women seduced by his reasons, forsook their husbands, and abundance of slaves deserted their masters houses. He was condemned at the council of Gangra in Paphlagonia, held between the years 326 and 341.

EUSTATHIUS, bishop of Thessalonica, in the 12th century, under the reigns of the emperors Emanuel, Alexander, and Andronicus Comnenus. He was a very eminent grammarian; and wrote commentaries upon Homer, and Dionysius the geographer. The best edition of his Commentaries on Homer is that of Rome, printed in Greek, in 1542, in four volumes folio. His Commentaries on the Periegesis of Dionysius were printed by Mr Hudson at Oxford, in 1697, 8vo. Eustathius appears to have been alive in the year 1194.

EUSTATIA, ST EUSTATIA, or *Eustatius*, one of the Caribbee islands, belonging to the Dutch, and situated in W. Long. 62. 56. N. Lat. 17. 29. It is little else than a huge mountain, which formerly has, in all probability, been a volcano. Its situation is so strong, that it has but one landing place; and that is fortified in such a manner as to be almost impregnable. Tobacco is the chief product of the island; and it is cultivated to the very top of the pyramid which terminates in a large plain surrounded with woods, but having a hollow in the middle, which serves as a large den for wild beasts. No fewer than 5000 white people and 15,000 negroes subsist on this spot, where they rear hogs, kids, rabbits, and all kinds of poultry, in such abundance, that they can supply their neighbours, after having served themselves.

The first Dutch colony sent to this island consisted of about 1600 people. They were dispossessed by the English from Jamaica in 1665. Soon after, the Dutch and French becoming confederates, the English were expelled in their turn. The French continuing to hold a garrison in the island till the treaty of Breda, when it was restored to the Dutch. Soon after the revolution, the French drove out the Dutch, and were in their turn driven out by the English under Sir Timothy Thornhill, with the loss of no more than eight men killed and wounded, though the fort they took mounted 16 guns, and was in every other respect very strong. Sir Timothy found it necessary for the protection of the Dutch, to leave a small English garrison in the fort; but he granted the French no terms of capitulation, except for their lives and baggage. By the peace of Ryswick, the entire property of this island was restored to the Dutch.

This island was reduced by the British in the year 1781. Though not 20 miles in circumference, it abounded at that time with riches, by reason of the vast conflux of trade from every other island in these seas. Being a free port, it was open to all the subjects of the belligerent powers; and thus a communication was established among them, through which they were enabled to carry on a commercial correspondence, which greatly mitigated the inconveniences of war. The greatest benefit, however, was reaped by the Dutch; who, by transacting all trading business for other nations, were thus intrusted with numberless commissions, and likewise enjoyed vast profits from the sale of the merchandises to which they were entitled. At the time the attack was made upon them, they were so little under the apprehensions of such an event, that their warehouses were not sufficient to contain the quantity of commercial articles imported for sale, and the beach and streets were covered with hogsheads of tobacco and sugar. In this situation, Admiral Rodney having received orders to commence hostilities against the Dutch, suddenly appeared before the island with such an armament of sea and land forces, as in its defenceless situation was not only useless but ridiculous. The governor could scarcely credit the officer who summoned him to surrender; but being convinced how matters stood, the only possible step was taken, namely, to surrender the whole island and every thing in it, at discretion. Along with the island there fell into the hands of the captors a ship of 60 guns, with 250 sail of merchantmen, while the value of property on the island was estimated at no less than four millions sterling. This capture became afterwards a subject of discussion in parliament, where the conduct of the British commanders was severely scrutinized by Mr Burke. The admiral and general made their defence in person: but the minority at that time were far from being satisfied; and it was supposed that on the change of ministry a rigid inquiry would have been set on foot, had not the splendour of Admiral Rodney's victory over de Grasse put an end to all thoughts of that nature.

The island of St Eustatius is naturally of such difficult access, as already observed, that it is almost impossible for an enemy to effect a landing if proper care is taken by those who are in possession of it. This very circumstance proved the ruin of the new possessors. The British, secure in their inaccessible situation, conducted themselves in such a manner as induced the Marquis de Bouille to make an attempt to regain it. Having sailed from Martinico at the head of 2000 men, he arrived on the 26th of November 1781, off one of the landing places of the island, which was deemed so inaccessible that it had been left without a guard. With much loss and difficulty, however, he landed here with four or five hundred of his people during the night. The appearance of day put an end to his landing any more; and he now saw himself obliged either to relinquish the enterprise or to attack the garrison, which was almost double the number of those he had on the island. He chose the latter: and was favoured in his enterprise by the extreme negligence of his antagonists. A difficult pass, which a few men might have occupied with success against a great number, was left unguarded, which the marquis secured in time, and then pushed forward with the utmost expedition. The British, mistaking a body of Irish troops which attended the French commander for their own comrades, suffered them to approach without thinking of opposing them. They were then exercising on the parade; but were soon made sensible of their fatal mistake by a close discharge from their supposed friends, by which many were killed and wounded. The surprise occasioned by this sudden attack was so great, that no resistance could be made; especially as their commanding officer, Colonel Cockburn, who happened at that instant to come upon the parade, was made prisoner. A number of them, however, hastened to the fort with a view of making head against the enemy; but the French had already taken possession of the gate, and prevented the drawbridge from being raised. They entered the fort; which, being surrendered by those who had taken shelter in it, the rest of the garrison, dispersed in various places, and imagining the number of the enemy to be much greater than it really was, submitted without any opposition. The French commander took this opportunity of showing his disinterestedness in pecuniary matters. Among the spoils that fell into his hands a large sum of money was claimed by the British commanding officer as being his private property, which was generously restored to him: in like manner the property of the Dutch inhabitants was reserved to them. St Eustatia was restored to the Dutch at the peace of 1783, was taken by the British again in 1801, and again restored to the Dutch in 1814.

EUSTYLE, in *Architecture*, a sort of building in which the pillars are placed at the most convenient distance one from another, the intercolumniations being just two diameters and a quarter of the column, except those in the middle of the face, before and behind, which are three diameters distant.

EUTERPE, one of the Muses, daughter of Jupiter and Mnemosyne. She presided over music, and was looked upon as the inventress of the flute. She is represented as crowned with flowers, and holding a flute in her hands: Some mythologists attributed to her the invention of tragedy, more commonly supposed to be the production of Melpomene.

EUTHYMIA, among the Greeks, signified such a disposition or state of the mind, as could not be ruffled either by good or bad fortune, by sickness or health, good or evil.

EUTROPIUS, Flavius, a Latin author, in the 4th century, was secretary to Constantine the Great, and afterwards bore arms under the emperor Julian, and followed that prince in his expedition against the Persians. He wrote an Abridgement of the Roman History, from the foundation of Rome to the reign of Valens; the best edition of which is that of Miss Le Fevre, afterwards Madame Dacier, published at Paris for the use of the Dauphin, in 4to, in the year 1683.

EUTYCHIANS, ancient heretics, who denied the duplicity of natures in Christ; thus denominated from Eutyches, the archimandrite, or abbot of a monastery at Constantinople, who began to propagate his opinion A. D. 448. He did not, however, seem quite steady and consistent in his sentiments: for he appeared to allow of two natures, even before the union; which was apparently a consequence he drew from the principles of the Platonic philosophy, which supposes a pre-existence of souls: accordingly, he believed that the soul of Jesus Christ had been united to the divinity before the incarnation; but then he allowed no distinction of natures in Jesus Christ since his incarnation. This heresy was first condemned in a synod held at Constantinople by Flavian, in 448, approved by the council of Ephesus, called *conventus latronum*, in 449, and re-examined, and fulminated in the general council of Chalcedon in 451. The legates of Pope Leo, who assisted at it, maintained that it was not enough to define, that there were two natures in Jesus Christ; but insisted strenuously, that, to remove all equivocations, they must add these terms, without being changed, or confounded, or divided.

The heresy of the Eutychians, which made a very great progress throughout the east, at length became divided into several branches. Nicephorus makes mention of no fewer than twelve: some called *Schematici*, or *Apparentes*, as only attributing to Jesus Christ a phantom or appearance of flesh, and no real flesh: others, *Theodosians*, from Theodosius bishop of Alexandria: others, *Jacobites*, from one James (*Jacobus*), of Syria; which branch established itself principally in Armenia, where it still subsists. Others were called *Acephali*, q. d. without head; and *Severians*, from a monk called *Severus*, who seized on the see of Antioch in 513. These last were subdivided into five factions, viz. *Agnoetæ*, who attributed some ignorance to Jesus Christ; the followers of Paul; Μελαινοι, that is, the black *Angelites*, thus called from the place where they were assembled; and lastly, *Adrites* and *Cononites*.

Eutychians was also the name of another sect, half Arian half Eunomian; which arose at Constantinople in the fourth century.

It being then a matter of mighty controversy among the Eunomians at Constantinople, whether or not the Son of God knew the last day and hour of the world, particularly with regard to that passage in the gospel of St Matthew, chap. xxiv. ver. 36. or rather that in St Mark, xiii. 32. where it is expressed, that the Son did not know it, but the Father only; Eutychius made no scruple to maintain, even in writing, that the Son did not know it; which sentiment displeasing the leaders of the Eunomian party, he separated from them, and made a journey to Eunomius, who was then in exile. That heretic acquiesced fully in Eutychius's doctrine, and admitted him to his communion. Eunomius dying soon after, the chief of the Eunomians at Constantinople refused to admit Eutychius; who, upon this, formed a particular sect of such as adhered to him, called *Eutychians*.

This same Eutychius, with one Theophronius, as was said in Sozomen's time, were the occasions of all the changes made by the Eunomians in the administration of baptism; which consisted, according to Nicephorus, in only using one immersion, and not doing it in the name of the Trinity, but in memory of the death of Jesus Christ. Nicephorus calls the chief of that sect, not *Eutychius*, but *Eupsychius*, and his followers *Eunomiaupsychians*.

EUTYCHIUS, patriarch of Alexandria, lived about the ninth age; and wrote annals in the Arabic language, printed at Oxford in 1658, with a Latin version by Mr Pococke. Selden had printed something of his before.

EUXINE or Black Sea, forms part of the boundary betwixt Europe and Asia. It receives the Nieper, the Danube, and other large rivers; and extends from 28 to 41 degrees of E. Long. and from 41 to 47 of N. Lat. The ancients imagined this sea to have been originally only a lake or standing pool which broke first into the Propontis, and then into the Egean, washing away by degrees the earth which first kept it within bounds, and formed the two channels of the Bosphorus Thracius and Hellespont, now the Dardanelles.—It was anciently called the *Axenus*, supposed to be from Ashkenaz the son of Gomer, who is said to have settled near it. This original being forgot in length of time, the Greeks explained it by *inhospitable*, which the word Axenos literally signifies; and therefore, when they came to consider the inhabitants of these coasts as more civilized and hospitable, they changed the name into Euxinus. See Black Sea, Supplement.

EWE, the English name of a female sheep. See Ovis, Mammalia *Index*.

EWERY, in the British customs, an office in the king's household, to which belongs the care of the table-linen, of laying the cloth, and serving up water in silver ewers after dinner.

EX, a river that rises in a barren tract of land, called Exmore, in Somersetshire; and after being joined by several little streams, runs by Tiverton, where there is a stone bridge over the river. About nine miles below Tiverton, it is joined by a pretty large stream called the *Colombton;* and about two miles lower, by another stream formed by the junction of the Horton and Credy. With these additions, it washes the walls of Exeter. At Topsham, above four miles below Exeter, it receives another considerable addition to its stream; two miles farther, it is joined by the Ken; and falls into the ocean at Exmouth, after a course of about 40 miles. Ships of great burden go up to Topsham, from whence vessels of 150 tons are conveyed to the quay at Exeter, by means of an artificial canal. The Ex is navigable for vessels of considerable burden to Topsham. The passage, however, at the mouth of the river, is but narrow, having rocks on the east side and broad sands on the west; nor is the water on the bar more than six or seven feet deep at low water, but the tide rises 14 or 15 feet, so that it is deep enough at high water. When ships are within the bar they may ride afloat at a place called Starcross, about a mile and a half from the river's mouth; but those that go to Topsham lie aground on the ooze at low water.

EX officio, among lawyers, signifies the power a person has, by virtue of his office, to do certain acts without being applied to. Thus a justice of peace may, *ex officio*, at his discretion, take surety of the peace, without complaint made by any person whatsoever.

There was formerly an oath *ex officio*, whereby a supposed offender was compelled in the ecclesiastical court to confess, accuse, or clear himself of a crime; but this law is repealed.

*Ex Post Facto*, in *Law*, something done after another: thus an estate granted may be good by matter *ex post facto*, that was not so at first, as in case of election.

EXACERBATION. See Paroxysm.

EXACTION, in *Law*, a wrong done by an officer, or a person in pretended authority, in taking a reward or fee that is not allowed by all.

A person guilty of exaction may be fined and imprisoned. It is often confounded with Extortion.

EXACUM, a genus of plants belonging to the tetrandria class; and in the natural method ranking under the 20th order, *Rotaceæ*. See Botany *Index*.

EXÆRESIS, in *Surgery*, the operation of extracting or taking away something that is hurtful to the human body.

EXAGGERATION, in *Rhetoric*, a kind of hyperbole, whereby things are augmented or amplified by saying more than the truth, either as to good or bad.

Exaggeration, in *Painting*, a method by which the artist, in representing things, changes them too much, or makes them too strong, either in respect of the design or colouring. It differs from *caricaturing*, in that the latter perverts or gives a turn to the features of a face, &c. which they had not, whereas exaggeration only heightens or improves what they had.

EXALTATION, or Elevation, is chiefly used in a figurative sense, for the raising or advancing a person to some ecclesiastical dignity; and particularly to the papacy.

*Exaltation of the Cross* is a feast of the Romish church, held on the 14th of September; in memory, as is generally supposed, of this, that the emperor Heraclius brought back the true cross of Jesus Christ on his shoulders, to the place on Mount Calvary from which it had been carried away 14 years before by Cosroes king of Persia, at his taking of Jerusalem, under the reign of the emperor Phocas. The cross was delivered up by a treaty of peace made with Siroe, Cosroes's son. The institution of this treaty is commonly said to have been signalized by a miracle; in that Heraclius could not stir out of Jerusalem with the cross while he had the imperial vestments on enriched with gold and precious stones, but bore it with ease in a common dress.

But long before the reign of Heraclius there had been a feast of the same denomination observed both in the Greek and Latin churches, on occasion of what our Saviour said in St John xiii. 32. *And I, if I be exalted, or lifted up, will draw all men unto me.* And again, in chap. viii. ver. 28. *When you have exalted, or lifted up the Son of Man, then shall ye know that I am he.*

The feast of the dedication of the temple built by Constantine was held, says Nicodemus, on the 14th of

September, the day on which the temple had been consecrated in the year 335; and this feast was also called the *exaltation of the cross*, because it was a ceremony therein, for the bishop of Jerusalem to ascend a high place, built by Constantine for that purpose, in manner of a pulpit, called by the Greeks the *sacred mysteries of God*, or *the holiness of God*, and there hoist up the cross for all the people to see it.

Exaltation, in *Physics*, denotes the act, or operation, of elevating, purifying, subtilizing, or perfecting any natural body, its principles and parts; also the quality or disposition which bodies acquire by such operation. The term *exaltation* has been peculiarly affected by the chemists and alchemists; who imagining it to have some extraordinary emphasis, are employing it on every occasion.

Exaltation, in *Astrology*, is a dignity which a planet acquires in certain signs or parts of the zodiac; which dignity is supposed to give it an extraordinary virtue, efficacy, and influence. The opposite sign, or part of the zodiac, is called the dejection of the planet. Thus the 15th degree of Cancer is the exaltation of Jupiter, according to Albumazor, because it was the ascendant of that planet at the time of the creation; that of the sun is in the 19th degree of Aries, and its dejection in Libra; that of the moon is in Taurus, &c. Ptolemy gives the reason of this in his first book De Quadrup.

**EXAMINATION**, an exact and careful search or inquiry, in order to discover the truth or falsehood of a thing.

*Self-Examination*, is a point much insisted on by divines, and particularly the ancient fathers, by way of preparation to repentance. St Ignatius reduces it to five points; viz. 1. A returning thanks to God for his benefits. 2. A begging of grace and light, to know and distinguish our sins. 3. A running over all our actions, occupations, thoughts, and words, in order to learn what has been offensive to God. 4. A begging of pardon, and conceiving a sincere sorrow for having displeased him. And, 5. Making a firm resolution not to offend him any more; and taking the necessary precautions to preserve ourselves from it.

**EXAMINERS**, in chancery, two officers of that court, who examine, upon oath, witnesses produced in causes depending there, by either the complainant or defendant, where the witnesses live in London or near it. Sometimes parties themselves, by particular order, are examined. In the country, above 20 miles from London, on the parties joining in commission, witnesses are examined by commissioners, being usually counsellors or attorneys not conserned in the cause.

**EXAMPLE**, in a general sense, denotes a copy or pattern.

Example, in a moral sense, is either taken for a type, instance, or precedent, for our admonition, that we may be cautioned against the faults or crimes which others have committed, by the bad consequences which have ensued from them; or example is taken for a pattern for our imitation, or a model for us to copy after.

That examples have a peculiar power above the naked precept, to dispose us to the practice of virtue and holiness, may appear by considering, 1. That they most clearly express to us the nature of our duties in their subjects and sensible effects. General precepts form abstract ideas of virtue; but in examples, virtues are most visible in all their circumstances. 2. Precepts instruct us in what things are our duty; but examples assure us that they are possible. When we see men like ourselves, who are united to frail flesh, and in the same condition with us, to command their passions, to overcome the most glorious and glittering temptations, we are encouraged in our spiritual warfare. 3. Examples, by secret and lively incentive, urge us to imitation. We are touched in another manner by the visible practice of good men, which reproaches our defects, and obliges us to the same zeal which laws, though wise and good, will not effect.

The example of our Saviour is most proper to form us to holiness; it being absolutely perfect, and accommodated to our present state. There is no example of a mere man that is to be followed without limitation: But the example of Christ is absolutely perfect; his conversation was a living law: "He was holy, harmless, undefiled, and separate from sinners."

Example, in *Rhetoric*, denotes an imperfect kind of induction or argumentation; whereby it is proved, that a thing which happened on some other occasion will happen again on the present one, from the similitude of the cases. As, "The war of the Thebans, against their neighbours the Phocians, was ruinous; consequently, that of the Athenians against their neighbours, will likewise be fatal."

**EXANTHEMA**, among *Physicians*, denotes any kind of efflorescence or eruption, as the measles, purple spots in the plague, or malignant fevers, &c.

**EXARCH**, in antiquity, an appellation given, by the emperors of the east, to certain officers sent into Italy, in quality of vicars, or rather prefects, to defend that part of Italy which was yet under their obedience, particularly the city of Ravenna, against the Lombards, who had made themselves masters of the greatest part of the rest.

The residence of the exarch was at Ravenna; which city, with that of Rome, was all that was left the emperors. The first exarch was the patrician Boetius, famous for his treatise, De Consolatione Philosophiæ; appointed in 568 by the younger Justin. The exarchs subsisted about 185 years, and ended in Eutychius: under whose exarchate the city of Ravenna was taken by the Lombard king Astulphus, or Astolphus.

The emperor Frederio created Heraclins, archbishop of Lyons, a descendant of the illustrious house of Montboissier, exarch of the whole kingdom of Burgundy; a dignity till that time unknown anywhere but in Italy, particularly in the city of Ravenna.

Homer, Philo, and other ancient authors, give likewise the name *exarchus* to the choragus or master of the singers in the ancient choruses, or him who sung first: the word αρχω or αρχομαι, signifying equally to *begin*, and to *commend*.

*Exarch of a Diocese* was, anciently, the same with primate. This dignity was inferior to the patriarchal, yet greater than the metropolitan.

Exarch also denotes an officer, still subsisting in the Greek church; being a kind of deputy or legate *à latere* of the patriarch, whose office it is to visit the provinces allotted him, in order to inform himself of the

the lives and manners of the clergy; take cognizance of ecclesiastical causes; the manner of celebrating divine service; the administration of the sacraments, particularly confession; the observance of the canons; monastic discipline; affairs of marriages, divorces, &c. but above all, to take an account of the several revenues which the patriarch receives from several churches; and, particularly, as to what regards the collecting the same.

The exarch, after having greatly enriched himself in his post, frequently rises to the patriarchate itself.

**Exarch** is also used, in the eastern church antiquity, for a general or superior over several monasteries; the same that we otherwise call archimandrite; being exempted, by the patriarch of Constantinople, from the jurisdiction of the bishops; as are now the generals of the Romish monastic orders.

**EXAUCTORATIO**, in the Roman military discipline, differed from the missio, which was a full discharge, and took place after they had served in the army 20 years; whereas the exauctoratio was only a partial discharge: they lost their pay indeed, but still kept under their colours or *vexilla*, though not under the *aquila* (or eagle), which was the standard of the legion; whence, instead of *Legionarii*, they were called *Subsignani*, and were retained till they had either served their full time or had lands assigned them. The exauctoratio took place after they had served 17 years.

**EXCALCEATION**, among the Hebrews, was a particular law, whereby a widow, whom her husband's brother refused to marry, had a right to summon him to a court of justice; and, upon his refusal, might excalceate him, that is, pull off one of his shoes, and spit in his face; both of them actions of great ignominy.

**EXCELLENCY**, a title anciently given to kings and emperors, but now to ambassadors, generals, and other persons who are not qualified for that of *highness*, and yet are to be elevated above the other inferior dignities.

**EXCENTRIC**, in *Geometry*, a term applied to circles and spheres which have not the same centre, and consequently are not parallel; in opposition to concentric, where they are parallel, having one common centre.

**EXCENTRICITY**, in *Astronomy*, is the distance of the centre of the orbit of a planet from the centre of the sun; that is, the distance between the centre of the ellipsis and the focus thereof.

**EXCEPTION**, something reserved, or set aside, and not included in a rule.

It is become proverbial, that there is no rule without an exception; intimating that it is impossible to comprehend all the particular cases, under one and the same maxim. But it is dangerous following the exception preferably to the rule.

**Exception**, in *Law*, denotes a stop or stay to an action; and is either dilatory or peremptory, in proceedings at common law; but in chancery it is what the plaintiff alleges against the sufficiency of an answer, &c.

An exception is no more than the denial of what is taken to be good by the other party, either in point of law or pleading. The counsel in a cause are to take all their exceptions to the record at one time, and before the court has delivered any opinion of it.

**EXCERPT**, in matters of literature. See Extract.

**EXCESS**, in *Arithmetic* and *Geometry*, is the difference between any two unequal numbers or quantities, or that which is left after the lesser is taken from or out of the greater.

**EXCHANGE**, in a general sense, a contract or agreement, whereby one thing is given or exchanged for another.

**Exchange**, in commerce, is the receiving or paying of money in one country for the like sum in another, by means of bills of exchange.

The security which merchants commonly take from one another when they circulate their business, is a bill of exchange, or a note of hand: these are looked upon as payment. See Bill, and *Mercantile* Laws.

The punctuality of acquitting these obligations is essential to commerce; and no sooner is a merchant's accepted bill protested, than he is considered as a bankrupt. For this reason, the laws of most nations have given very extraordinary privileges to bills of exchange. The security of trade is essential to every society; and were the claims of merchants to linger under the formalities of courts of law when liquidated by bills of exchange, faith, confidence, and punctuality would quickly disappear, and the great engine of commerce would be totally destroyed.

A regular bill of exchange is a mercantile contract, in which four persons are concerned, viz. 1. The drawer, who receives the value: 2. His debtor, in a distant place, upon whom the bill is drawn, and who must accept and pay it: 3. The person who gives value for the bill, to whose order it is to be paid: and, 4. The person to whom it is ordered to be paid, creditor to the third.

By this operation, reciprocal debts, due in two distant parts, are paid by a sort of transfer, or permutation of debtors and creditors.

(A) in London is creditor to (B) in Paris, value 100l. (C) again in London is debtor to (D) in Paris for a like sum. By the operation of the bill of exchange, the London creditor is paid by the London debtor; and the Paris creditor is paid by the Paris debtor; consequently the two debts are paid, and no money is sent from London to Paris nor from Paris to London.

In this example, (A) is the drawer, (B) is the accepter, (C) is the purchaser of the bill, and (D) receives the money. Two persons here receive the money, (A) and (D); and two pay the money, (B) and (C); which is just what must be done when two debtors and two creditors clear accounts.

This is the plain principle of a bill of exchange. From which it appears that reciprocal and equal debts only can be acquitted by them.

When it therefore happens, that the reciprocal debts of London and Paris (to use the same example) are not equal, there arises a balance on one side. Suppose London to owe Paris a balance, value 100l. How can this be paid? Answer, it may either be done with or without the intervention of a bill.

With a bill, if an exchanger, finding a demand for a bill upon Paris for the value of 100l. when Paris owes.

owes no more to London, sends 100l. to his correspondent at Paris in coin, at the expence (suppose) of 1l. and then, having become creditor on Paris, he can give a bill for the value of 100l. upon his being repaid his expence, and paid for his risk and trouble.

Or it may be paid without a bill, if the London debtor sends the coin himself to his Paris creditor, without employing an exchanger.

This last example shows of what little use bills are in the payment of balances. As far as the debts are equal, nothing can be more useful than bills of exchange; but the more they are useful in this easy way of business, the less profit there is to any person to make a trade of exchange, when he is not himself concerned either as debtor or creditor.

When merchants have occasion to draw and remit bills for the liquidation of their own debts, active and passive, in distant parts, they meet upon 'Change; where, to pursue the former examples, the creditors upon Paris, when they want money for bills, look out for those who are debtors to it. The debtors to Paris again, when they want bills for money, seek for those who are creditors upon it.

This market is constantly attended by brokers, who relieve the merchant of the trouble of searching for those he wants. To the broker every one communicates his wants, so far as he finds it prudent; and by going about among all the merchants, the broker discovers the side upon which the greater demand lies, for money or for bills.

He who is the demander in any bargain, has constantly the disadvantage in dealing with him of whom he demands. This is nowhere so much the case as in exchange, and renders secrecy very essential to individuals among the merchants. If the London merchants want to pay their debts to Paris, when there is a balance against London, it is their interest to conceal their debts, and especially the necessity they may be under to pay them; from the fear that those who are creditors upon Paris would demand too high a price for the exchange over and above par.

On the other hand, those who are creditors upon Paris, when Paris owes a balance to London, are as careful in concealing what is owing to them by Paris, from the fear that those who are debtors to Paris would avail themselves of the competition among the Paris creditors, in order to obtain bills for their money, below the value of them, when at par. A creditor upon Paris, who is greatly pressed for money at London, will willingly abate something of his debt, in order to get one who will give him money for it.

From the operation carried on among merchants upon 'Change, we may discover the consequence of their separate and jarring interests. They are constantly interested in the state of the balance. Those who are creditors on Paris, fear the balance due to London; those who are debtors to Paris, dread a balance due to Paris. The interest of the first is to dissemble what they fear; that of the last, to exaggerate what they wish. The brokers are those who determine the course of the day; and the most intelligent merchants are those who despatch their business before the fact is known.

Now, how is trade in general interested in the question, Who shall outwit, and who shall be outwitted, in this complicated operation of exchange among merchants?

The interest of trade and of the nation is principally concerned in the proper method of paying and receiving the balances. It is also concerned in preserving a just equality of profit and loss among all the merchants, relative to the real state of the balance. Unequal competition among men engaged in the same pursuit, constantly draws along with it bad consequences to the general undertaking; and secrecy in trade will be found, upon examination, to be much more useful to merchants in their private capacity, than to the trade they are carrying on.

Merchants endeavour to simplify their business as much as possible; and commit to brokers many operations which require no peculiar talents to execute. This of exchange is of such a nature, that it is hardly possible for a merchant to carry on the business of his bills without their assistance, upon many occasions. When merchants come upon 'Change, they are so full of fear and jealousies, that they will not open themselves to one another, lest they should discover what they want to conceal. The broker is a confidential man, in some degree, between parties, and brings them together.

Besides the merchants who circulate among themselves their reciprocal debts and credits arising from their importation and exportation of goods, there is another set of merchants who deal in exchange; which is the importation and exportation of money and bills.

Were there never any balance on the trade of nations, exchangers and brokers would find little employment; reciprocal and equal debts would easily be transacted openly between the parties themselves. No man feigns and dissembles, except when he thinks he has an interest in so doing.

But when balances come to be paid, exchange becomes intricate; and merchants are so much employed in particular branches of business, that they are obliged to leave the liquidation of their debts to a particular set of men, who make it turn out to the best advantage to themselves.

Whenever a balance is to be paid, that payment costs, as we have seen, an additional expence to those of the place who owe it, over and above the value of the debt.

If, therefore, this expence be a loss to the trading man, he must either be repaid this loss by those whom he serves, that is, by the nation; or the trade he carries on will become less profitable.

Every one will agree, that the expence of high exchange upon paying a balance is a loss to a people, no way to be compensated by the advantages they reap from enriching the few individuals among them who gain by contriving methods to pay it off; and if an argument is necessary to prove this proposition, it may be drawn from this principle, viz. whatever renders the profit upon trade precarious or uncertain, is a loss to trade in general; this loss is the consequence of high exchange; and although a profit does result from it upon one branch of trade, the exchange business, yet that cannot compensate the loss upon every other.

We may, therefore, here repeat what we have said above, that the more difficulty is found in paying a balance, the greater is the loss to a nation.

*The Course of Exchange.*

The course of exchange is the current price betwixt two places, which is always fluctuating and unsettled, being sometimes above, and sometimes below par, according to the circumstances of trade.

When the course of exchange rises above par, the country where it rises may conclude for certain that the balance of trade runs against them. The truth of this will appear, if we suppose Britain to import from any foreign place goods to the value of 100,000l. at par, and export only to the value of 80,000l. In this case, bills on the said foreign place will be scarce in Britain, and consequently will rise in value; and after the 80,000l. is paid, bills must be procured from other places at a high rate to pay the remainder, so that perhaps 120,000l. may be paid for bills to discharge a debt of 100,000l.

Though the course of exchange be in a perpetual flux, and rises or falls according to the circumstances of trade; yet the exchanges of London, Holland, Hamburgh, and Venice, in a great measure regulate those of all other places in Europe.

I. *Exchange with Holland.*

## MONEY TABLE.

| | | *Par in Sterling.* | | s. | d. |
|---|---|---|---|---|---|
| 8 Pennings, or 2 duytes, | make | 1 great or penny | = | 0 | 0.54 |
| 2 Groats, or 16 pennings, | | 1 stiver | = | 0 | 1.09 |
| 6 Stivers, or 12 pence, | | 1 schilling | = | 0 | 6.56 |
| 20 Schillings, | | 1 pound Flemish | = | 10 | 11.18 |
| 20 Stivers, or 40 pence, | | 1 guilder or florin | = | 1 | 9.86 |
| 6 Guilders, or florins, | | 1 pound Flemish | = | 10 | 11.18 |
| $2\frac{1}{2}$ Guilders or florins, | | 1 rix dollar | = | 4 | 6.66 |

In Holland there are two sorts of money, bank and current. The bank is reckoned good security; demands on the bank are readily answered; and hence bank money is generally rated from 3 to 6 *per cent.* better than the current. The difference between the bank and current money is called the *agio*.

Bills on Holland are always drawn in bank money; and if accounts be sent over from Holland to Britain in current money, the British merchant pays these accounts by bills, and in this case has the benefit of the agio.

**Prob. I.** *To reduce bank money to current money.*

**Rule.** As 100 to 100+agio, so the given guilders to the answer.

**Examp.** What will 2210 guilders in bank money amount to in Holland currency, the agio being $3\frac{1}{8}$ *per cent.*?

```
                   Guild.
As 100 : 103⅛ :: 2210
     8      8      825
   ---    ---     ----
   800    825    11050
                 4420
                17680
            --------- Guild. st. pen.
     8|00)18232|50(2279    1    4 cur.
           16... 20
           ---   ---
            22 10|00(
            16  8
            --  --
            63 . 2
            56 16
            -- --
            72 32
            72 32
```

Or, by practice.

```
.50)2210
      44.2   = 2 per cent.
      22.1   = 1 per cent.
      2.7625 = ⅛ per cent.
   ---------
   2279.0625
```

If the agio only be required, make the agio the middle term, thus:

*Guil. st. pen.*

As 100 : $3\frac{1}{8}$ :: 2210 : 69 1 4 agio. Or work by practice as above.

**Prob. II.** *To reduce current money to bank money.*

**Rule.** As 100+agio to 100, so the given guilders to the answer.

**Example.** What will 2279 guilders 1 stiver 4 pennings Holland currency, amount to in bank money, the agio being $3\frac{1}{8}$ *per cent*?

```
        Guild.  Guild.   Guild. st. pen.
As 103⅛ : 100 :: 2279   1    4
      8      8         20
   ------b-----   -------
     825    800     45581
      20               16
   ------          ------
   16500           273490
   16               45581
   ------          ------
     990           729300
    165               800
   ------        --------
  8)264|000     8)583440|000
   3)33          3)72930 Guild.
     11          11)24310(2210 bank.
```

At

At Amsterdam, Rotterdam, Middleburgh, &c. books and accounts are kept by some in guilders, stivers, and pennings, and by others in pounds, shillings, and pence Flemish.

Britain gives 1l. sterling for an uncertain number of shillings and pence Flemish. The par 1l. sterling for 36.59s. Flemish; that is, 1l. 16s. 7.08d. Flemish.

When the Flemish rate rises above par, Britain gains and Holland loses by the exchange, and *vice versa*.

Sterling money is changed into Flemish, by saying,
As 1l. sterling to the given rate,
So is the given sterling to the Flemish sought.
Or, the Flemish money may be cast up by practice.

Dutch money, whether pounds, shillings, pence Flemish, or guilders, stivers, pennings, may be changed into sterling, by saying,
As the given rate to 1l. sterling,
So the given Dutch to the sterling sought.

**Example I.** A merchant in Britain draws on Amsterdam for 782l. sterling: How many pounds Flemish, and how many guilders, will that amount to, exchange at 34s. 8d. per pound sterling?

```
   L.  s.  d.  L.      |          Decimally.
If 1 : 34   8 :: 782   |       L.    s.     L.
       12              |   If  1 : 34.6 :: 782
      ----             |           782
       416             |          ----
       782             |          693
      ----             |        27733
       832             |       242066
      3328             |      --------
     2912              |    2|0)2710|9.3
    ------             |      --------
  12)325312            |    L. 1355 9 4 Flem.
    -------d.          |
  2|0)2710|9 4         |
   L. 1355 9 4 Flem.   |
```

```
     By practice.              |       Or thus:
            | L.   s.  d.      |             | L.    s.   d.
            | 782              |             | 782
   10s.=1/2 | 391              |  14s.=7/10  | 547   8
    4s.=1/5 | 156  8           |   8d.=1/30  |  26   1    4
    8d.=1/6 |  26  1   4       |             |-------------
            |-----------       |             |1355   9    4 Fl.
            |1355  9   4 Fl.   |
```

Multiply the Flemish pounds and shillings by 6, and the product will be guilders and stivers; and if there be any pence, multiply them by 8 for pennings: or, divide the Flemish pence by 40, and the quot will be guilders, and the half of the remainder, if there be any, will be stivers, and one penny odd will be half a stiver, or 8 pennings, as follows:

```
    L.    s.  d.                  Flem. pence.
   1355   9   4               4|0)32531|2(32 rem.
          6
  -------------               ------------
Guild. 8131  16 stiv.     Guild. 8132    16 stiv.
```

3. Change 591l. 5s. Flemish into sterling money, exchange at 37s. 6d. Flemish *per* l. Sterling.

```
  Flem.  Ster.  Flem.
  s. d.   L.    L.  s.
If 37 6 : 1 :: 591  5
    2            20
   --          ------
 5)75           11825
   --               2
 4)15          ------
   --         5)23650
    3          ------
              5) 4730
               ------
              3)  946
               ------
   L. s. d.       315 1/3
Ans. 314 5 8 Ster.
```

```
               Decimally.
     5) L.     L.    5) L.
If 1.875   :   1  ::  591.25
  -------             ------
 5) .375            5)118.25
 5) .075            5) 23.65
    .015       .015)  4.73(313.3
                      45
                      --
                       23
                       15
                       --
                       80
                       75
                       --
                        50
                        45
                        --
                        *5
```

Holland exchanges with other nations as follows, viz. with

| | | Flem. d. |
|---|---|---|
| Hamburgh, on the dollar, | = | $66\frac{2}{3}$ |
| France, on the crown, | = | 54 |
| Spain, on the ducat, | = | $109\frac{4}{7}$ |
| Portugal, on the crusade, | = | 50 |
| Venice, on the ducat, | = | 93 |
| Genoa, on the pezzo, | = | 100 |
| Leghorn, on the piastre, | = | 100 |
| Florence, on the crown, | = | 120 |
| Naples, on the ducat, | = | $74\frac{2}{7}$ |
| Rome, on the crown, | = | 136 |
| Milan, on the ducat, | = | 102 |
| Bologua, on the dollar, | = | $94\frac{4}{5}$ |

Exchange between Britain and Antwerp, as also the Austrian Netherlands, is negotiated the same way as with Holland; only the par is somewhat different, as will be described in article 2d following.

## II. *Exchange with Hamburgh.*

### Money Table.

| | | | Par in Sterling. | | s | d. |
|---|---|---|---|---|---|---|
| 12 | Phenning | make | 1 schilling-lub | = | 0 | $1\frac{1}{8}$ |
| 16 | Schilling-lubs | | 1 mark | = | 1 | 6 |
| 2 | Marks | | 1 dollar | = | 3 | 0 |
| 3 | Marks | | 1 rixdollar | = | 4 | 6 |
| $6\frac{1}{4}$ | Marks | | 1 ducat | = | 9 | $4\frac{1}{2}$ |

Books

Books and accounts are kept at the bank, and by most people in the city, in marks, schilling-lubs, and phennings; but some keep them in pounds, schillings, and groots Flemish.

The agio at Hamburgh runs between 20 and 40 per cent. All bills are paid in bank money.

Hamburgh exchabges with Britain by giving an uncertain number of schillings and groots Flemish for the pound sterling. The groot or penny Flemish here, as also at Antwerp, is worth $\frac{54}{96}$ of a penny sterling; and is something better than in Holland, where it is only $\frac{54}{100}$d. sterling.

| | | | *Flemish.* |
|---|---|---|---|
| 6 | Phennings | makes | 1 groot or penny |
| 6 | Schilling-lubs | | 1 schilling |
| 1 | Schilling-lub | | 2 pence or groots |
| 1 | Mark | | 32 pence or groots |
| $7\frac{1}{2}$ | Marks | | 1 pound. |

The par with Hamburgh, and also with Antwerp, is 35s. $6\frac{2}{3}$d. Flemish for 1l. sterling.

EXAMPLES. 1. How many marks must be received at Hamburgh for 300l. sterling, exchange at 35s. 3d. Flemish per l. sterling?

```
   L.  s. d.     L.
If 1 : 35  3 :: 300
       12
      ----
      423
        300
     --------       M. sch.
  32)126900(3965   10
     96...
     ---
     309
     288
     ----
      210
      192
      ---
       180
       160
       ----
        (20)
         16
        ----
        )320
         32
        ----
         (0)
```

Decimally.

```
Flem. s. Marks. Flem. s.
  If 20  :  7.5 :: 35.25
      4  :  1.5 :: 35.25
                    1.5
                  -------
                   17625
                  3525
                 --------
                4)52.875
                ---------
Marks in 1l. sterling     13.21875
                               300
                          ---------
Marks in 300l. sterling   3965.62500
                                 16
                               -----
                               3750
                               625
                          ---------
       Schilling-lubs       10.000
```

2. How much sterling money will a bill of 3965 marks 10 schilling-lubs amount to, exchange at 35s. 3d. Flemish per pound sterling?

```
Fl. s.  d. L.St. Mks.  sch.
If 35   3 : 1 :: 3965  10
   12              32   2
  ----            ----  --
  423             7930  20d.
                 11897
                -------
          423(126900(300l. ster.
              1269
              -----
```

Decimally.

```
       4 : 1.5 :: 35.25
                    1.5
                  ------
                  17625
                  2225
                  ------
               4)52.875(13.21875
   13.21875)3965.62500(300l. ster.
            3965625
```

## III. *Exchange with France.*

### MONEY TABLE.

| | | | | *Par in Ster.* | s. | d. |
|---|---|---|---|---|---|---|
| 12 | Deniers | make | 1 sol | | =0 | $0\frac{19}{80}$ |
| 20 | Sols | | 1 livre | | =0 | $9\frac{1}{4}$ |
| 3 | Livres | | 1 crown | | =2 | $5\frac{1}{2}$ |

At Paris, Rouen, Lyons, &c. books and accounts are kept in livres, sols, and deniers; and the exchauge with Britain is on the crown, or ecu, of 3 livres, or 60 sols Tournois. Britain gives for the crown an uncertain number of pence, commonly between 30 and 34, the par, as mentioned above, being $29\frac{1}{2}$d.

EXAMPLE I. What sterling money must be paid in London to receive in Paris 1978 crowns 25 sols, exchange at $31\frac{5}{8}$d. per crown?

```
 Sols.   d.     Cr.  sols.
If 60 : 31⅝ :: 1978  25
        ----     60
        253  -------
             118705
                253
             -------
             356115
            593525
           237410
        -------------
     6|0)3003236|5 Rem.
        -----------
        8)500539   3
        -----------
        12)62567  11
        ----------
        2|0)521|3  13
        ----------
        L.260 13 11¼ Ans.
```

By Practice.

| d. |  | Cr. | Sols. |  |
|---|---|---|---|---|
|  |  | 1978 | 25, at 31⅝d. |  |
| 30 = ⅛ |  | 247 | 5 | 0 |
| 1½ = 1/20 |  | 12 | 7 | 3 |
| ⅛ = 1/12 |  | 1 | 0 | 7¼ |
| Sols. 20 = ⅓ |  | 0 | 0 | 10½ |
| 5 = ¼ |  | 0 | 0 | 2⅝ |
|  |  | 260 | 13 | 11⅜ |

If you work decimally, say,

*Cr.* *d. Ster.* *Cr.* *d. Ster.*
As 1 : 31.625 :: 1978.416 : 62567.427083.

2. How many French livres will 121 : 18 : 6 sterling amount to, exchange at 32⅞d. per crown?

*d.* *Liv.* *L.* *s.* *d.*
If 32⅞ : 3 :: 121 18 6
8 20
865 — —
24 2438
12
29262
24
117048
58524
*Liv.* *sols.* *den.*
263)702288(2670 5 11 *Ans.*
Rem. (78=5 sols 11 deniers.

### IV. *Exchange with Portugal.*

### Money Table.

|  |  |  | *Par in Ster.* |  | *s.* | *d.* | *f.* |
|---|---|---|---|---|---|---|---|
|  |  |  | 1 ree | = | 0 | 0 | 0.27 |
| 400 rees | make | 1 crusade | = | 2 | 3 |  |  |
| 1000 rees | make | 1 millree | = | 5 | 7½ |  |  |

In Lisbon, Oporto, &c. books and accounts are generally kept in rees and millrees; and the millrees are distinguished from the rees by a mark set between them thus, 485 ✢ 372; that is, 485 millrees and 372 rees.

Britain, as well as other nations, exchanges with Portugal on the millree; the par, as in the table, being 67½d. sterling. The course with Britain runs from 63d. to 68d. sterling per millree.

Example 1. How much sterling money will pay a bill of 827 ✢ 160 rees, exchange at 63⅜d. sterling per millree?

*Rees.* *d.* *Rees.*
If 1000 : 63⅜ :: 827.160
8 507
8000 507 579012
413580
*Rem.*
8000)419370.120 2
12)52421 — 5d.
20) 4368 — 8s.
L. 218 8 5¼ *Ans.*

By Practice.

| d. | *Rees.* |
|---|---|
|  | 827.160, at 63⅜d. |
| 60 = ¼ | 206.790 |
| 3 = 1/20 | 10.3395 |
| ¼ = 1/12 | .861625 |
| ⅛ = ½ | .4308125 |
|  | 218.4219375 |

The rees being thousandth-parts of the millrees, are annexed to the integer, and the operation proceeds exactly as in decimals.

2. How many rees of Portugal will 500l. sterling amount to, exchange at 5s. 4⅝d. per millree?

*d.* *Rees.* *L.*
If 64⅝ : 1000 :: 500
8 20
517 8000 10000
12
120000
8000
*Rees.*
517)960000000)1856.866 *Ans.*

### V. *Exchange with Spain.*

### Money Table.

|  |  |  | *Par in Ster.* |  | *s.* | *d.* |
|---|---|---|---|---|---|---|
| 35 mervadies | make | 1 rial | = | 0 | 5⅜ |  |
| 8 rials | make | 1 piastre | = | 3 | 7 |  |
| 375 mervadies | make | 1 ducat | = | 4 | 11¼ |  |

In Madrid, Bilboa, Cadiz, Malaga, Seville, and most of the principal places, books and accounts are kept in piastres, called also *dollars*, rials, and mervadies; and they exchange with Britain generally on the piastre, and sometimes on the ducat. The course runs from 35d. to 45d. sterling for a piastre or dollar of 8 rials.

Examp. 1. London imports from Cadiz goods to the value of 2163 piastres and 4 rials: How much sterling will this amount to, exchange at 38⅜ sterling per piastre?

| d. | *Piast.* | *Rials.* |  |
|---|---|---|---|
|  | 2163 | 4 at 38⅜d. |  |
| 24 = 1/10 | 216 | 6 |  |
| 12 = ½ | 108 | 3 |  |
| 2 = ⅙ | 18 | 0 | 6 |
| ¼ = ⅛ | 2 | 5 | 0¾ |
| ⅛ = ½ | 1 | 2 | 6⅜ |
|  | 345 | 17 | 1⅛ |
|  |  | 1 | 7 3/16 |
| L. | 345 | 18 | 8 5/16 *Ans.* |

| *Rials.* | *d.* |
|---|---|
|  | 38⅜ each. |
| 4 = | 19 3/16 |

2. London remits to Cadiz 345l. 18s. 8 5/16d. How much Spanish money will this amount to, exchange at 38⅜d. sterling per piastre?

If

Exchange.

```
    d.  Piast.   L.   s.  d.
If 38⅜ : 1 :: 345  18  8 1/16
                   20
  307        ----       614)1328389(2163 piastres.
    2        6918           1228 ···
  ---          12           ----
  614        ------          1003
             83024            614
                16           ----
             ------           3898
             498149           3684
              83024           ----
             ------            2149
Carried up 1328389             1842
                               ----
                                307
                                  8
                               ----
  Piast. Rials.           614)2456(4 rials.
                              2456
```

### VI. *Exchange with Venice.*

MONEY TABLE.

5⅙ Soldi } make { 1 gros
24 Gros } { 1 ducat = 50¼d. sterling.

The money of Venice is of three sorts, viz. two of bank money and the picoli money. One of the banks deals in banco money, and the other in banco current. The bank money is 20 per cent. better than the banco current, and the banco current 20 per cent. better than the picoli money. Exchanges are always negotiated by the ducat banco, the par being 4s. 2¼d. sterling, as in the table.

Though the ducat be commonly divided into 24 gros, yet bankers and negotiators, for facility of computation, usually divide it as follows, and keep their books and accounts accordingly.

12 Deniers d'or } make { 1 sol d'or
20 Sols d'or } { 1 ducat = 50¼d. sterling.

The course of exchange is from 45d. to 55d. sterling per ducat.

EXAMP. 1. How much sterling money is equal to 1459 ducats 18 sols 1 denier, bank money of Venice, exchange at 52¾ sterling per ducat?

```
Duc.  d.    Duc. sol. den.                  d.
If 1 : 52¾ :: 1459  18  1              |  52¾ rate.
              52¾          Sols.       |  -----
            ------          10 = 1/2   |  26⅜
              2918           5 = 1/4   |  13 3/16
             7295            2 = 1/10  |   5 2/8
            ------           1 = 1/20  |   2 5/8
         d. 75868      den.  1 = 1/240 |   0 2/8
       1/2 = 729 4/8                     -----
       1/4 = 364 6/8                      47⅝
            ------
             76962 2/8
                47⅝
           -------- Rem.
         12)77010(6d.
           ------
         2|0)641|7(17s.
           ------
         L. 320   17   6 sterling.  Ans.
```

2. How many ducats at Venice are equal to 385l. 12s. 6d. sterling, exchange at 4s. 4d. per ducat?

```
    L.   Duc.  L.
If .216̸ : 1 :: 385.625
         .216̸)385.625
           21 385.625
       ------------- Duc.
       195)347062.5(1779.8  Ans.
           195
           ---
           1520
           1365
           ----
            1556
            1365
            ----
             1912
             1755
             ----
              1575
              1560
              ----
              (15)
```

Bank money is reduced to current money, by allowing for the agio, as was done in exchange with Holland; viz. say, As 100 to 120, or as 10 to 12, or as 5 to 6, so the given bank money to the current sought. And current money is reduced to bank money by reversing the operation. And in like manner may picoli money be reduced to current or to bank money, and the contrary.

100 ducats banco of Venice.

| | | | |
|---|---|---|---|
| In Leghorn | =73 pezzos | In Lucca | = 77 crowns |
| In Rome | =68½ crowns | In Frankfort | =139½ florins |

### VII. *Exchange with Genoa.*

MONEY TABLE.

12 Denari } make { 1 soldi *s. d.*
20 Soldi } { 1 pezzo = 4 6 sterling.

Books and accounts are generally kept in pezzos, soldi, and denari; but some keep them in livres, soldi, and denari; and 12 such denari make 1 soldi, and 20 soldi make 1 lire.

The pezzo of exchange is equal to 5¾ lires; and, consequently exchange money is 5¾ times better than the lire money. The course of exchange runs from 47d. to 58d. sterling per pezzo.

EXAMP. How much sterling money is equivalent to 3390 pezzos 16 soldi of Genoa, exchange at 51⅞d. sterling per pezzo?

```
Sold.   d.    Pez. soldi.
If 20 : 51⅞ :: 3390  16
    8  ----         20
  ---   415   ------
  160          67816
                 415
              ------
              339080
              67816
             271264
      ------------- d.            L.  s.  d.
160)28143640(175897½ = 732  18  1½
```

If

If sterling money be given, it may be reduced or changed into pezzos of Genoa, by reversing the former operation.

Exchange money is reduced to lire money, by being multiplied by $5\frac{3}{4}$, as follows:

| | *Pez.* | *soldi.* | Decimally. |
|---|---|---|---|
| | 3390 | 16 | 3390.8 |
| | | $5\frac{3}{4}$ | 5.75 |
| | 16054 | 0 | 169540 |
| $\frac{1}{2}$= | 1695 | 8 | 237356 |
| $\frac{1}{4}$= | 847 | 14 | 169540 |
| Lires | 19497 | 2 | Lires 19497.100 |

And lire money is reduced to exchange money by dividing it by $5\frac{3}{4}$:

| | | |
|---|---|---|
| In Milan, 1 crown | = | 80 |
| In Naples, 1 ducat | = | 86 |
| In Leghorn, 1 piastre | = | 20 |
| In Sicily, 1 crown | = | $127\frac{1}{9}$ |

### VIII. *Exchange with Leghorn.*

MONEY TABLE.

| | | | *s.* | *d. Ster.* |
|---|---|---|---|---|
| 12 Denari | make | 1 soldi | | |
| 20 Soldi | make | 1 piastre = | 4 | 6 |

Books and accounts are kept in piastres, soldi, and denari. The piastre here consists of 6 lires, and the lire contains 20 soldi, and the soldi 12 denari; and consequently exchange money is 6 times better than lire money. The course of exchange is from 48d. to 58d. sterling per piastre.

EXAMPLE. What is the sterling value of 731 piastres at $55\frac{1}{2}$d each?

| *s.* | *d.* | | 731 piastres, at $55\frac{1}{2}$d. | | |
|---|---|---|---|---|---|
| 4 or | 48 | = $\frac{1}{5}$ | 146 | 4 | |
| | 6 | = $\frac{1}{8}$ | 18 | 5 | 6 |
| | $1\frac{1}{2}$ | = $\frac{1}{4}$ | 4 | 11 | $4\frac{1}{2}$ |
| | | | L. 169 | 0 | $10\frac{1}{2}$ *Ans.* |

Sterling money is reduced to money of Leghorn, by reversing the former operation; and exchange money is reduced to lire money by multiplying by 6, and lire money to exchange money by dividing by 6.

100 piastres of Leghorn are

In Naples = 134 ducats | In Geneva = $185\frac{1}{5}$ crowns.

*Soldi of Leghorn.*

| | | |
|---|---|---|
| In Sicily, 1 crown | = | $133\frac{1}{3}$ |
| In Sardinia, 1 dollar | = | $95\frac{5}{8}$ |

The above are the chief places in Europe with which Britain exchanges directly; the exchanges with other places are generally made by bills on Hamburgh, Holland, or Venice. We shall here, however, subjoin the par of exchange betwixt Britain and most of the other places in Europe with which she has any commercial intercourse.

| | *Par in Sterling.* | | | *L.* | *s.* | *d.* |
|---|---|---|---|---|---|---|
| Rome, | 1 | crown | = | 0 | 6 | $1\frac{2}{3}$ |
| Naples, | 1 | ducat | = | 0 | 3 | $4\frac{1}{2}$ |
| Florence, | 1 | crown | = | 0 | 5 | $4\frac{5}{8}$ |
| Milan, | 1 | ducat | = | 0 | 4 | 7 |
| Bologna, | 1 | dollar | = | 0 | 4 | 3 |
| Sicily, | 1 | crown | = | 0 | 5 | 0 |
| Vienna, | 1 | rixdollar | = | 0 | 4 | 8 |
| Augsburgh, | 1 | florin | = | 0 | 3 | $1\frac{4}{5}$ |
| Francfort, | 1 | florin | = | 0 | 3 | 0 |
| Bremen, | 1 | rixdollar | = | 0 | 3 | 6 |
| Breslau, | 1 | rixdollar | = | 0 | 3 | 3 |
| Berlin, | 1 | rixdollar | = | 0 | 4 | 0 |
| Stetin, | 1 | mark | = | 0 | 1 | 6 |
| Embden, | 1 | rixdollar | = | 0 | 3 | 6 |
| Bolsenna, | 1 | rixdollar | = | 0 | 3 | 8 |
| Dantzic, | $13\frac{1}{2}$ | florins | = | 1 | 0 | 0 |
| Stockholm, | $34\frac{4}{7}$ | dollars | = | 1 | 0 | 0 |
| Russia, | 1 | ruble | = | 0 | 4 | 5 |
| Turkey, | 1 | asper | = | 0 | 4 | 6 |

The following places, viz. Switzerland, Nuremburgh, Leipsic, Dresden, Osnaburgh, Brunswic, Cologne, Liege, Strasburgh, Cracow, Denmark, Norway, Riga, Revel, Narva, exchange with Britain, when direct exchange is made, upon the rixdollar, the par being 4s. 6d. sterling.

### IX. *Exchange with America and the West Indies.*

In North America and the West Indies, accounts, as in Britain, are kept in pounds, shillings, and pence. In North America they have few coins circulating among them, and on that account have been obliged to substitute a paper currency for a medium of their commerce; which having no intrinsic value, is subjected to many disadvantages, and generally suffers a great discount. In the West Indies coins are more frequent, owing to their commercial intercourse with the Spanish settlements.

Exchange betwixt Britain and America, or the West Indies, may be computed as in the following examples:

1. The neat proceeds of a cargo from Britain to Boston amount to 845l. 17s. 6d. currency: How much is that in sterling money, exchange at 80 per cent.?

| | | | *L.* | *s.* | *d.* |
|---|---|---|---|---|---|
| If 180 : | 100 | | | | |
| 18 : | 10 | | | | |
| 9 : | 5 | :: | 845 | 17 | 6 |
| | | | | | 5 |
| | | | 9)4229 | 7 | 6 |
| | | | *L.* 469 | 18 | $7\frac{1}{3}$ Ster. *Ans.* |

2. Boston remits to Britain a bill of 469l. 18s. $7\frac{1}{3}$d. sterling: How much currency was paid for the bill at Boston, exchange at 80 per cent.?

| | | | *L.* | *s.* | *d.* |
|---|---|---|---|---|---|
| If 100 : | 180 | | | | |
| 5 : | 9 | :: | 469 | 18 | $7\frac{1}{3}$ |
| | | | | | 9 |
| | | | 5)4229 | 7 | 6 |
| | | | 845 | 17 | 6 currency. *Ans.* |

3. How much sterling money will 1780l. Jamaica currency amount to, exchange at 40 per cent.?

If

If 140 : 100
14 : 10 *L.*
7 : 5 :: 1780
5
7)8900
*s.* *d.*
127*l.* 8 6¼ Ster. *Ans.*

Bills of exchange from America, the rate being high, is an expensive way of remitting money to Britain; and therefore merchants in Britain generally choose to have the debts due to them remitted home in sugar, rum, or other produce.

### X. *Exchange with Ireland.*

At Dublin, and all over Ireland, books and accounts are kept in pounds, shillings, and pence, as in Britain; and they exchange on the 100l. sterling.

The par of one shilling sterling is one shilling and one penny Irish; and so the par of 100l. sterling is 108l. 6s. 8d. Irish. The course of exchange runs from 6 to 15 per cent.

Examp. 1. London remits to Dublin 586l. 10s. sterling: How much Irish money will that amount to, exchange at 9⅝ per cent.

*L.*
If 100 : 109⅝ :: 586.5
8 877
800 : 877 41055
41055
46920
800)514360.5
642.950625

*Ans.* 642l. 19s. Irish.

By practice.

| | 586.5 |
|---|---|
| p. cent. | |
| 10 = $\frac{1}{10}$ | 58.65 |
| 2 = $\frac{1}{5}$ | 11.75 sub. |
| 8 = | 46.92 |
| 1 = $\frac{1}{8}$ | 5.865 |
| $\frac{4}{8}$ = $\frac{1}{2}$ | 2.9325 |
| $\frac{1}{8}$ = $\frac{1}{4}$ | .733125 |
| 9⅝ | 56.450625 add. |
| | 642.950625 |

2. How much sterling will 625l. Irish amount to, exchange at 10⅜ per cent.?

If 110⅜ : 100 :: 625
8 800
*L.* *s.* *d.*
883 800 883)500000(566 5 0¼ Ster. *Ans.*

### XI. *Exchange betwixt London and other places in Britain.*

The several towns in Britain exchange with London for a small premium in favour of London; such as 1, 1½, &c. per cent. The premium is more or less, according to the demand for bills.

Examp. Edinburgh draws on London for 860l. exchange at 1⅜ per cent.: How much money must be paid at Edinburgh for the bill?

| | *L.* | | |
|---|---|---|---|
| | 860 | | |
| per cent. | | | |
| 1 = $\frac{1}{100}$ | 8 | 12 | |
| $\frac{1}{4}$ = $\frac{1}{4}$ | 2 | 3 | |
| $\frac{1}{8}$ = $\frac{1}{2}$ | 1 | 1 | 6 |
| | 11 | 16 | 6 premium. |
| | 871 | 16 | 6 paid for the bill. |

To avoid paying the premium, it is an usual practice to take the bill payable at London a certain number of days after date: and in this way of doing, 73 days is equivalent to 1 per cent.

### XII. *Arbitration of Exchanges.*

The course of exchange betwixt nation and nation naturally rises or falls according as the circumstances and balance of trade happen to vary. Now, to draw upon and remit to foreign places, in this fluctuating state of exchange, in the way that will turn out most profitable, is the design of arbitration. Which is either simple or compound.

#### I. *Simple Arbitration.*

In simple arbitration the rates or prices of exchange from one place to other two are given; whereby is found the correspondent price between the said two places, called the *arbitrated price*, or *par of arbitration*; and hence is derived a method of drawing and remitting to the best advantage.

Examp. 1. If exchange from London to Amsterdam be 33s. 9d. per pound sterling; and if exchange from London to Paris be 32d. per crown; what must be the rate of exchange from Amsterdam to Paris, in order to be put on a par with the other two?

*Ster.* *Flem.* *Ster.*
*s.* *s.* *d.* *d.*
If 20 : 33 9 :: 32
12 12
230 405
32
810
1215
240)12960(54d. Flem. per crown. *Ans.*

2. If exchange from Paris to London be 32d. sterling per crown; and if exchange from Paris to Amsterdam be 54d. Flemish per crown: what must be the rate of exchange between London and Amsterdam, in order to be on a par with the other two?

If

*Ster. Flem. Ster.*
*d. d. d.*
If 32 : 54 :: 240
240

216
108

12 *s. d.*
32)12960(405(33 9 Flem. per. l. Ster. *Ans.*

From these operations it appears, that if any sum of money be remitted, at the rates of exchange mentioned, from any one of the three places to the second, and from the second to the third, and again from the third to the first, the sum so remitted will come home entire, without increase or diminution.

From the par of arbitration thus found, and the course of exchange given, is deduced a method of drawing and remitting to advantage, as in the following example.

3. If exchange from London to Paris be 32d. sterling per crown, and to Amsterdam 405d. Flemish per pound sterling: and if, by advice from Holland to France, the course of exchange between Paris and Amsterdam is fallen to 52d. Flemish per crown; what may be gained per cent. by drawing on Paris, and remitting to Amsterdam?

The par of arbitration between Paris and Amsterdam in this case by Ex. 1. is 54d. Flemish per crown. Work as under.

*d. St. Cr. L. St. Cr.*
If 32 : 1 :: 100 : 750 debit at Paris.
*Cr. d.Fl. C. d.Fl.*
If 1 : 52 :: 750 : 39000 credit at Amsterdam.
*d.Fl. L.St. d.Fl. L. s. d. Ster.*
If 405 : 1 :: 39000 : 96 5 $11\frac{1}{9}$ to be remitted.
100

3 14 $0\frac{8}{9}$

But if the course of exchange between Paris and Amsterdam, instead of falling below, rise above the par of arbitration, suppose to 56d. Flemish per crown; in this case if you propose to gain by the negotiation, you must draw on Amsterdam, and remit to Paris. The computation follows:

*L.St. d.Fl. L.St. d.Fl.*
If 1 : 405 :: 100 : 40500 debit at Amsterdam.
*d.Fl. Cr. d.Fl. Cr.*
If 56 : 1 :: 40500 : $723\frac{3}{14}$ credit at Paris.
*Cr. d.St. Cr. L. s. d. Ster.*
If 1 : 32 : $723\frac{3}{14}$ :: 96 8 $6\frac{6}{7}$ to be remitted.
100

3 11 $5\frac{1}{7}$ gained per cent.

In negotiations of this sort, a sum for remittance is afforded out of the sum you receive for the draught; and your credit at the one foreign place pays your debt at the other.

## II. *Compound Arbitration.*

In compound arbitration the rate or price of exchange between three, four, or more places, is given, in order to find how much a remittance passing through them all will amount to at the last place; or to find the arbitrated price, or par of arbitration, between the first place and the last. And this may be done by the following

RULES. I. Distinguish the given rates or prices into antecedents and consequents; place the antecedents in one column, and the consequents in another on the right, fronting one another by way of equation.

II. The first antecedent, and the last consequent to which an antecedent is required, must always be of the same kind.

III. The second antecedent must be of the same kind with the first consequent, and the third antecedent of the same kind with the second consequent, &c.

IV. If to any of the numbers a fraction be annexed, both the antecedent and its consequent must be multiplied into the denominator.

V. To facilitate the operation, terms that happen to be equal or the same in both columns, may be dropped or rejected, and other terms may be abridged.

VI. Multiply the antecedent continually for a divisor, and the consequents continually for a dividend, and the quot will be the answer or antecedent required.

EXAMP. 1. If London remit 1000l. sterling to Spain, by way of Holland, at 35s. Flemish per pound sterling; thence to France, at 58d. Flemish per crown; thence to Venice, at 100 crowns per 60 ducats; and thence to Spain, at 360 mervadies per ducat: how many piastres, of 272 mervadies, will the 1000l. sterling amount to in Spain?

| *Antecedents.* | | *Consequents.* | *Abridged.* |
|---|---|---|---|
| 1l. Sterling | = | 35s. or 420d. Fl. | 1 = 210 |
| 58d. Flemish | = | 1 crown France | 29 = 31 |
| 100 crowns France | = | 60 ducats Venice | 1 = 0 |
| 1 ducat Venice | = | 360 mervadies Spain | 1 = 45 |
| 272 mervadies | = | 1 piastre | 17 = 1 |
| How many piastres | = | 1000 sterling | = 10 |

In order to abridge the terms, divide 58 and 420 by 2, and you have the new antecedent 29, and the new consequent 210; reject two ciphers in 100 and 1000; divide 272 and 360 by 8, and you have 34 and 45: divide 34 and 60 by 2, and you have 17 and 30; and the whole will stand abridged as above.

Then, $29 \times 17 = 493$ divisor; and $210 \times 30 \times 45 + 10 = 2835000$ dividend; and, 493) 2835000($5750\frac{1}{2}$ piastres. *Ans.*

Or, the consequents may be connected with the sign of multiplication, and placed over a line by way of numerator; and the antecedent, connected in the same manner, may be placed under the line, by way of denominator; and then abridged as follows:

$$\frac{420 \times 60 \times 360 \times 100}{58 \times 100 \times 272} = \frac{210 \times 60 \times 360 \times 10}{29 \times 1 \times 272}$$

$$= \frac{210 \times 60 \times 45 \times 10}{29 \times 34} = \frac{210 \times 30 \times 45 \times 10}{29 \times 17}$$

$$= \frac{2835000}{493},$$

And, 493)2835000($5750\frac{1}{2}$ piastres. *Ans.*

The placing the terms by way of antecedent and consequent,

sequent working as the rules direct, saves so many statings of the rule of three, and greatly shortens the operation. The proportions at large for the above question would be stated as under.

| | | | | | | |
|---|---|---|---|---|---|---|
| | *L. St.* | | *d. Fl.* | | *L. St.* | *d. Fl.* |
| If | 1 | : | 420 | :: | 1000 | : 420000 |
| | *d. Fl.* | | *Cr.* | | *d. F.* | *Cr.* |
| If | 58 | : | 1 | :: | 420000 | : $7241\frac{11}{29}$ |
| | *Cr.* | | *Duc.* | | *Cr.* | *Duc.* |
| If | 100 | : | 60 | :: | $7241\frac{11}{29}$ | : $4344\frac{24}{29}$ |
| | *Duc.* | | *Mer.* | | *Duc.* | *Mer.* |
| If | 1 | : | 360 | :: | $4344\frac{24}{29}$ | : $1564137\frac{27}{29}$ |
| | *Mer.* | | *Piast.* | | *Mer.* | *Piast.* |
| If | 272 | : | 1 | :: | $1564137\frac{27}{29}$ | : $5750\frac{256}{493}$ |

If we suppose the course of direct exchange in Spain to be $42\frac{1}{2}$d. sterling per piastre, the 1000l. remitted would only amount to $5647\frac{1}{17}$ piastres; and, consequently 103 piastres are gained by the negotiation; that is, about 2 per cent.

1. A banker in Amsterdam remits to London 400l. Flemish; first to France at 56d. Flemish per crown; from France to Venice, at 100 crowns per 60 ducats; from Venice to Hamburgh, at 100d. Flemish per ducat; from Hamburgh to Lisbon, at 50d. Flemish per crusade of 400 rees; and, lastly, from Lisbon to London at 64d. sterling per millree: How much sterling money will the remittance amount to; and how much will be gained or saved, supposing the direct exchange from Holland to London at 36s. 10d. Flemish per pound sterling?

| *Antecedents.* | | *Consequents.* |
|---|---|---|
| 36d. Flem. | = | 1 crown. |
| 100 crowns | = | 60 ducats. |
| 1 ducat | = | 100d. Flem. |
| 50d. Flem. | = | 400 rees. |
| 1000 rees | = | 64d. sterling. |
| How many d. ster. | = | 400l. or 96000d. Flemish? |

This, in the fractional form, will stand as follows.

$$\frac{60\times100\times400\times64\times96000}{65\times100\times50\times1000}=\frac{368640}{7}, \text{ and}$$

7)368640($52662\frac{6}{7}$d. ster.=219l. 8s. $6\frac{6}{7}$d. ster. *Ans.*

To find how much the exchange from Amsterdam directly to London, at 36s. 10d. Flemish per l. sterling, will amount to, say,

| *s.* | *d.* | | *d. Fl.* | | *L. St.* | | *d. Fl.* | | *L.* | *s.* | *d. St.* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 36 | 10 | If | 442 | : | 1 | :: | 96000 | : | 217 | 3 | $10\frac{1}{2}$ |
| 12 | | | | | | | | | 219 | 8 | $6\frac{3}{4}$ |
| 442 | | | | | Gained or saved, | | | | 2 | 4 | $8\frac{1}{4}$ |

In the above example, the par of arbitration, or the arbitrated price, between London and Amsterdam, viz. the number of Flemish pence given for 1l. sterling, may be found thus:

Make 64d. sterling, the price of the millree, the first antecedent; then all the former consequents will become antecedents, and all the antecedents will become consequents. Place 240, the pence in 1l. sterling, as the last consequent, and then proceed as taught above, viz.

| *Antecedents.* | | *Consequents.* |
|---|---|---|
| 64d. ster. | = | 100 rees. |
| 400 rees | = | 50d. Flem. |
| 100d. Flem. | = | 1 ducat. |
| 60 ducats | = | 100 crowns. |
| 1 crown | = | 56d. Flem. |
| How many d. Flem. | = | 240 ster.? |

$$\frac{1000\times30\times100\times56\times240}{64\times400\times100\times60}=\frac{875}{2}, \text{ and}$$

2)875($437\frac{1}{2}$d.=36s. $5\frac{1}{2}$d. Flem. per l. ster. *Ans.*

Or the arbitrated price may be found from the answer to the question by saying

$$\begin{array}{llll} & \textit{d. Ster.} & \textit{d. Flem.} & \textit{d. St.} \\ \text{If} & \frac{368640}{7} & :\ 96000\ :: & 240 \\ & & \quad 7 & \\ \hline & & 672000 & \\ & & 240 & \\ \hline & & 2688 & \\ & & 1344 & \end{array}$$

$$\hphantom{368640)161280000(}\ \textit{d.}\qquad \textit{s.}\quad \textit{d. Flem.}$$

368640)161280000($437\frac{1}{2}$=36 $5\frac{1}{2}$ as before.

The work may be proved by the arbitrated price thus: As 1l. sterling to 36s. $5\frac{1}{2}$d. Flemish, so 219l. 8s. $6\frac{6}{7}$d. sterling to 400l. Flemish.

The arbitrated price compared with the direct course shows whether the direct or circular remittance will be most advantageous, and how much. Thus the banker at Amsterdam will think it better exchange to receive 1l. sterling for 36s $5\frac{1}{2}$d. Flemish, than for 36s. 10d. Flemish.

Exchange, signifies also a place in most considerable trading cities, wherein the merchants, negotiants, agents, bankers, brokers, interpreters, and other persons concerned in commerce, meet on certain days, and at certain times thereof, to confer and treat together of matters relating to exchanges, remittances, payments, adventures, assurances, freightments, and other mercantile negotiations, both by sea and land.

In Flanders, Holland, and several cities of France, these places are called *burses;* at Paris and Lyons, *places de change;* and in the Hanse towns, *colleges of merchants.* These assemblies are held with so much exactness, and merchants and negotiants are so indispensably required to attend at them, that a person's absence alone makes him to be suspected of a failure or bankruptcy. The most considerable exchanges in Europe, are that of Amsterdam; and that of London, called the *Royal Exchange.*

Even in the time of the ancient Romans, there were places for the merchants to meet, in most of the considerable cities of the empire. That said by some to have been built at Rome in the year of the city 259, 493 years before our Saviour, under the consulate of Appius Claudius and Publius Servilius, was called *collegium mercatorum;* whereof it is pretended there are still some remains, called by the modern Romans *loggia,* the lodge; and now usually the place of St George. This notion of a Roman exchange is supposed to be founded

founded on the authority of Livy, whose words are as follows: *Certumen consulibus inciderat uter dedicaret Mercurii ædem. Senatus à se rem ad populum rejicit: utri eorum dedicatio jussu populi datu esset, eum præesse annonæ, mercatorum collegium instituere jussit.* Liv. lib. ii. But it must be here remarked, that *collegium* never signified a building for a society in the purer ages of the Latin tongue; so that *collegium mercatorum instituere* must not be rendered to build an exchange for the merchants, but to incorporate the merchants into a company. As Mercury was the god of traffick, this *ædes Mercurii* seems to have been chiefly designed for the devotions of this company or corporation.

Exchange, *Bills of.* The following information concerning the origin of bills of exchange is extracted from Beckmann's History of Inventions.

"I shall not here repeat (says he) what has been collected by many learned men respecting the important history of this noble invention, but only lay before my readers an ordinance of the year 1394, concerning the acceptance of bills of exchange, and also two bills of the year 1404, as they may serve to illustrate farther what has been before said on the subject by others. These documents are, indeed, more modern than those found by Raphael de Turre in the writings of the jurist Baldus, which are dated March the 9th 1328; but they are attended with such circumstances as sufficiently prove that the method of transacting business by bills of exchange was fully established so early as the fourteenth century; and that the present form and terms were even then used. For this important information I am indebted to Mr Von Martens, who found it in a book which, as far as I know, has never been noticed in any literary journal, though it is much more deserving of attention than many others better known. It is a history, written in Spanish, of the maritime trade and other branches of commerce at Barcelona, taken entirely from the archives of that city, and accompanied with documents from the same source, which abound with matter highly interesting (A).

"Among these is an ordinance issued by the city of Barcelona in the year 1394, that bills of exchange should be accepted within twenty-four hours after they were presented; and that the acceptance should be written on the back of the bill.

"In the year 1404, the magistrates of Bruges, in Flanders, requested the magistrates of Barcelona to inform them what was the common practice, in regard to bills of exchange, when the person who presented a bill raised money on it in an unusual manner, in the case of its not being paid, and by these means increased the expences so much that the drawer would not consent to sustain the loss. The bill which gave occasion to this question is inserted in the memorial. It is written in the short form still used; which certainly seems to imply great antiquity. It speaks of usance; and it appears that first and second bills were at that time drawn, and that when bills were not accepted, it was customary to protest them.'

"As this article is of great importance I shall here transcribe it, from vol. ii. p. 203: "Cum de mensibus Aprilis et Maii ultimo elapsis Antonius Quarti, mercator Lucanus residens in villa Brugensi, a Joanne Colom, mercatore civitatis Barchinonæ, etiam residente in prædicta villa Brugensi, duo millia scutorum Philippi, quolibet scuto pro xxii grossis computato, solvendi per Franciscum de Prato mercatorem Florentiæ, more solito, in Barchinona, mediatim Petro Gilberto et Petro Olivo, et mediatim Petro Scorp, et supradicto Petro Gilberto, mercatoribus Cardonæ: prout de dictis cambiis apparet quatuor litteris papireis, quarum tenores subsequuntur.

"Superscriptio autem primæ litteræ fuit talis: *Franc. do Prato et comp. à Barselona.* Tenor vero ejusdem ad intra fuit. talis: *Al nome di Dio, Amen, à di* xxviii. *Aprile* 1404. *Pagate per questa prima di camb. à usanza à Piero Gilberto, è Piero Olivo scuti mille à sold.* x. *Barselonesi per scuto, i quali scuti mille sono per cambio che con Giovani Colombo à grossi* xxii. *di g. scuto: et pag. à nostro conto, et Christo vi guardi.* Subtus vero erat scriptum: *Antonio Quarti Sal de Bruggias.*

"Superscriptio vero secundæ litteræ fuit talis: *Francisco de Prato et comp. à Barselona.* Et ab intra sic habebatur: *Al nome de Dio, Amen. à di* xviii. *di Magio* 1404. *Pagate per questa prima di camp. à usanza à Piero Gilberto et à P. de Scorpo scuti mille de Felippo à sold.* x. *Barselonesi per scuto: i quali scuti mille sono per camb. che con Giov. Colombo à grossi* xxii. *di g. scuto: et pag. à nostro conto: et Christo vi guardi.* Subtus vero erat sic scriptum: *Ant. Quadri Sal de Bruggias**."

Bills of exchange are justly considered as of the greatest importance to the interest of commerce; but several queries have been proposed respecting them, which do not as yet appear to have received a satisfactory solution. It still seems to be a disputed point, whether the law ought to consider them as nothing more than a deposit belonging to the drawer, and successively confided to the remittees; or as property capable of being transferred, and entirely vested in the holder at all times, who should be alone responsible for neglecting it, when its value is vitiated.

Professor Busch of Hamburgh thought that bills of exchange should always be viewed as the exclusive property of the person holding them, which, in a work published

* Vol. iii. p. 460.

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(A) "*Memorias historicas sobre la marina commercio y artes de la antiqua ciudad de Barcelonia, por D. Antonio de Capmany y de Montpalau.* Madrid 1799, 2 vol. 4to. As a proof of what I have said above, I shall mention the following important article, which may be found in this work. A custom-house tariff, written in Latin, of the year 1221, in which occur a great number of remarkable names and articles of merchandise not explained. Another of the like kind in the year 1252. Letters of power to appoint consuls in distant countries, such as Syria, Egypt, &c. dated in the years 1266, 1268, and 1321. An ordinance of the year 1458, respecting insurances, which required that underwriting should be done in the presence of a notary, and declared *polices à scriptures privades* to be null and void. A *privilegium* of the emperor Andronicus II. to the merchants of Barcelona, written in Greek and Spanish, in 1290. Account of the old Spanish trade with wool, silk, salt, and saffron; and of the oldest guilds or incorporated societies of tradesmen at Barcelona," &c.

published in 1792, is defended by a number of plausible arguments. This theory was applied to the difficult and fluctuating case of the holder of a bill which has several indorsements, where the drawer, the drawee, and persons early indorsing it, have all become bankrupts. Should the person holding it under each bankruptcy prove the entire amount of said bill, it is manifest that he must receive much more than he can in justice claim as his due. It seems most equitable that he should be forced to prove his debt against none but his immediate predecessor, the assignees of such predecessor being allowed a similar proof up to the drawer. To such as are in the habit of discounting bills, this becomes a matter of the utmost consequence; for farther information concerning which, see the work of Professor Busch already alluded to, and *Additions to the Theoretical and Practical Delineation of Commerce*, published in 1798 (B). See also the article EXCHANGE in the SUPPLEMENT.

**EXCHEQUER**, in the British jurisprudence, an ancient court of record, in which all causes concerning the revenues and rights of the crown are heard and determined, and where the crown revenues are received. It took this name from the cloth that covered the table of the court, which was party-coloured, or chequered.

This court is said to have been erected by William the Conqueror, its model being taken from a like court established in Normandy long before that time. Anciently its authority was so great, that it was held in the king's palace, and the acts thereof were not to be examined or controlled in any other of the king's courts; but, at present, it is the last of the four courts at Westminster.

In the exchequer, some reckon seven courts, viz. those of pleas, accounts, receipts, exchequer-chamber (which is an assembly of all the judges on difficult matters in law), errors in the exchequer, errors in the king's bench, and, lastly, the court of equity in the exchequer.

But the exchequer, for the dispatch of business, is generally divided into two parts; one of which is chiefly conversant in the judicial hearing and deciding of all causes relating to the king's coffers, formerly termed the *exchequer accounts*: the other is called the *receipt of the exchequer*, as being principally employed in receiving and paying of money.

Officers of the receipt may take one penny in the pound, as their fee, for sums issued out; and they are obliged, without delay, to receive the money brought thither; and the money received is to be put into chests under three different locks and keys, kept by three several officers. All sheriffs, bailiffs, &c. are to account in the exchequer; and in the lower part, termed the receipt, the debtors of the king, and persons in debt to them, the king's tenants, and the officers and ministers of the court, are privileged to sue one another, or any stranger, and to be sued in the like actions as are brought in the court of king's bench and common pleas.

The judicial part of the exchequer, is a court both of law and equity. The court of law is held in the office of pleas, according to the course of common law, before the barons: in this court, the plaintiff ought to be a debtor or accountant to the king; and the leading process is either a writ of subpœna, or *quo minus*, which last goes into Wales, where no process out of courts of law ought to run, except a capias utlagatum.

The court of equity is held in the exchequer chamber, before the treasurer, chancellor, and barons; but generally, before the barons only: the lord chief baron being the chief judge to hear and determine all causes. The proceedings of this part of the exchequer are by English bill and answer, according to the practice of the court of chancery; with this difference, that the plaintiff here must set forth, that he is a debtor to the king, whether he be so or not. It is in this court of equity that the clergy exhibit bills for the recovery of their tithes, &c. Here too the attorney-general exhibits bills for any matters concerning the crown; and a bill may be exhibited against the king's attorney by any person aggrieved in any cause prosecuted against him on behalf of the king, to be relieved therein; in which case the plaintiff is to attend on the attorney general, with a copy of the bill, and procure him to give an answer thereto; in the making of which he may call in any person interested in the cause, or any officer, or others, to instruct him, that the king be not prejudiced thereby; and his answer is to be put in without oath.

But, besides the business relating to debtors, farmers, receivers, accountants, &c. all penal punishments, intrusion, and forfeitures upon popular actions, are matters

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(B) In Vol. III. p. 613. under the article BILL, the old duty on stamps is mentioned, and the new entirely omitted.

The following are the duties on such stamps for the year 1820. The duty on promissory notes for the payment of money to the bearer on demand, for a sum not exceeding 1l. 1s. is 5d. For a sum exceeding 1l. 1s. and not 2l. 2s.; 10d. For a sum exceeding 2l. 2s. and not 5l. 5s.; 1s. 3d. For a sum exceeding 5l. 5s. and not 10l.; 1s. 9d. Which notes may be reissued after payment as often as shall be thought fit.

Bill of exchange, draft, or promissory or other note, payable to the bearer on demand or otherwise, not exceeding 2 months after date, or 60 days after sight, for 40s. and not exceeding 5l. 5s.; 1s.

Bill of exchange, draft, order, or promissory note for the payment of money, where the sum shall exceed 5l. 5s. and not 20l.; 1s. 6d. Exceeding 20l. and not 30l.; 2s. Above 30l. and not 50l.; 2s. 6d. Above 50l. and not 100l.; 3s. 6d. Above 100l. and not 200l.; 4s. 6d. Above 200l. and not 300l.; 5s. Above 300l. and not 500l.; 6s. Above 500l. and not 1000l.; 8s. 6d.

Foreign bills of exchange drawn in sets, where the sum shall not exceed 100l.; for each bill in each set, 1s. 6d. Exceeding 100l. and not 200l.; 3s. Exceeding 200l. and not 500l.; 4s. Exceeding 500l. and not 1000l.; 5s.

ters likewise cognizable by this court; where there also sits a puisne-baron, who administers the oaths to high sheriffs, bailiffs, auditors, receivers, collectors, comptrollers, surveyors, and searchers of all the customs, &c.

The exchequer in Scotland has the same privileges and jurisdiction as that of England; and all matters competent to the one are likewise competent to the other.

*Black Book of the* EXCHEQUER, is a book under the keeping of the two chamberlains of the exchequer; said to have been composed in 1175 by Gervais of Tilbury, nephew of King Henry II. and divided into several chapters. Herein is contained a description of the court of England, as it then stood, its officers, their ranks, privileges, wages, perquisites, power, and jurisdiction; and the revenues of the crown, both in money, grain, and cattle. Here we find, that for one shilling, as much bread might be bought as would serve 100 men a whole day; that the price of a fat bullock was only 12 shillings, and a sheep four, &c.

*Chancellor of the* EXCHEQUER. See CHANCELLOR.

*EXCHEQUER Bills.* By statute 5 Ann. c. 13. the lord treasurers may cause exchequer bills to be made of any sums not exceeding 1,500,000l. for the use of the war; and the duties upon houses were made chargeable with 4l. 10s. per cent. per annum to the bank for circulating them. The bank not paying the bills, actions to be brought against the Company, and the money and damages recovered; and if any exchequer bills be lost, upon affidavit of it before a baron of the exchequer, and certificate from such baron, and security to pay the same if found, duplicates are to be made out: also when bills are defaced, new ones shall be delivered. The king, or his officers in the exchequer, by former statutes, might borrow money upon the credit of bills, payable on demand, with interest after the rate of 3d per diem for every 100l. bill. And by 8 and 9 W. III. c. 20. an interest of 5d. a day was allowed for every 100l. But 12 W. III. c. 1. lowered the interest on these bills to 4d. a-day per cent. And by 12 Ann. c. 11. it is sunk to 2d. a day. Forging exchequer bills, or the indorsements thereof, is felony.

EXCISE, (from the Belgic *acciisse*, tributum, "tribute,") an inland duty or imposition, paid sometimes upon the consumption of the commodity, or frequently upon the wholesale, which is the last stage before the consumption. This is doubtless, impartially speaking, the most economical way of taxing the subject; the charges of levying, collecting, and managing the excise duties, being considerably less in proportion than in other branches of the revenue. It also renders the commodity cheaper to the consumer, than charging it with customs to the same amount would do; for the reason just now given, because generally paid in a much later stage of it. But, at the same time, the rigour and arbitrary proceedings of excise laws seem hardly compatible with the temper of a free nation. For the frauds that might be committed in this branch of the revenue, unless a strict watch is kept, make it necessary, wherever it is established, to give the officers a power of entering and searching the houses of such as deal in exciseable commodities, at any hour of the day, and, in many cases, of the night likewise. And the proceedings, in case of transgressions, are so summary and sudden, that a man may be convicted in two days time in the penalty of many thousand pounds, by two commissioners or justices of the peace; to the total exclusion of the trial by jury, and disregard of the common law. For which reason, though Lord Clarendon tells us, that to his knowledge the earl of Bedford (who was made lord treasurer by King Charles I. to oblige his parliament) intended to have set up the excise in England, yet it never made a part of that unfortunate prince's revenue; being first introduced, on the model of the Dutch prototype, by the parliament itself after its rupture with the crown. Yet such was the opinion of its general unpopularity, that when in 1642 "aspersions were cast by malignant persons upon the house of commons, that they intended to introduce excises, the house for its vindication therein did declare, that these rumours were false and scandalous, and that their authors should be apprehended and brought to condign punishment." Its original establishment was in 1643, and its progress was gradual; being at first laid upon those persons and commodities where it was supposed the hardship would be least perceivable, viz. the makers and venders of beer, ale, cyder, and perry; and the royalists at Oxford soon followed the example of their brethren at Westminster, by imposing a similar duty: both sides protesting that it should be continued no longer than to the end of the war, and then be utterly abolished. But the parliament at Westminster soon after imposed it on flesh, wine, tobacco, sugar, and such a multitude of other commodities, that it might be fairly denominated *general:* in pursuance of the plan laid down by Mr Pymme (who seems to have been the father of the excise), in his letter to Sir John Hotham, signifying, "that they had proceeded in the excise to many particulars, and intended to go on farther; but that it would be necessary to use the people to it by little and little."— And afterwards, when the nation had been accustomed to it for a series of years, the succeeding champions of liberty boldly and openly declared "the impost of excise to be the most easy and indifferent levy that could be laid upon the people;" and accordingly continued it during the whole usurpation. Upon King Charles's return, it having then been long established, and its produce well known, some part of it was given to the crown, in 12 Car. II. by way of purchase for the feudal tenures and other oppressive parts of the hereditary revenue. But, from its first original to the present time, its very name has been odious to the people. It has, nevertheless, been imposed on abundance of other commodities in the reigns of King William III. and every succeeding prince, to support the enormous expences occasioned by our wars on the continent. Thus brandies and other spirits are now excised at the distillery; printed silks and linens, at the printer's; starch and hair powder, at the maker's; gold and silver wire, at the wiredrawer's; all plate whatsoever, first in the hands of the vender, who pays yearly for a license to sell it, and afterwards in the hands of the occupier, who also pays an annual duty for having it in his custody; and coaches and other wheel carriages, for which the occupier is excised; though not with the same circumstances of arbitrary strictness with regard to plate and coaches as in the other instances. To these we may add coffee and tea, chocolate and cocoa paste, for which the duty ty is paid by the retailer; all artificial wines, commonly called *sweets;* paper and pasteboard, first when made, and again, if stained or printed; malt, as before mentioned; vinegars; and the manufacture of glass; for all which the duty is paid by the manufacturer; hops, for which the person that gathers them is answerable; candles and soap, which are paid for at the makers; malt liquors brewed for sale, which are excised at the brewery; cyder and perry at the vender's; leather and skins, at the tanner's; and, lately, tobacco, at the manufacturer's: A list, which no friend to his country would wish to see farther increased.

The excise was formerly farmed out: but is now managed for the king by commissioners in both kingdoms, who receive the whole product of the excise, and pay it into the exchequer. These commissioners are nine in number in England, and five in Scotland. The former have a salary of 1000l. a-year, the latter 600l. They are obliged by oath to take no fee or reward but from the king himself; and from them there lies an appeal to five other commissioners called *commissioners of appeals.*

EXCISION, in *Surgery*, the cutting out, or cutting off, any part of the body.

Excision, in a scripture sense, means the cutting off of a person from his people, by way of punishment for some sin by him committed. The Jews, Selden informs us, reckon 36 crimes, to which they pretend this punishment is due. The Rabbins reckon three kinds of excision; one, which destroys only the body; another, which destroys the soul only; and a third, which destroys both body and soul. The first kind of excision they pretend is an untimely death; the second is an utter extinction of the soul: and the third, a compound of the two former: thus, making the soul mortal or immortal, says Selden, according to the degrees of misbehaviour and wickedness of the people.

EXCLAMATION. See Oratory, N° 85.

EXCLUSION, or *Bill of* Exclusion, a bill proposed about the close of the reign of King Charles II. for excluding the duke of York, the king's brother, from the throne, on account of his being a Papist.

EXCLUSIVE, is sometimes used adjectively, thus: *A patent carries with it an exclusive privilege.* Sometimes adverbially: as, *He sent him all the numbers from* N° 145 to N° 247 *exclusive;* that is, all between these two numbers, which themselves were excepted.

EXCOECARIA, a genus of plants belonging to the diœcia class, and in the natural method ranking under the 38th order, *Tricoccæ*. See Botany *Index*.

EXCOMMUNICATION, an ecclesiastical penalty or censure, whereby such persons as are guilty of any notorious crime or offence, are separated from the communion of the church, and deprived of all spiritual advantages.

Excommunication is founded on a natural right which all societies have, of excluding out of their body such as violate the laws thereof; and it was originally instituted for preserving the purity of the church; but ambitious ecclesiastics converted it by degrees into an engine for promoting their own power, and inflicted it on the most frivolous occasions.

The power of excommunication, as well as other acts of ecclesiastical discipline, was lodged in the hands of the clergy, who distinguished it into the *greater* and *lesser*. The lesser excommunication, simply called *aphorismos*, "separation or suspension," consisted in excluding men from the participation of the eucharist, and the prayers of the faithful. But they were not expelled the church; for they had the privilege of being present at the reading of the Scriptures, the sermons, and the prayers of the catechumens and penitents. This excommunication was inflicted for lesser crimes; such as neglecting to attend the service of the church, misbehaviour in it, and the like.

The greater excommunication, called *panteles aphorismos*, "total separation and anathema," consisted in an absolute and entire exclusion from the church and the participation of all its rites. When any person was thus excommunicated, notice of it was given by circular letters to the most eminent churches over all the world, that they might all confirm this act of discipline, by refusing to admit the delinquent to their communion. The consequences of this latter excommunication were very terrible. The excommunicated person was avoided in civil commerce and outward conversation. No one was to receive him into his house, nor eat at the same table with him; and when dead, he was denied the solemn rites of burial.

The Romish pontifical takes notice of three kinds of excommunication. 1. The minor, incurred by those who have any correspondence with an excommunicated person. 2. The major, which falls upon those who disobey the commands of the holy see, or refuse to submit to certain points of discipline; in consequence of which they are excluded from the church militant and triumphant, and delivered over to the devil and his angels. 3. Anathema, which is properly that pronounced by the pope against heretical princes and countries. In former ages, these papal fulminations were most terrible things; but at present, they are formidable to none but a few petty states of Italy.

Excommunication, in the Greek church, cuts off the offender from all communion with the 318 fathers of the first council of Nice, and with the saints; consigns him over to the devil and the traitor Judas; and condemns his body to remain after death as hard as a flint or piece of steel, unless he humbles himself and makes atonement for his sins by a sincere repentance. The form abounds with dreadful imprecations; and the Greeks assert, that if a person dies excommunicated, the devil enter into the lifeless corpse; and therefore, in order to prevent it, the relations of the deceased cut his body in pieces, and boil them in wine. It is a custom for the patriarch of Jerusalem annually to excommunicate the pope and the church of Rome; on which occasion, together with a great deal of idle ceremony, he drives a nail into the ground with a hammer, as a mark of malediction.

The form of excommunication in the church of England anciently ran thus: "By the authority of God the Father Almighty, the Son and Holy Ghost, and of Mary the blessed mother of God, we excommunicate, anathematize, and sequester from the pale of the holy mother church," &c. The causes of excommunication in England are, contempt of the bishop's court, heresy, neglect of public worship and the sacraments, incontinency, adultery, simony, &c. It is described to be twofold. The less is an ecclesiastical censure, excluding the party from the participation of the sacraments: the greater proceeds farther, and excludes him not only from these, but from the company of all Christians. But if the judge of any spiritual court excommunicates a man for a cause of which he hath not the legal cognizance, the party may have an action against him at common law, and he is also liable to be indicted at the suit of the king.

Heavy as the penalty of excommunication is, considered in a serious light, there are, notwithstanding, many obstinate or profligate men, who would despise the *brutum fulmen* of mere ecclesiastical censures, especially when pronounced by a petty surrogate in the country, for railing or contumelious words, for nonpayment of fees or costs, or other trivial cause. The common law, therefore, compassionately steps in to their aid, and kindly lends a supporting hand to an otherwise tottering authority. Imitating herein the policy of the ancient Britons, among whom, according to Cæsar, whoever were interdicted by the druids from their sacrifices, "In numero impiorum ac sceleratorum habentur: ab iis omnes decedunt, aditum eorum sermonemque defugiunt, ne quid ex contagione incommodi accipiant: neque eis petentibus jus redditur, neque honos ullus communicatur." And so with us, by the common law, an excommunicated person is disabled to do any act that is required to be done by one that is *probus et legalis homo*. He cannot serve upon juries; cannot be a witness in any court; and, which is the worst of all, cannot bring an action, either real or personal, to recover lands or money due to him. Nor is this the whole: for if, within 40 days after the sentence has been published in the church, the offender does not submit and abide by the sentence of the spiritual court, the bishop may certify such contempt to the king in chancery. Upon which there issues out a writ to the sheriff of the county, called from the bishop's certificate a *significavit*; or from its effect, a writ *de excommunicato capiendo*: and the sheriff shall thereupon take the offender and imprison him in the county jail, till he is reconciled to the church, and such reconciliation certified by the bishop; upon which another writ *de excommunicato deliberando*, issues out of chancery to deliver and release him.

EXCOMMUNICATION was also practised among the Jews, who used to expel from their synagogue such as had committed any grievous crime. See the Gospel according to St John, ix. 22. xii. 42. xvi. 2. And Joseph. Antiq. Jud. lib. ix. cap. 22. and lib. xvi. cap. 2.

Godwyn, in his *Moses and Aaron*, distinguishes three degrees, or kinds, of excommunication among the Jews. The first he finds intimated in John ix. 22. The second in 1 Cor. v. 5. And the third in 1 Cor. xvi. 22. See NIDDUI.

The rule of the Benedictines gives the name of *excommunication* to the being excluded from the oratory, and the common table of the house; in our inns of court called *discommoning*. This was the punishment of such monks as came too late.

EXCOMMUNICATION, or a being secluded from a participation in the mysteries of religion, was also in use under paganism.

Such as were thus excommunicated were forbidden to assist or attend at the sacrifices, or enter within the temples; and were afterwards delivered over to the demons and furies of hell, with certain imprecations; which was called among the Romans *diris devovere*. See EXECRATION.

The Druids among the ancient Britons and Gauls, likewise, made use of excommunication against rebels; and interdicted the communion of their mysteries to such as refused to acquiesce in their decisions. See DRUIDS.

**EXCORIATION**, in *Medicine* and *Surgery*, the galling or rubbing off the cuticle, especially of the parts between the thighs and about the anus. In adults, it is occasioned by riding, much walking, or other vehement exercise, and may be cured by vulnerary applications. In children there is often an excoriation, not only of the parts near the pudenda, chiefly of the groin and scrotum, but likewise in the wrinkles of the neck, under the arms, and in other places; proceeding from the acrimony of urine and sweat; and occasioning itching pains, crying, watching, restlessness, &c. To remedy this, the parts affected may be often washed with warm water, and sprinkled with drying powders, as chalk, hartshorn, but especially tutty, lapis calaminaris, and ceruss, which may be tied loosely in a rag, and the powder shook out on the parts.

**EXCREMENT**, whatever is discharged out of the body of animals after digestion; or the fibrous part of the aliment, mixed with the bile, saliva, and other fluids. Urine and the feces are the gross excrements that are discharged out of the bladder or belly. Other excrements are the various humours that are secreted from the blood through the different strainers in the body, and which serve for several uses; such as the saliva, sweat, bile, the pancreatic juice, lymph, the semen, nails, the hair, the horns and hoofs of animals.

Alchemists, who have sought everywhere for their *great work*, as they called it, have particularly operated much on the excrements of men and other animals; but philosophical chemistry has acquired no knowledge from all these alchemical labours, from the obscurity with which their authors have described them. The philosophic chemists have not much examined animal excrements. Of these Homberg is the only one who has particularly analyzed and examined human ordure; and this was done to satisfy an alchemical project of one of his friends, who pretended that from this matter a white oil could be obtained, without smell, and capable of fixing mercury into silver. The oil was found by Homberg, but mercury was not fixed by it.

The labours of this able chemist were not, however, useless, like those of the alchemists; because he has clearly related the experiments he made on this matter, in the memoirs of the Academy of Sciences. These experiments are curious, and teach several essential things concerning the nature of excrements. The result of these experiments is as follows: Fresh human feces, being distilled to dryness in a water bath, furnish a clear, watery, insipid liquor, of a disagreeable smell, but which contains no volatile alkali; which is a proof that this matter, although nearly in a putrefactive state, is not however putrefied; for all substances really putrid furnish with this degree of heat a manifest volatile alkali *. The dry residuum of the foregoing experiment, being distilled in a retort with a graduated fire, furnishes a volatile alkaline spirit and salt,

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* See *Putrefaction*.

salt, a fetid oil, and leaves a residuous coal. These are the same substances which are obtained from all animal matters.

Human feces, diluted and lixiviated in water, furnish by filtration and evaporation of the water an oily salt of a nitrous nature, which deflagrates like nitre upon ardent coals, and which inflames in close vessels when heated to a certain degree. The same matter yielded to Homberg, who treated it by a complete fermentation or putrefaction, excited by a digestion during 40 days in a gentle water-bath heat, and who afterwards distilled it, an oil without colour, and without bad smell, and such as he endeavoured to find; but which did not, as we said before, fix mercury into silver.

EXCRESCENCE, in *Surgery*, denotes every preternatural tumour which arises upon the skin, either in the form of a wart or tubercle. If they are born with a person, as they frequently are, they are called *nævi materni*, or marks from the mother; but if the tumour is large, so as to depend from the skin, like a fleshy mass, it is then called a *sarcoma*. See SURGERY.

EXCRETION, or SECRETION, in *Medicine*, a separation of some fluid, mixed with the blood, by means of the glands. Excretions, by which we mean those that evacuate superfluous and heterogeneous humours, purify the mass of blood; the humours which are generated in the blood are excreted by the glands, and are replaced by a sufficient quantity of aliment.

EXCRETORY, in *Anatomy*, a term applied to certain little ducts or vessels, destined for the reception of a fluid, secreted in certain glandules, and other viscera, for the excretion of it in the appropriated places.

EXCUBIÆ, in antiquity, the watches and guards kept in the day by the Roman soldiers. They are contradistinguished from the *vigiliæ* which were kept in the night. The *excubiæ* were placed either at the gates and intrenchments or in the camp; for the latter there was allowed a whole *manipulus* to attend before the *prætorium*, and four soldiers to the tent of every *tribune*. The *excubiæ* at the gates of the camp, and at the entrenchments, were properly called *stationes*. One company of foot and one troop of horse were assigned to each of the four gates every day. To desert their post, or abandon their corps of guards, was an unpardonable crime.

The *triarii*, as the most honourable order of soldiers, were excused from the ordinary watches; yet being placed opposite to the *equites*, they were obliged to have an eye over them.

LETTERS *of* EXCULPATION, in *Scots Law*, a writ or summons issued by authority of the court of justiciary, at the instance of a pannel, for citing witnesses to prove his defences, or his objections to any of the jury or witnesses cited against him.

EXCUSATI, in church history, a term used to denote slaves, who flying to any church for sanctuary, were excused and pardoned by their masters; but these were obliged to take an oath to the purpose before they could have them again; and, if they broke the oath, they were punished and fined as persons guilty of perjury.

EXEAT, in church discipline, a Latin term used for a permission which a bishop grants a priest to go out of his diocese; or an abbot to a religious to go out of his monastery.

EXECRATION, in antiquity, a kind of punishment, consisting of direful curses and marks of infamy: such was that used against Philip king of Macedon by the Athenians. A general assembly of the people being called, they made a decree, that all the statues and images of that king, and of all his ancestors, should be demolished, and their very name razed; that all the festivals, sacred rites, priests, and whatever else had been instituted in honour of him, should be profaned; that the very places where there had been any monument or inscription to his honour, should be detestable; that nothing should be set up, or dedicated in them, which could be done in clean places; and, lastly, that the priests, as often as they prayed for the Athenian people, allies, armies, and fleets, should as many times detest and execrate Philip, his children, kingdom, land and sea forces, and the whole race and name of the Macedonians.

At the taking and demolishing of cities, it was usual among the Jews, Greeks, and Romans, to pronounce curses upon, and load with direful execrations, the rebuilders of them.

EXECUTION, in a general sense, the act of accomplishing, finishing, or achieving any thing.

EXECUTION, in *Law*, the completing or finishing some act, as of judgment, deed, &c. and it usually signifies the obtaining possession of any thing recovered by judgment of law.

Sir Edward Coke observes, that there are two sorts of executions: the one final; and the other a quousque, that tends to an end. An execution final is that which makes money of the defendant's goods, or extends to his land and delivers them to the plaintiff, who accepts the same in satisfaction; and this is the end of the suit, and the whole that the king's writ requires to be done. The writ of execution with a quousque, though it tends to an end, yet is not final, as in the case *capias ad satisfac.* where the defendant's body is to be taken, in order that the plaintiff may be satisfied for his debt. See CAPIAS.

Executions are either in personal, real, or mixed actions. In a personal action, the execution may be made three ways, viz. by the writs of *capias ad satisfaciendam*, against the body of the defendant; *fieri facias*, against his goods; or *elegit*, against his lands. See *FIERI Facias* and ELEGIT.

In a real and mixed action, the execution is by writ of *habere facias sasinam*, and *habere possessionem* *. Writs of execution bind the property of goods only from the time of delivery of the writ to the sheriff; but the land is bound from the day of the judgment obtained: and here the sale of any goods for valuable consideration, after a judgment, and before the execution awarded, will be good. It is otherwise as to lands, of which execution may be made, even on a purchase after the judgment, though the defendant sell such land before execution. Likewise, sheriffs may deliver in all the lands whereof others shall be seized in trust for him against whom execution is had on a judgment, &c.

When any judgment is signed, the execution may be taken out immediately thereon; but if it be not issued within a year and a day after, where there is no fault

fault in the defendant, as in the case of an injunction, writ of error, &c. there must be a *scire facias*, to revive the judgment; though, if the plaintiff sues out any writ of execution within the year, he may continue it after the year is expired. After judgment against the defendant, in an action wherein special bail is given, the plaintiff is at liberty to have execution against such defendant, or against his bail: but this is understood where the defendant does not render himself, according to law, in safeguard of the bail; and execution may not regularly be sued forth against a bail, till a default is returned against the principal: also if the plaintiff takes the bail, he shall never take the principal. It is held that an execution may be executed after the death of the defendant: for his executor, being privy thereto, is liable, as well as the testator. The execution is an entire thing, so that he who begins must end it; therefore, a new sheriff may distrain an old one, to sell the goods seized on a distringas, and to bring the money into court.

**Execution**, in criminal cases, the completion of human punishment. This follows judgment †; and must in all cases, capital as well as otherwise, be performed by the legal officer, the sheriff or his deputy; whose warrant for so doing was anciently by precept under the hand and seal of the judges, as it is still practised in the court of the lord high steward, upon the execution of a peer: though, in the court of the peers in parliament, it is done by writ from the king. Afterwards it was established, that in case of life, the judge may command execution to be done without any writ. And now the usage is, for the judge to sign the kalendar or list of all the prisoners names, with their separate judgments in the margin, which is left with the sheriff. As for a capital felony, it is written opposite to the prisoner's name, "let him be hanged by the neck:" formerly in the days of Latin and abbreviation, "*sus. per. col.*" for "*suspendatur per collum.*" And this is the only warrant that the sheriff has for so material an act as the taking away the life of another. It may certainly afford matter of speculation, that in civil causes there should be such a variety of writs of execution to recover a trifling debt, issued in the king's name, and under the seal of the court, without which the sheriff cannot legally stir one step; and yet that the execution of a man, the most important and terrible task of any, should depend upon a marginal note.

*Blackst. Comment.*

The sheriff, upon receipt of his warrant, is to do execution within a convenient time: which in the country is also left at large. In London, indeed, a more solemn and becoming exactness is used, both as to the warrant of execution and the time of executing thereof: for the recorder, after reporting to the king in person the case of the several prisoners, and receiving his royal pleasure, that the law must take its course, issues his warrant to the sheriffs, directing them to do execution on the day and at the place assigned. And in the court of king's bench, if the prisoner be tried at the bar, or brought there by *habeas corpus*, a rule is made for his execution; either specifying the time and place, or leaving it to the discretion of the sheriff. And, throughout the kingdom, by statute 25 Geo. II. c. 37. it is enacted that, in case of murder, the judge shall in his sentence direct execution to be performed on the next day but one after sentence passed. But, otherwise, the time and place of execution are by law no part of the judgment. It has been well observed, that it is of great importance that the punishment should follow the crime as early as possible; that the prospect of gratification or advantage, which tempts a man to commit the crime, should instantly awake the attendant idea of punishment. Delay of execution serves only to separate these ideas; and then the execution itself affects the minds of the spectators rather as a terrible sight, than as the necessary consequence of transgression.

The sheriff cannot alter the manner of the execution, by substituting one death for another, without being guilty of felony himself. It is held also by Sir Edward Coke and Sir Matthew Hale, that even the king cannot change the punishment of the law, by altering the hanging or burning into beheading; though, when beheading is part of the sentence, the king may remit the rest. And, notwithstanding some examples to the contrary, Sir Edward Coke strongly maintains, that *judicandum est legibus, non exemplis*. But others have thought, and more justly, that this prerogative, being founded in mercy, and immemorially exercised by the crown, is part of the common law. For hitherto, in every instance, all these exchanges have been for more merciful kinds of death; and how far this may also fall within the king's power of granting conditional pardons (viz. by remitting a severe kind of death, on condition that the criminal submits to a milder) is a matter that may bear consideration. It is observable, that when Lord Stafford was executed for the popish plot in the reign of King Charles II. the then sheriffs of London, having received the king's writ for beheading him, petitioned the house of lords, for a command or order from their lordships, how the said judgment should be executed: for, he being prosecuted by impeachment, they entertained a notion (which is said to have been countenanced by Lord Russel), that the king could not pardon any part of the sentence. The lords resolved, that the scruples of the sheriffs were unnecessary; and declared, that the king's writ ought to be obeyed. Disappointed of raising a flame in that assembly, they immediately signified to the house of commons by one of their members, that they were not satisfied as to the powers of the said writ. That house took two days to consider of it; and then sullenly resolved, that the house was *content* that the sheriff do execute Lord Stafford by severing his head from his body. It is farther related, that when afterwards the same Lord Russel was condemned for high treason upon indictment, the king, while he remitted the ignominious part of the sentence, observed, "That his lordship would now find he was possessed of that prerogative, which in the case of Lord Stafford he had denied him." One can hardly determine (at this distance from those turbulent times), which most to disapprove of, the indecent and sanguinary zeal of the subject, or the cool and cruel sarcasm of the sovereign.

To conclude: It is clear, that if, upon judgment to be hanged by the neck till he is dead, the criminal be not thoroughly killed, but revives, the sheriff must hang him again. For the former hanging was no execution of the sentence; and, if a false tenderness were to be indulged in such cases, a multitude of collusions might ensue. Nay, even while abjurations were in force, such

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† See *Judgment*.

a criminal, so reviving, was not allowed to take sanctuary and abjure the realm; but his fleeing to sanctuary was held an escape in the officer.

EXECUTION, in the law of Scotland. See LAW *Index*.

EXECUTION, in the French music, is used to denote the manner of singing, or of the performance of a song. "As to the manner of singing, called in France *execution*, no nation may, with any probability, dispute it with the French. If the French, by their commerce with the Italians, have gained a bolder composition, the Italians have made their advantage of the French, in learning of them a more polite, moving, and exquisite execution." St Evremond.

EXECUTIVE POWER. The supreme executive power of these kingdoms is vested by our laws in a single person, the king or queen for the time being. See the article KING.

The executive power, in this state, hath a right to a negative in parliament, i. e. to refuse assent to any acts offered; otherwise the two other branches of legislative power would, or might, become despotic.

EXECUTOR, a person nominated by a testator, to take care to see his will and testament executed or performed, and his effects disposed of according to the tenor of the will. See LAW.

EXECUTOR, in *Scots Law*, signifies either the person entitled to succeed to the moveable estate of one deceased, or who by law or special appointment is intrusted with the administration of it.

EXECUTORY, in *Law*, is where an estate in fee, that is, made by deed or fine, is to be executed afterwards by entry, livery, or writ. Lease for years, annuities, conditions, &c. are termed *inheritances executory*.

EXECUTRY, in *Scots Law*, is the moveable estate falling to the executor. Under executry, or moveables, is comprehended every thing that moves itself, or can be moved; such as corns, cattle, furniture, ready money, &c.

EXEDRÆ, in antiquity, denoted halls with many seats, where the philosophers, rhetoricians, and men of learning, met for discourse and disputation. The word occurs in ecclesiastical writers as a general name for such buildings as were distinct from the main body of the churches, and yet within the limits of the church taken in its largest sense. Among the exedræ the chief was the BAPTISTERY.

EXEGESIS, a discourse by way of explanation or comment upon any subject. In the Scotch universities, there is an exercise among the students in divinity, called an *exegesis*, in which a question is stated by the respondent, who is then opposed by two or three other students in their turns; during which time the professor moderates, and solves the difficulties which the respondent cannot overcome.

EXEGETES, (formed of ἐξηγεομαι, "I explain,") among the Athenians, persons learned in the laws, whom the judges used to consult in capital causes.

EXEGETICA, in *Algebra*, the art of finding, either in numbers or lines, the roots of the equation of a problem, according as the problem is either numerical or geometrical.

EXEMPLAR, a model, or original, to be imitated or copied. See MODEL.

EXEMPLAR also denotes the idea, or image, conceived or formed in the mind of the artist, whereby he conducts his work. Such is the idea of Cæsar, which a painter has in his mind when he goes to make a picture of Cæsar.

EXEMPLIFICATION *of Letters Patent*, denotes an exemplar, or copy of letters patent, made from the enrolment thereof, and sealed with the great seal of England. Such exemplifications are as effectual to be showed or pleaded, as the letters patent themselves.

EXEMPTION, in *Law*, a privilege to be free from some service of appearance: thus, barons and peers of the realm are, on account of their dignity, exempted from being sworn upon inquests; and knights, clergymen, and others, from appearing at the sheriff's turn. Persons of 70 years of age, apothecaries, &c. are also by law exempted from serving on juries; and justices of the peace, attorneys, &c. from parish offices.

EXERCISE, among physicians, such an agitation of the body as produces salutary effects in the animal economy.

Exercise may be said to be either active or passive. The active is walking, hunting, dancing, playing at bowls, and the like; as also speaking and other labour of the body and mind. The passive is riding in a coach, on horseback, or in any other manner. Exercise may be continued to a beginning of weariness, and ought to be used before dinner in a pure light air; for which reason, journeys, and going into the country, contribute greatly to preserve and re-establish health.

Exercise increases the circulation of the blood, attenuates and divides the fluids, and promotes a regular perspiration, as well as a due secretion of all the humours; for it accelerates the animal spirits, and facilitates their distribution into all the fibres of the body, strengthens the parts, creates an appetite, and helps digestion. Whence it arises, that those who accustom themselves to exercise are generally very robust, and seldom subject to diseases.

Boerhaave recommends bodily exercise in diseases of a weak and lax fibre. By riding on horseback, says his commentator, the pendulous viscera of the abdomen are shaken every moment, and gently rubbed as it were one against another, while in the meantime the pure air acts on the lungs with greater force. But it is to be observed that a weak man should not ride with a full stomach, but either before dinner, or after the digestion is nearly finished; for when the stomach is distended, weak people do not bear these concussions of the horse without difficulty; but when the primæ viæ are nearly empty, the remaining feces are discharged by this concussion Sailing in a ship is also an exercise of great use to weak people. If the vessel moves with an even motion, by increasing perspiration it usually excites a wonderful alacrity, creates an appetite, and promotes digestion. These exercises are more especially serviceable to weak people; but, in order to strengthen the body by muscular motion, running and bodily exercises are to be used. In these we should begin with the most gentle, such as walking, and increase it by degrees till we come to running. Those exercises of the body are more especially serviceable which give delight to the mind at the same time, as tennis, fencing, &c.; for which reason, the wisdom of antiquity appointed rewards for those who excelled in these gymnastic exercises,

ercises, that by this means the bodies of their youth might be hardened for warlike toils.

As nothing is more conducive to health than moderate exercise, so violent exercise dissipates the spirits, weakens the body, destroys the elasticity of the fibres, and exhausts the fluid parts of the blood. No wonder, then, that acute and mortal fevers often arise from too violent exercise of the body; for the motion of the venous blood towards the heart being quickened by the contraction of the muscles, and the veins being thus depleted, the arteries more easily propel their contained humours through the smallest extremities into the now less resisting veins; and therefore the velocity of the circulation will be increased through all the vessels. But this cannot be performed without applying the humours oftener, or in a greater quantity, to the secretory organs in the same time, whence the more fluid parts of the blood will be dissipated, and what remains will be inspissated; and by the greater action of the vessels upon their contained fluids, and of the reacting fluids upon the vessels, the blood acquires an inflammatory density. Add to this, that by the violent attrition of the solids and fluids, together with the heat thence arising, all the humours will incline to a greater acrimony, and the salts and oils of the blood will become more acrid and volatile. Hence, says Boerhaave, these fevers which arise from too much exercise or motion, are cured by rest of body and mind, with such aliments and medicines as moisten, dilute, and soften or allay acrimony.

The exercise of a soldier in camp, considered as conducive to health, Dr Pringle distinguishes into three heads; the first relating to his duty, the second to his living more commodiously, and the third to his diversions. The first, consisting chiefly in the exercise of his arms, will be no less the means of preserving health than of making him expert in his duty: and frequent returns of this, early, and before the sun grows hot, will be made more advantageous than repeating it seldom, and staying out long at a time; for a camp affording little convenience for refreshment, all unnecessary fatigue is to be avoided. As to the second article, cutting boughs for shading the tents, making trenches round them for carrying off the water, airing the straw, cleaning their clothes and accoutrements, and assisting in the business of the mess, ought to be no disagreeable exercise to the men for some part of the day. Lastly, As to diversions, the men must be encouraged to them either by the example of their officers, or by small premiums to those who shall excel in any kind of sports as shall be judged most conducive to health: but herein great caution is necessary, not to allow them to fatigue themselves too much, especially in hot weather or sickly times; but, above all, that their clothes be kept dry, wet clothes being the most frequent causes of camp diseases.

**Exercise**, in military affairs, is the ranging a body of soldiers in form of battle, and making them perform the several motions and military evolutions with different management of their arms, in order to make them expert therein. See also Words *of Command.*

**Exercise**, in the royal navy, is the preparatory practice of managing the artillery and small arms, in order to make the ship's crew perfectly skilled therein, so as to direct its execution successfully in the time of battle.

The exercise of the great guns was formerly very complicated, and abounding with superfluities, in our navy, as well as all others. The following method was, it is said, successfully introduced by an officer of distinguished abilities.

1st, Silence.
2d, Cast loose your guns.
3d, Level your guns.
4th, Take out your tompions.
5th, Run out your guns.
6th, Prime.
7th, Point your guns.
8th, Fire.
9th, Sponge your guns.
10th, Load with cartridge.
11th, Shot your guns.
12th, Put in your tompions.
13th, House your guns.
14th, Secure your guns.

Upon beat to arms (every body having immediately repaired to their quarters) the midshipman commanding a number of guns, is to see that they are not without every necessary article, as (at every gun) a sponge, powder horn, with its priming wires, and a sufficient quantity of powder, crow, handspike, bed, quoin, train tackle, &c. sending without delay for a supply of any thing that may be wanting; and for the greater certainty of not overlooking any deficiency, he is to give strict orders to each captain under him, to make the like examination at his respective gun, and to take care that every requisite is in a serviceable condition, which he is to report accordingly. And (besides the other advantages of this regulation) for the still more certain and speedy account being taken upon these occasions, the midshipman is to give each man his charge at quarters (as expressed in the form of the monthly report), who is to search for his particular implements, and, not finding them, is immediately to acquaint his captain, that, upon his report to the midshipman, they may be replaced.

The man who takes care of the powder is to place himself on the opposite side of the deck from that where we engage, except when fighting both sides at once, when he is to be amid ships. He is not to suffer any other man to take a cartridge from him but he who is appointed to serve the gun with that article, either in time of a real engagement or at exercise.

Lanthorns are not to be brought to quarters in the night, until the midshipman gives his orders for so doing to the person he charges with that article. Every thing being in its place, and not the least lumber in the way of the guns, the exercise begins with,

1. "Silence." At this word every one is to observe a silent attention to the officers.

2. "Cast loose your guns." The muzzle lashing is to be taken off from the guns, and (being coiled up in a small compass) is to be made fast to the eye-bolt above the port. The lashing tackles at the same time to be cast loose, and middle of the breeching seized to the thimble of the pomillion. The sponge to be taken down, and, with the crow, handspike, &c. laid upon the deck by the gun. N. B. When prepared for engaging

gaging an enemy, the seizing within the clinch of the breeching is to be cut, that the gun may come sufficiently within board for loading, and that the force of the recoil may be more spent before it acts upon the breeching.

3. "Level your guns." The breech of your metal is to be raised so as to admit the foot of the bed's being placed upon the axletree of the carriage, with the quoin upon the bed, both their ends being even one with the other. N. B. When levelled for firing, the bed is to be lashed to the bolt which supports the inner end of it, that it may not be thrown out of its place by the violence of the gun's motion when hot with frequent discharges.

4. "Take out your tompions." The tompion is to be taken out of the gun's mouth, and left hanging by its laniard.

5. "Run out your guns." With the tackles hooked to the upper bolts of the carriage, the gun is to be bowsed out as close as possible, without the assistance of crows or handspikes; taking care at the same time to keep the breeching clear of the trucks, by hauling it through the rings; it is then to be bent so as to run clear when the gun is fired. When the gun is out, the tacklefalls are to be laid alongside the carriages in neat fakes, that, when the gun by recoiling overhauls them, they may not be subject to get foul, as they would if in a common coil.

6. "Prime." If the cartridge is to be pierced with the priming wire, and the vent filled with powder, the pan also is to be filled; and the flat space having a score through it at the end of the pan, is to be covered, and this part of the priming is to be bruised with the round part of the horn. The apron is to be laid over, and the horn hung up out of danger from the flash of the priming.

7. "Point your guns." At this command the gun is, in the first place, to be elevated to the bright of the object, by means of the side sights; and then the person pointing is to direct his fire by the upper sight, having a crow on one side and a handspike on the other, to heave the gun by his direction till he catches the object.

N. B. The men who heave the gun for pointing are to stand between the ship's side and their crows or handspikes, to escape the injury they might otherwise receive from their being struck against them, or splintered by a shot; and the man who attends the captain with a match is to bring it at the word, "Point your guns," and kneeling upon one knee opposite the train-truck of the carriage, and at such a distance as to be able to touch the priming, is to turn his head from the gun, and keep blowing gently upon the lighted match to keep it clear from ashes. And as the missing of an enemy in action, by neglect or want of coolness, is most inexcusable, it is particularly recommended to have the people thoroughly instructed in pointing well, and taught to know the ill consequences of not taking proper means to hit their mark; wherefore they should be made to elevate their guns to the utmost nicety, and then to point with the same exactness. Having caught the object through the upper sight, at the word,

8. "Fire," The match is instantly to be put to the bruised part of the priming; and when the gun is discharged, the vent is to be closed, in order to smother any spark of fire that may remain in the chamber of the gun; and the man who sponges is immediately to place himself by the muzzle of the gun in readiness; when, at the next word,

9. "Sponge your guns," The sponge is to be rammed down to the bottom of the chamber, and then twisted round, to extinguish effectually any remains of fire; and, when drawn out, to be struck against the outside of the muzzle, to shake off any sparks or scraps of the cartridge that may have come out with it; and next, its end is to be shifted ready for loading; and while this is doing, the man appointed to provide a cartridge is to go to the box, and by the time the sponge is out of the gun, he is to have it ready; and at the word,

10. "Load with cartridge," The cartridge (with the bottom-end first, seam downwards, and wad after it) is to be put into the gun, and thrust a little way within the mouth, when the rammer is to be entered: the cartridge is then to be forcibly rammed down; and the captain at the same time is to keep his priming-wire in the vent, and feeling the cartridge, is to give the word *home*, when the rammer is to be drawn, and not before. While this is doing, the man appointed to provide a shot is to provide one (or two, according to the order at that time) ready at the muzzle, with a wad likewise; and when the rammer is drawn, at the word,

11. "Shot your guns," The shot and wad upon it are to be put into the gun, and thrust a little way down, when the rammer is to be entered as before. The shot and wad are to be rammed down to the cartridge, and there have a couple of forcible strokes; when the rammer is to be drawn, and laid out of the way of the guns and tackles, if the exercise or action is continued; but if it is over, the sponge is to be secured in the place it is at all times kept in.

12. "Put in your tompions." The tompions to be put into the muzzle of the cannon.

13. "House your guns." The seizing is to be put on again upon the clinched end of the breeching, leaving it no slacker than to admit of the guns being housed with ease. The quoin is to be taken from under the breech of the gun, and the bed, still resting upon the bolt within the carriage, thrust under, till the foot of it falls off the axletree, leaving it to rest upon the end which projects out from the foot. The metal is to be let down upon this. The gun is to be placed exactly square; and the muzzle is to be close to the wood, in its proper place for passing the muzzle-lashings.

14. "Secure your guns." The muzzle-lashings must first be made secure, and then with one tackle (having all its parts equally taught with the breeching) the gun is to be lashed. The other tackle is to be bowsed taught, and by itself made fast, that it may be ready to cast off for lashing a second breeching. N. B. Care must be taken to hook the first tackle to the upper bolt of the carriage, that it may not otherwise obstruct the reeving of the second breeching, and to give the greater length to the end part of the fall. No pains must be spared in bowsing the lashing very taught, that the gun may have the least play that is possible, as their being loose may be productive of very

dangerous consequences. The quoin, crow, and handspike are to be put under the gun, the powder-horn hung up in its place, &c.

Being engaged at any time when there is a large swell, a rough sea, or in squally weather, &c. as the ship may be liable to be suddenly much heeled, the port-tackle fall is to be kept clear, and (whenever the working of the gun will admit of it) the man charged with that office is to keep it in his hand; at the same time the muzzle-lashing is to be kept fast to the ring of the port, and being hauled taught, is to be fastened to the eye-bolt over the port-hole, so as to be out of the gun's way in firing, in order to haul it in at any time of danger.

This precaution is not to be omitted, when engaging to the windward, any more than when to the leeward, those situations being very subject to alter at too short a warning.

A train tackle is always to be made use of with the lee guns; and the man stationed to attend it is to be very careful in preventing the guns running out at an improper time.

EXERCISE, may also be applied with propriety to the forming our fleets into orders of sailing, lines of battle, &c. an art which the French have termed *evolutions*, or *tactiques*. In this sense exercise may be defined, the execution of the movements which the different orders and disposition of fleets occasionally require, and which the several ships are directed to perform by means of signals. See TACTICS.

EXERCISES, are also understood of what young gentlemen learn in the academies and riding schools, such as fencing, drawing, riding the great horse, &c.

How useful, how agreeable soever, study may be to the mind, it is very far from being equally salutary to the body. Every one observes, that the Creator has formed an intimate connexion between the body and the mind; a perpetual action and reaction, by which the body instantly feels the disorders of the mind, and the mind those of the body. The delicate springs of our frail machines lose their activity and become enervated, and the vessels are closed by obstructions, when we totally desist from exercise, and the consequences necessarily affect the brain; a more studious and sedentary life is therefore equally prejudicial to the body and the mind. The limbs likewise become stiff; we contract an awkward constrained manner; a certain disgustful air attends all our actions, and we are very near being as disagreeable to ourselves as to others. An inclination to study is highly commendable; but it ought not, however, to inspire us with an aversion to society. The natural lot of man is to live among his fellows: and whatever may be the condition of our birth, or our situation in life, there are a thousand occasions where a man must naturally desire to render himself agreeable; to be active and adroit; to dance with a grace; to command the fiery steed; to defend himself against a brutal enemy; to preserve his life by dexterity, as by leaping, swimming, &c. Many rational causes have therefore given rise to the practice of particular exercises; and the most sagacious and benevolent legislators have instituted, in their academies and universities, proper methods of enabling youth, who devote themselves to study, to become expert also in laudable exercises.

EXERCITOR, in *Scots Law*, he who employs a ship in trade, whether he be owner, or only freights her from the owner.

EXERGESIA. See ORATORY, N° 90.

EXERGUM, among antiquarians, a little space around or without the figures of a medal, left for the inscription, cipher, device, date, &c.

EXETER, the capital city of Devonshire, situated on the river Ex, ten miles north of the British channel. W. Long. 3. 40. N. Lat. 50. 44. Anciently the name of this city was *Isex*, and *Isa Dumnoniorum*. The present name is a contraction of *Excester*, that is, a city upon the Ex. It is large, populous, and wealthy, with gates, walls, and suburbs: the circumference of the whole is about three miles. It is the see of a bishop, transferred hither from Crediton, by Edward the Confessor; and is one of the principal cities in the kingdom, for its buildings, wealth, and number of its inhabitants. It had six gates, besides many turrets, several of which are now pulled down. It had formerly so many convents, that it was called *Monktown*, till King Athelstan changed its name to Exeter, about the year 940; at which time he also fortified the city (which had before been only enclosed with a ditch and a fence of timber) with circular walls, embattlements, towers, and turrets of squared stone, encircling the whole, except the western side, with a deep moat. Besides chapels and five large meeting-houses, there are now 15 churches within the walls, and four without. St Peter's, the cathedral, is a magnificent pile; though little now remains of the ancient fabric of the church, except that part which is called *Our Lady's Chapel*. It has a ring of 12 bells, reckoned the largest ring of the largest bells in England; as is also its organ, whose largest pipes are 15 inches in diameter. In 1763 the cathedral was repaired, beautified, and new paved; when, in removing the old pavement, was found the leaden coffin of Bishop Bitton, who died in 1307; the top of which, being decayed, afforded an opportunity of viewing the skeleton lying in its proper form: near the bones of the finger was found a sapphire ring set in gold; the stone considerably large, but of no great value, on account of several flaws in it. Near this stood a small neat chalice and patten of silver gilt, but the damp had destroyed the greatest part of the gilding. In the centre of the patten was engraved a hand, with the two forefingers extended in the attitude of benediction. The top of the crozier was also found, but totally decayed. A most beautiful modern painted glass window has been lately erected at the western end of the cathedral, the eastern end having before a remarkable fine antique one. In the other windows there is much fine ancient painted glass. The altar is remarkable for its beautiful design and execution. On the left hand side of it there yet exists the seat where Edward the Confessor and his queen sat and installed Leofricus, his chancellor, the first bishop of Exeter; and in the fourth cross aisle is the monument of the same Leofricus, who died 1073, which at the time of his interment was a part of the churchyard, but by the enlarging of the church by his successors, became nearly the middle of the building. The grand western end of the church is most magnificently adorned with the statues of the patriarchs, &c. The chapter house was built in 1439. The

The beautiful throne for the bishop was constructed about 1466, and is said to be the grandest of the kind in Britain. The great north tower was completed in 1485, which contains a bell, that weighs 12,500 pounds; and exceeds the great Tom of Lincoln by 2500 pounds. This city has had divers charters granted, or confirmed by most of our kings; but it was made a mayor town in the reign of King John, and a county of itself by King Henry VIII. It is governed by a mayor, 24 aldermen, four bailiffs, a recorder, chamberlain, sheriff, town-clerk, &c. They have a sword-bearer, and four stewards, four serjeants at mace wearing gowns, and staff-bearers in liveries with silver badges. It had anciently a mint; and in the reigns of King William III. and Queen Anne, many pieces of silver money were coined here, which have the letter E under the bust. Here are 12 or 13 incorporate city companies. All pleas and civil causes are tried by the mayor, recorder, aldermen, and common council; but criminal causes, and those relating to the peace, are determined by eight aldermen, who are justices of the peace. Here are four principal streets, all entering in the middle of the city, which is therefore called *Carfox*, from the old Norman word *Quatre voix*, i. e. the four ways. Near it is a conduit, lately removed from the centre to the side of the principal street, which was first erected by William Duke, mayor of the city, in the reign of Edward IV. and there are others well supplied with water brought in pipes from the neighbourhood. There is an old castle in the north-east part of the city, called *Rougemont*, from the red soil it stands on; from thence there is a pleasant prospect from the walls. It is supposed to have been built by the West Saxon kings, and that they resided here, as did afterwards the earls and dukes of Cornwall. This castle was remarkably strong both by nature and art. The gate which originally led into it, was walled up by order of William the Conqueror, in token of his having reduced it to his obedience after a very obstinate resistance; and close by it an inferior gate was made in the wall in which state they both remain. The outward stone facing is kept in tolerable repair; but the inside being but earth, is gradually crumbled down. Here yet remains the ancient chapel, built in 1260, and kept in good repair, where prayers are read, and a sermon preached in sessions weeks. The city itself is healthy, and pleasantly situated on the sides of a hill, having other hills to its N. W. and S. by which it is sheltered from the force of storms. The bank which sustained the ditch that in a great part surrounded the castle, is planted and gravelled, and accommodated with seats, it being the place of resort for walking for the inhabitants; and the ditch between it and the castle being filled up, is now thickly planted with elms, which form a delightful grove. The old palace is now entirely demolished, and an elegant sessions house erected, where the assizes, quarter-sessions, and county courts are held. In the city and suburbs are prisons both for debtors and malefactors; a workhouse, alms-houses, and charity schools; an hospital for the sick and lame poor of the city and county, upon the model of the infirmaries of London and Westminster; and two free grammar-schools. It has markets on Wednesdays and Fridays; and four fairs in the year. Great trade is carried on here in serges, perpetuanas, long ells, and other woollen goods, in which it is computed that at least 600,000l. a year is traded for: yet no markets were erected here for wool, yarn, and kerseys, till the 30th of Henry VIII. Before that time the merchants drove a considerable trade to Spain and France: they were incorporated in the reign of Queen Mary I. by the name of "The Governor, Consuls, and Society of Merchant adventurers, trading to France." Here is also a weekly serge market, the greatest in England, next to the Brigg market at Leeds in Yorkshire. It is said that some weeks as many serges have been sold here as amount to 80,000l. or 100,000l.; for besides the vast quantities of their woollen goods shipped for Portugal, Spain, and Italy, the Dutch give large commissions for buying up serges, perpetuanas, &c. for Holland and Germany. It is particularly remarked of this city, that it is almost as full of gentry as of tradesmen; and that more of its mayors, and bailiffs have descended from, or given rise to good families, than in any other city of its bigness in the kingdom: for the great trade and flourishing state of this city tempted gentlemen to settle their sons in it, contrary to the practice of many of the inland as well as northern counties, where, according to the vain and ruinous notion of the Normans, trade was despised by the gentry as fit for only mechanics and the vulgar. This city was under the jurisdiction of the Romans, whose coins have been frequently dug up in and about it. After they left England, the Saxons drove the Britons out of it into Cornwall, and encompassed it with a ditch, besides bulwarks. The Danes attacked and spoiled it in 875; and afterwards in revenge of the general massacre of the Danes by the English, Sweyn one of their kings, came hither with a great force, put the men to the sword, ravished the women, massacred the children, burnt the city, and defaced the walls. A long time after this, just as it was reviving, William the Conqueror besieged and took it; and it was again besieged in the reigns of King Stephen and Edward IV. In the reign of Henry VII. it was again besieged by Perkin Warbeck, and battered furiously; but the citizens forced him to raise the siege; which so pleased the king that he came hither, and presented a cap of maintenance to the city, and gave the very sword from his side to be borne always before the mayor. In the reign of Edward VI. in July 1544, it was smartly cannonaded by the rebels of Cornwall and Devon, who almost starved it by breaking down its bridges, cutting off its water, and stopping up all passages; but it held out till the lord John Russel came with a force and raised the siege on the 6th of August, which was then appointed as an anniversary day of thanksgiving by the city, and is still observed as such. King Charles I.'s queen, to whom this city gave shelter in the civil wars, was here delivered of Henrietta, afterwards duchess of Orleans; whose picture is in its guildhall, as are also General Monk's and George I.'s, &c. In the south-east quarter of the city was a house called *Bedford house*, wherein the above queen was delivered of the princess. This having lately been taken down, an elegant circus is built on the spot, with a theatre adjoining it; and for the conveniency of the inhabitants, a passage has been made through the town wall to Southern Hay, on which green stands the county hospital, already spoken of, besides a considerable number of new buildings. There are remains of several ancient structures, which are daily giving way to modern erections; among the rest, an old building, said to have been a palace of King Athelstan. The guildhall is a spacious and convenient building, whose front or portico projects a great way into the street, and was first erected in 1330, to which its present front was rebuilt in 1593, and repaired in 1720. An arm of the sea formerly flowed nearly up to the city's wall, till 1316, when Hugh Courtenay earl of Devon, in revenge for an affront, ruined the navigation, by constructing wears and dams in the river; but to remedy it, in 1539, an act of parliament passed for making a navigable canal, for the better conveyance of goods in barges to and from the city to Topsham. This was carried into execution in 1581, but not completed till 1675; nor was it after all found sufficient, till the present haven was constructed in 1697, when it was rendered capable of bringing ships of 150 tons quite to the quay, constructed near the walls of the city. In short, Exeter, by a constant adherence to its motto, *Semper fidelis*, has been applauded by all historians for its inviolable fidelity to its sovereigns, whether they held their crown by hereditary or parliamentary right. The city sends two members to parliament; and gives title of earl to the Cecils. The number of houses in Exeter, according to the return ordered by act of parliament in 1811, was 2971, and the number of inhabitants amounted to 18,896. The see of Exeter was once one of the most wealthy in the kingdom; but it revenues were most shamefully wasted by Bishop Voysey, who alienated its lands. What little he left was so much encumbered, that the see has never been able to recover its former grandeur; and so small are its present revenues, that it has been found necessary for the bishop to hold some other preferment for the better support of his dignity and rank. The diocese contains the entire counties of Devonshire and Cornwall, wherein are 604 parishes, whereof 239 are impropriate. It hath four archdeacons, viz. of Cornwall, Exeter, Barnstable, and Totness. The diocese was formerly valued in the king's books at 1556l. 14s. 6d.; but, since Bishop Voysey's time, it is lowered to 500l. and is computed to be worth annually 2700l. The clergy's tenth is 1200l. 15s. 2½d. To the cathedral belong a bishop, a dean, four archdeacons, a chancellor, a treasurer, a chantor, 24 prebendaries, and other inferior officers and servants.

EXFOLIATION, a term used by surgeons for the scaling of a bone, or the separation of the dead part of a bone from the living part.

EXHALATION, a general term for all effluvia or steams raised from the surface of the earth in form of vapour.

EXHAUSTIONS, in *Mathematics.* Method of exhaustions, is a way of proving the equality of two magnitudes, by a *reductio ad absurdum;* showing, that if one be supposed either greater or less than the other, there will arise a contradiction.

The method of exhaustions was of frequent use among the ancient mathematicians; as Euclid, Archimedes, &c. It is founded on what Euclid says in his tenth book; viz. that those quantities whose difference is less than any assignable quantity, are equal; for if they were unequal, be the difference never so small, yet it may be so multiplied, as to become greater than either of them; if not so, then it is really nothing. This he assumes in the proof of Prob. I. book x. which imports, that if, from the greater of two quantities, you take more than its half, and from the remainder more than its half, and so continually, there will, at length, remain a quantity less than either of those proposed. On this foundation it is demonstrated, that if a regular polygon of infinite sides be inscribed in, or circumscribed about a circle; the space, which is the difference between the circle and the polygon, will, by degrees, be quite exhausted, and the circle become equal to the polygon.

EXHEREDATION, in the civil law, with us ordinarily called *disinheriting*, is the father's excluding his sons from inheriting his estate.

There are 14 causes of exheredation, expressed in Justinian's Novellæ; without some one of which causes, he decrees the exheredation null, and the testament inofficious, as the civilians call it. Indeed, by the ancient Roman law, the father might pronounce exheredation without any cause; but the rigour of this law was restrained and moderated by Justinian.

EXHIBIT, in *Law*, is where a deed, or other writing, being produced in a chancery suit, to be proved by witnesses, the examiner, or commissioner appointed for the examination of any such, certifies on the back of the deed or writing, that the same was shewn to the witness at the time of his examination, and by him sworn to.

EXHIBITION, in *Law*, a producing, or shewing, of titles, authorities, and other proofs, of a matter in contest.

Anciently they used the phrase, *exhibition* of a tragedy, comedy, or the like; but now we say *representation* in lieu thereof.

Exhibition, in our old writers, is used for an allowance of meat and drink, such as was customary among the religious appropriators of churches, who usually made it to the depending vicar. The benefactions settled for the maintaining of scholars in the universities not depending on the foundation, are also called *exhibitions*.

EXHORTATION, in *Rhetoric*, differs only from *suasion*, in that the latter principally endeavours to convince the understanding, and the former to work on the affections.

EXHUMATION, (of *ex*, "out of," and *humus*, "ground"); the act of digging up a body interred in holy ground, by the authority of the judge. In France, the exhumation of a dead body is ordered, upon proof that he was killed in a duel. By the French laws, a parson has a right to demand the exhumation of the body of one of his parishioners, when interred out of the parish without his consent.

EXIGENCE, or Exigency, that which a thing requires, or which is expedient or suitable thereto.

EXIGENT, in *Law*, a writ which lies where the defendant in a personal action cannot be found, nor any effects of his within the county, by which he might be attached or distrained.

EXIGENTERS, four officers in the court of common pleas, who make all exigents and proclamations, in all actions where process of outlawry lies. Writs of supersedeas, as well as the prothonotaries, upon exigents, are likewise drawn up in their office.

**EXILE.** See BANISHMENT.

Among the Romans, the word *exilium* properly signified an interdiction or exclusion from water and fire; the necessary consequence of which was, that the interdicted person must betake himself into some other country, since there was no living without fire and water.—Thus Cicero, *ad Herenn.* observes, that the form of the sentence did not express *exilium*, but only *aquæ et ignis interdictio*. The same author remarks, that exile was not properly a punishment, but a voluntarily flying or avoiding the punishment decreed: *Exilium non esse supplicium, sed perfugium, portusque supplicii.* He adds, that there was no crime among the Romans, as among other nations, punished with exile; but exile was a resource to which people flew voluntarily, in order to avoid chains, ignominy, starving, &c.

The Athenians frequently sent their generals and great men into exile, out of envy of their merits, or distrust of their too great authority. See OSTRACISM.

EXISTENCE, that whereby any thing has an actual essence, or is said to *be*. See the article METAPHYSICS.

EXIT, properly expresses the departure of a player from off the stage, when he has acted his part. The word is also used in a figurative sense, to express any kind of departure, even death.

EXITERIA, in antiquity, oblations or prayers to any of the gods for a prosperous expedition or journey. There were also feasts under this denomination, which were celebrated by the Greeks with sacrifices and prayers, when their generals undertook expeditions against an enemy.

EXOCOETUS, the FLYING FISH, a genus of fishes belonging to the order of abdominales. See ICHTHYOLOGY *Index*.

EXODIARY, in the ancient Roman tragedy, was the person who, after the drama or play was ended, sung the EXODIUM.

EXODIUM, in the ancient Greek drama, one of the four parts or divisions of a tragedy, being so much of the piece as included the catastrophe and unravelling of the plot, and answering nearly to our fourth and fifth acts.

EXODIUM, among the Romans, consisted of certain humorous verses rehearsed by the exodiary at the end of the Fabulæ Atellanæ.

EXODIUM, in the Septuagint, signifies the end or conclusion of a feast. Particularly, it is used for the eighth day of the feast of tabernacles, which, it is said, had a special view to the commemoration of the *exodus* or departure out of Egypt.

EXODUS, a canonical book of the Old Testament; being the second of the Pentateuch, or five books of Moses.

It is so called from the Greek ἔξοδος, the "going out" or departure of the children of Israel from the land of Egypt; the history of which is delivered in this book, together with the many miracles wrought on that occasion.

EXOMPHALUS, in *Surgery*, called also *omphalocele* and *hernia umbilicalis*, is a preternatural tumor of the abdomen, at the navel, from a rupture or distension of the parts which invest that cavity.

EXORCISM, the expelling of devils from persons possessed, by means of conjurations and prayers. The Jews made great pretences to this power. Josephus tells several wonderful tales of the great success of several exorcists. One Eleazer, a Jew, cured many dæmoniacs, he says, by means of a root set in a ring. This root, with the ring, was held under the patient's nose, and the devil was forthwith evacuated. The most part of conjurors of this class were impostors, each pretending to a secret nostrum or charm which was an overmatch for the devil. Our Saviour communicated to his disciples a real power over dæmons, or perhaps over the diseases said to be occasioned by dæmons. See DÆMONIAC.

Exorcism makes a considerable part of the superstition of the church of Rome, the rituals of which forbid the exorcising any person without the bishop's leave. The ceremony is performed at the lower end of the church, towards the door. The exorcist first signs the possessed person with the sign of the cross, makes him kneel, and sprinkles him with holy water. Then follow the litanies, psalms, and prayer; after which the exorcist asks the devil his name, and adjures him by the mysteries of the Christian religion not to afflict the person any more: then, laying his right hand on the dæmoniac's head, he repeats the form of exorcism, which is this: "I exorcise thee, unclean spirit, in the name of Jesus Christ: tremble, O Satan! thou enemy of the faith, thou foe of mankind, who hast brought death into the world; who hast deprived men of life, and hast rebelled against justice: thou seducer of mankind, thou root of evil, thou source of avarice, discord, and envy." The Romanists likewise exorcise houses and other places, supposed to be haunted by unclean spirits; and the ceremony is much the same with that for persons possessed.

EXORCISTS, in church history, an order of men, in the ancient church, whose employment it was to exorcise or cast out devils. See the preceding article.

EXORDIUM, in *Oratory*, is the preamble or beginning, serving to prepare the audience for the rest of the discourse.

Exordiums are of two kinds; either just and formal, or vehement and abrupt. The last are more suitable on occasions of extraordinary joy, indignation, or the like. See ORATORY, N° 26.

EXOSTOSIS (from ἐξ, *out*, and οστεον, *a bone*), in *Anatomy*, an acute eminence or excrescence, pushing preternaturally above the bone.

EXOTERIC and ESOTERIC, are terms denoting *external* and *internal*, and applied to the double doctrine of the ancient philosophers: the one was public or *exoteric*; the other secret, or *esoteric*. The first was that which they openly professed and taught to the world; the latter was confined to a small number of chosen disciples. This method was derived originally from the Egyptians; who, according to the united testimony of Herodotus, Diodorus Siculus, Strabo, Plutarch, &c. had a twofold philosophy, one secret and sacred, another public and common. The same practice also obtained among the Persian Magi, the Druids of the Gauls, and the Brachmans of India. The Egyptian priests, with whom it originated, sustained the character of judges and magistrates, and probably introduced this distinction with a view to the public welfare, and to serve the purpose of legislation and government. Clement of Alexandria informs us, that

that they communicated their mysteries principally to those who were concerned in the administration of the state; and Plutarch confirms the same declaration. However, others have supposed that they invented the fables of their gods and heroes, and the other external ceremonies of their religion, to disguise and conceal natural and moral truths; but whatever was the motive of their practice, it was certainly applied to political purposes.

EXOTIC, a term properly signifying *foreign* or *extraneous*, i. e. brought from a remote or strange country. In which sense we sometimes say *exotic* or *barbarous terms* or *words*, &c. The word is derived from the Greek ἐξω, ἐξωθεν, *extra*, "without, on the outside."

Exotic, is chiefly applied to plants which are natives of foreign countries, particularly those brought from the East or West Indies, and which do not naturally grow in Europe.

The generality of exotics, or exotic plants, do not thrive in England without some peculiar care or culture: they require the warmth of their own climates; whence the use of hot beds, glass frames, green houses, &c. See Gardening *Index*.

EXPANSION, among metaphysicians, denotes the idea which we have of lasting distance, all whose parts exist together.

Expansion, in *Physics*, the enlargement or increase of bulk in bodies, chiefly by means of heat. This is one of the most general effects of that subtile principle, being common to all bodies whatever, whether solid or fluid. In some few cases, indeed, bodies seem to expand as they grow cold, as water in the act of freezing: but this is found to be owing to a new arrangement of the particles, or to crystallization; and is not at all a regular and gradual expansion like that of metals, or any other solid or fluid substance by means of heat. In certain metals also, an expansion takes place when they pass from a fluid to a solid state: but this too is not to be accounted any proper effect of cold, but of the arrangement of the parts of a metal in a peculiar manner; and is therefore to be ascribed to a kind of crystallization.

The expansion of bodies by heat is very various, and in solids does not seem to be guided by any certain rule. In the 48th volume of the Phil. Trans. Mr Smeaton has given a table of the expansions of many different substances. See Chemistry *Index*.

EXPECTANCY, estates in, are of two sorts; one created by act of the parties, called a *remainder;* the other, by act of law, called *reversion*.

EXPECTATION, in the doctrine of chances, is applied to any contingent event, and is capable of being reduced to the rules of computation. Thus a sum of money in expectation when a particular event happens, has a determinate value before that event happens; so that if a person is to receive any sum, e. gr. 10l. when an event takes place which has an equal probability of happening and failing, the value of the expectation is half that sum or 5l.; and in all cases the expectation of obtaining any sum is estimated by multiplying the value of the sum expected by the fraction which represents the probability of obtaining it. The expectation of a person who has three chances in five of obtaining 100l. is equal to $\frac{3}{5}\times 100$ or 60l. and the probability of obtaining 100l. in this case is equal to $\frac{60}{100}=\frac{3}{5}$.

*Expectation of Life*, signifies, in the doctrine of life annuities, that share or number of the years of human life, which a person of any given age may expect to enjoy on an equality of chance.

According to Mr Simpson, by the expectation of life we are not to understand that period which a person may have an equal chance of surviving, which is a different and more simple consideration; but the number of years at which the purchase of an annuity ought to be valued, granted on it without discount of money. There will be a greater or less difference in this number of years, in proportion to the various degrees of mortality to which the different stages of human life are exposed. Thus, it is more than an equal chance that an infant just come into the world, will not reach the age of 10 years; yet the expectation of life, or share of existence due to it, is almost 20 years upon an average. The reason of this vast difference is the excess of the probability of death in the first tender years of existence above that which respects the more advanced stages. If the numbers of those who die at every assignable period were always found to be on an equality, the two quantities already mentioned would be the same; but when these numbers constantly become less and less, the expectation must of consequence become the greater of the two.

EXPECTORANTS, in *Pharmacy*, medicines which promote Expectoration. See Materia Medica *Index*.

EXPECTORATION, the act of evacuating or bringing up phlegm or other matters out of the trachea, lungs, &c. by coughing, hawking, spitting, &c.

EXPEDITATION, in the forest laws, signifies a cutting out the balls in a dog's fore feet for the preservation of the king's game.

Every one that keeps any great dog not expeditated forfeits three shillings and four pence to the king. In mastiffs, not the ball of the feet, but the three claws, are to be cut to the skin. Instit. Part VI. p. 308.

This expeditation was to be performed once in every three years, and was done to every man's dog who lived near the forest, and even the dogs of the foresters themselves.

EXPEDITION, the march of an army to some distant place, with a view of hostilities. Such were the expeditions of Cyrus against Artaxerxes, and of Bacchus and Alexander into the Indies.

Expeditions for the recovery of the Holy Land were called *croisades*.

EXPERIENCE, a kind of knowledge acquired by long use without any teacher. It consists in the ideas of things we have seen or read, which the judgment has reflected on, to form for itself a rule or method.

Authors make three kinds of experience: The first is the simple uses of the external senses, whereby we perceive the phenomena of natural things without any direct attention thereto, or making any application thereof. The second is, when we premeditately and designedly make trials of various things, or observe those done by others, attending closely to all effects and circumstances. The third is that preceded by a foreknowledge, or at least an apprehension of the event, and perience, periment. and determines whether the apprehension were true or false; which two latter kinds, especially the third, are of great service in philosophy.

EXPERIMENT, in *Philosophy*, is the trial of the result or effect of the applications and motions of certain natural bodies, in order to discover something of their motions and relations, by which some of their phenomena or causes may be ascertained. Experiment.

# EXPERIMENTAL PHILOSOPHY

IS that which has its foundation in experience, wherein nothing is assumed as a truth but what is founded upon ocular demonstration, or which cannot be denied without violating the common sense and perceptions of all mankind.

In former times philosophers, when reasoning about natural things, instead of following this method, assumed such principles as they imagined sufficient for explaining the phenomena, without considering whether these principles were just or not. Hence for a great number of ages no progress was made in science; but systems were heaped upon systems, having neither consistency with one another nor with themselves. No proper explanations indeed were given of any thing; for all these systems, when narrowly examined, were found to consist merely in changes of words, which were often very absurd and barbarous. The first who deviated from this method of philosophizing, if we may call it by that name, was Friar Bacon, who lived in the 13th century, and who spent 2000l. (an immense sum in those days) in making experiments. The Admirable Crichton, who flourished about the year 1580, not only disputed against the philosophy of Aristotle, which had for so long been in vogue, but wrote a book against it. Cotemporary with this celebrated personage was Francis Bacon lord chancellor of England, who is looked upon to be the founder of the present mode of philosophizing by experiments. But though others might lay the foundation, Sir Isaac Newton is justly allowed to have brought this kind of philosophy to perfection; and to him we are certainly indebted for the greatest part of it. Unfortunately, however, neither Lord Bacon nor Sir Isaac Newton had an opportunity of knowing many important facts relating to the principles of fire and electricity, which have since been brought to light. Hence all their philosophy was merely mechanical, or derived from the visible operations of solid bodies, or of the grosser fluids, upon one another. In such cases, therefore, where the more subtile and active fluids were concerned, they fell into mistakes, or were obliged to deny the existence of the principles altogether, and to make use of terms which were equally unintelligible and incapable of conveying any information with those of their predecessors. A remarkable instance of the errors into which they were thus betrayed, we have in the doctrine of projectiles, where the most enormous deviations from truth were sanctified by the greatest names of the last century, merely by reasoning from the resistance of the air to bodies moving slowly and visibly, to its resistance to the same bodies when moved with high degrees of velocity †. In other cases they were reduced to make use of words to express immechanical powers, as attraction, repulsion, rarefaction, &c. which have since tended in no small degree to embarrass and confound science by the disputes that have taken place concerning them. The foundations of the present system of experimental philosophy are as follows:—

I. All the material substances of which the universe is composed are called *natural bodies*. What we perceive uniform and invariable in these substances we call their *properties*. Some of these are general and common to all matter, as extension; others are proper to particular substances, for instance fluidity; while some appear to be compounded of general and particular properties, and thus belong to a still smaller number; as the properties of air, which are derived from the general property of extension combined with those of fluidity, elasticity, &c.

II. In taking a particular review of the properties of bodies we naturally begin with that of *extension*. This manifests itself by the three dimensions of length, breadth, and thickness. Hence proceeds the divisibility of matter; which the present system supposes to reach even to infinity: but though this proposition be supported by mathematical demonstrations, it is impossible we can either have any distinct idea of it, or of the opposite doctrine, which teaches that matter is composed of excessively minute particles called *atoms*, which cannot be divided into smaller ones. The subtility indeed to which solid bodies may be reduced by mechanical means is very surprising; and in some cases is so great, that we might be tempted to suppose that a farther division is impossible. Thus, in grinding a speculum, the inequalities of its surface are so effectually worn off, that the whole becomes in a certain degree invisible, showing not itself by the light which falls upon it, but the image of other bodies; but the smallest scratch which disturbs the equality of the surface is at once distinctly visible.

III. From the arrangement of these ultimate particles of matter, whatever we suppose them to be, arise the various figures of bodies: and hence figure is a property of all bodies no less universal than extension, unless we choose to speak of the ultimate particles of matter, which, as they are supposed to be destitute of parts, must consequently be equally destitute of figure; and the same consequence will follow whether we adopt this supposition or the other. The figures of bodies are so extremely various and dissimilar, that it is impossible to find any two perfectly alike. It is indeed the next thing to impossible to find two in which the dissimilarity may not be perceived by the naked eye; but if any such should be found, the microscope will quickly discover the imbecility of our senses in this respect. Solidity is another property essential to all matter. By this we mean that property which one quantity of matter has of excluding any other from the space which itself occupies

† Gun-

occupies at that time. Hence arises what we call *resistance*, which is always an indication of solidity; and no less so in those bodies which we call *fluid* than in those which are the most solid. This may at first seem to be a contradiction; but fluids yield only when they can get away from the pressure; in all other cases they resist as violently as the most solid bodies. Thus water confined in a tube will as effectually resist the impression of a piston thrust down upon it as though it were the most solid substance. Air indeed will yield for a certain time; but this, as appears from several experiments, is entirely owing to a more subtile fluid, viz. that of elementary fire, being pressed out from among its particles. As long as this fluid can be forced out, either from among the particles of air, water, or any other more gross fluid substance, the latter will be found compressible, as a heap of wet sand would be by squeezing the water out from it; but when we come to the most subtile of all elements, such as we suppose that of fire to be, there cannot be any possibility of compressing it, even though we had a vessel so close as to prevent it from escaping through its sides; because its parts are already as near each other as they can be.

IV. The distance of the parts of bodies from each other is what we call their porosity, and was formerly supposed to be owing to a vacuum interspersed between them; but now it is generally allowed that the pores of solid bodies as well as of fluids are filled with an extremely subtile matter which pervades all nature. The porosity of bodies with regard to one another may be thus explained. Wood or a sponge is porous with regard to water: but water itself is porous with regard to air, which it absorbs in considerable quantity. But air and water are porous with regard to the element of fire, which produces very considerable changes upon them, according to the quantity of it they contain, or the manner it acts in their pores. The element itself, however, is not porous with regard to any other substance. Its pores, therefore, if it has any, must be absolute vacuities, destitute of any matter whatever. Vacuities of this kind indeed are supposed to be absolutely necessary to motion: for though we may say, matter being divisible almost *ad infinitum*, that a body or substance more solid may move in another substance that is more subtile, and that will give way to its motion, we must nevertheless have recourse to a last resort, and admit of an ultimate vacuum, which will give room sufficient to the least corpuscle, that its part *A* may take the place of its part *B* without the least resistance: besides, it is not to be imagined, that nature, in fact, admits of that infinite divisibility which our imagination can conceive, and that every thing which is possible in idea, is at all times practicable. All that exists is possible, but all that is possible does not however exist. By density, is understood the proportion between the extension and solidity of a body; one body therefore is more dense than another, when, under the same degree of extension, it contains more solid matter: and this quality arises from condensation and compression. Elasticity is nothing more than that effort by which certain bodies, when compressed, endeavour to restore themselves to their former state; and this property supposes them compressible. As all these natural properties of bodies are of great utility in explaining the principles of physics, and in applying them to all the arts, experimental philosophy proves their reality by a thousand examples.

V. We discover still other properties in bodies; such as mobility, which we must not here confound with motion. This mobility arises from certain dispositions which are not in an equal degree in all bodies: from whence it comes that some are more easily moved than others: and this proceeds from the resistance to motion which is perceived in all bodies: having regard merely to their masses; and this resistance is called *vis inertiæ*, or *inert force*. A body is said to be in motion when it is actually moving from one place to another: or, whenever a body changes its situation with regard to the objects that surround it, either nearly or remotely, it is said to be in motion. There are three principal matters to be considered in a moving body; its direction, its velocity, and the quantity of its motion: and here physics explains the force or moving power; it likewise distinguishes between simple and compound motion. Simple motion is that which arises from only one force, or which tends to one point only. It describes the laws, and explains the resistance, of mediums; the resistance of friction; the difficulties of a perpetual motion; the alteration of direction occasioned by the opposition of a fluid matter; reflected or reverberated motion; the communication of motion by the shock of bodies, &c. Compound motion is that of a body impelled to move by several causes or powers which act according to their different directions. Physics here likewise investigates the laws of motion; and is particularly applied to the explaining, under this head, what are called the *central forces*, which produce a motion that is either circular or in a curve line, and which incessantly urge the moving body either to approach or recede from the centre. To distinguish these from each other, the former is called the *centripetal force*, and the latter the *centrifugal force*. See DYNAMICS.

VI. By gravity, or ponderosity, is to be understood that force which occasions bodies to pass from a higher to a lower place, when nothing opposes their course, or when the obstacles are not sufficient to stop them. Speculative philosophy investigates its cause, and perhaps in vain. Experimental philosophy contents itself with describing the phenomena, and teaching the laws of gravity, which are thoroughly established by a thousand reiterated experiments. In order properly to understand this subject, we must take care not to confound the term *gravity* with that of *weight*. By the former, we understand that force which urges bodies to descend through a certain space in a given time. By the latter, is meant the quantity of a heavy body that is contained under the same bulk. The phenomena are explained by the experiments themselves, and by inferences deduced from them.

VII. Hydrostatics is a science of which the object is the gravity and equilibrium of fluids in particular. Though the gravity of these bodies is the same with that of others, and is subject to the same laws, yet their state of fluidity gives rise to particular phenomena, which it is of consequence to know. But as hydrostatics cannot be successfully treated without the assistance of calculation, it has been ranked among the mathematical sciences.

VIII. We say the same with regard to mechanics; which is the art of employing, by the aid of machines, the

the motion of bodies, in conformity to its properties and laws, as well with regard to solids as fluids, either more commodiously or more advantageously.

IX. After it has made the most accurate experiments, and the most judicious observations, on all these different subjects, and the properties of bodies in particular, Experimental Philosophy passes to the examination of the air, the water, fire, the wind, colours, &c. The air is a fluid with which we are surrounded from the instant of our birth, and without which we cannot exist. It is by the properties and the influences of the air, that nature gives increase and perfection to all that it produces for our wants and conveniences: it is the spirit of navigation: sound, voice, speech itself, are nothing more than percussions of the air: this globe that we inhabit is completely surrounded by air; and this kind of coverture, which is commonly called the *atmosphere*, has such remarkable functions, that it evidently appears to concur to the mechanism of nature. Experimental physics, therefore, considers the air, 1. Of itself, independent of its bulk, and the figure of its whole body: it examines its essential properties; as its gravity, density, spring, &c. The air-pump is here of indispensable use; and by this machine physics examines in what manner space, or a vacuum, is made. It likewise shows the necessity of air to the preservation of animal life; the effect it has on sound, fire, and gunpowder, *in vacuo;* and a hundred other experiments of various degrees of curiosity. 2. It considers the air as the terrestrial atmosphere, sometimes as a fluid at rest, and sometimes as in motion. And by these means it accounts for the variation of the mercury in the barometer, and why it sinks in proportion as the height of the atmosphere diminishes; as also for the figure, the extent, and weight of the atmosphere: it shows the method of determining the height of mountains, the nature of sound in general, of its propagation, and of sonorous bodies. The late discoveries have added greatly to experimental philosophy, of which an account is given under the article CHEMISTRY, &c.

X. It is here also, that experimental philosophy considers the nature of the wind; which is nothing more than agitated air, a portion of the atmosphere that moves like a current, with a certain velocity and determinate direction. This fluid, with regard to its direction, takes different names according to the different points of the horizon from whence it comes, as east, west, north, and south. Winds are likewise distinguished into three sorts; one of which is called *general* or *constant*, as the trade winds which continually blow between the tropics: another is the *periodical*, which always begin and end within a certain time of the year, or a certain hour of the day, as the monsoons, the land breezes and sea breezes, which arise constantly in the morning and evening; and lastly, such as are *variable*, as well with regard to their direction as their velocity and duration.

M. Mariotte computes the velocity of the most impetuous wind to be at the rate of 32 feet in a second, and Mr Derham makes it 66 feet in the same time. The first, doubtless, meant the wind of the greatest velocity that had then come to his knowledge. The invention of aerostatic machines has tended more to show the real velocity of the wind than any other invention as yet made public; but all of them move slower than the aerial current; so that the real velocity of the wind remains yet undetermined.

XI. The force of the wind, like that of other bodies, depends on its velocity and mass: that is, the quantity of air which is in motion; so the same wind has more or less force on any obstacle that opposes it, in proportion as that obstacle presents a greater or a less surface: for which reason it is that they spread the sails of a vessel more or less, and place the wings of a windmill in different directions. The machine by which the winds are measured, are called *anemometers.* They show the direction, the velocity, and the duration of winds. It is by the agitations of the winds that the air is purified; that the seeds of trees and herbs are conveyed through the forests and fields; that ships are driven from one pole to the other; that our mills turn upon their axles, &c.: and art, by imitating nature, sometimes procures us artificial winds, by which we refresh our bodies, invigorate our fires, purify our corn, &c.

XII. Water is an universal agent, which nature employs in all her productions. It may be considered as in three states: 1. As a liquid; 2. As a vapour; 3. As ice. These three different states do not in any manner change its essence, but make it proper to answer different ends. The natural state of water would be that of a solid body, as fat, wax, and all those other bodies which are only fluid when heated to a certain degree; for water would be constantly ice, if the particles of fire, by which it is penetrated in the temperate climates, did not render it fluid, by producing a reciprocal motion among its parts; and, in a country where the cold is continually strong enough to maintain the congelation, the assistance of art is necessary to make it fluid in the same manner as we do lead, &c. Water, when not in ice, is a fluid that is insipid, transparent, without colour and without smell, and that easily adheres to the surface of some bodies, that penetrates many, and extinguishes fire. Experimental philosophy investigates the origin of fountains; the cause of the saltness of the sea; the means of purifying water; what is its weight, and what are its effects when heated, &c. It likewise examines this fluid in the state of vapour; and finds that a drop of water, when in vapour, occupies a space vastly greater than it did before. It explains the *æolipile* and its effects; fire engines; and the force of vapour that gives motion to immense machines in mines and elsewhere, &c. And lastly, It considers water in the state of ice. Ice consequently is more cold than water; and its coldness increases if it continue to lose that matter, already too rare, or too little active, to render it fluid. Experimental physics endeavours to investigate the causes of the congelation of water, and why ice is lighter than water; from whence it derives that expansive force by which it breaks the containing vessel; the difference there is between the congelation of rivers and that of standing waters; why ice becomes more cold by the mixture of salts; and many other similar phenomena.

XIII. The nature of fire is yet very much unknown to the most learned philosophers. As objects when at a great distance are not perceptible to our senses, so when we examine them too nearly, we discern them but confusedly. It is still disputed whether fire be a homogene, unalterable matter, designed, by its presence, or by its action,

action, to produce heat, inflammation, and dissolution, in bodies; or if its essence consists in motion only, or in the fermentation of those particles which we call *inflammable*, and which enter as principles, in greater or less quantities, in the composition of mixed bodies. The most learned inquirers into nature incline to the former opinion; and to have recourse to a matter which they regard as the principle of fire. They suppose that there is in nature a fluid adapted to this purpose, created such from the beginning, and that nothing more is necessary than to put it in action. The numberless experiments which are daily made in electricity seem to favour this opinion, and to prove that this matter, this fluid, this elementary fire, is diffused through all nature, and in all bodies, even ice itself. We cannot say to what important knowledge this great discovery of electricity may lead if we continue our inquiries concerning it. It appears, however, that we may believe, without any inconvenience or absurdity, that fire and light, considered in their first principle, are one and the same substance differently modified.

XIV. Be this matter however as it may, experimental philosophy is employed in making the most ingenious and most useful researches concerning the nature of fire, its propagation, and the means by which its power may be excited or augmented; concerning the phosphorus and its inflammation; fire excited by the reflection of the sun's rays from a mirror; and on the effects of fire in general; concerning lightning and its effects; the fusion of metals; gunpowder and its explosion; flame and the aliments of fire; and an infinity of like objects which it explains, or concerning which it makes new discoveries, by the aid of experiments.

XV. By the word *light*, we understand that agent by which nature affects the eye with that lively and almost constantly pleasing sensation, which we call *seeing*, and by which we discern the size, figure, colour, and situation of objects, when at a convenient distance. All philosophers agree, that the light which is diffused in any place, is a real body. But what this body is, and by what means it enters that place where it is perceived, is a question about which philosophers are divided.

XVI. Experimental philosophy is applied in discovering or proving, by an infinity of experiments, what is the nature of light, in what manner it is propagated, what its velocity and progressive motion. It also investigates and explains the principle of *optics* properly so called, and shows the directions which light observes in its motions. From thence it proceeds to the examen of the principles of catoptrics, and describes the laws and effects of reflected light. It next treats of the principles of dioptrics, and explains the laws of refracted light; and lastly, it teaches, from the principles of natural and artificial vision, the construction of optical instruments, as lenses, concave mirrors, prisms, telescopes, &c. &c. and the uses to which they are applied.

XVII. By resolving or separating the rays of light, philosophy has obtained true and clear discoveries of the nature of colours. We are naturally led to imagine that colours, and their different degrees, make a part of the bodies that present them to our sight; that white is inherent in snow, green in leaves and grass, and red in a a stuff dyed of that colour. But this is far from being true. If an object, which presents any colour to our sight, be not illuminated, it presents no colour whatsoever. In the night all is black. Colours therefore depend on light; for without that we could form no idea of them; but they depend also on bodies; for of several objects presented to the same light, some appear white, others red, blue, &c. But all these matters being separate from our own bodies, we should never acquire any idea of them, if the light, transmitted or reflected by these objects, did not make them sensible to us, by striking upon the organs of our sight, and if these impressions did not revive in us those ideas which we have been used to express by certain terms. For these reasons philosophy considers colours from three points of view, 1. As in the light; 2. In bodies, as being coloured; and, 3. From the relation they have to our visual faculties, which they particularly affect, and by which we are enabled to distinguish them.

It is unnecessary in this place to say more, either on colour in particular, or experimental philosophy in general. The different subjects of this collective article are particularly treated under their proper names, in the order of the alphabet: the reader will therefore turn, as he has occasion, to ACOUSTICS, CATOPTRICS, CHROMATICS, DIOPTRICS, HYDRODYNAMICS, MECHANICS, OPTICS, PNEUMATICS, ELECTRICITY, MAGNETISM, &c. &c. &c. Also, AEROSTATION, ATMOSPHERE, *BURNING Glass*, CHEMISTRY, &c. &c.

Experimentum ‖ Expiation.

**EXPERIMENTUM** CRUCIS, a capital, leading, or decisive experiment; thus termed, either on account of its being like a cross, or direction-post placed in the meeting of several roads, guiding men to the true knowledge of the nature of that thing they are inquiring after; or, on account of its being a kind of torture, whereby the nature of the thing is as it were extorted by force.

**EXPHORESIS.** See ORATORY, N° 85.

**EXPIATION**, a religious act, by which satisfaction or atonement is made for the commission of some crime, the guilt done away, and the obligation to punishment cancelled.

Expiation.

Expiations among the Heathens, were of several kinds; as sacrifices and religious washings. They were used for effacing a crime, averting any calamity, and on numberless other occasions, as purifying towns, temples, and sacred places, and armies before and after battle. And they were performed for whole cities as well as particular persons.

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The method of expiation among the Jews was chiefly by sacrifice, whether for sins of ignorance, or to purify themselves from certain pollutions.

*Feast of* EXPIATION, among the Jews, called by our translators the *day of atonement*, was held on the tenth day of Tisri, or the seventh month of the Jewish year, answering to part of our September and October. It was instituted by God himself, Levit. xxiii. 27, &c. On that day the high-priest, the figure or type of Jesus Christ, entered into the most holy place, and confessed his sins; and, after several ceremonies, made an atonement for all the people, to wash them from their sins. Lev. chap. xvi. See *Scape-Goat*.

EXPIATION, in a figurative sense, is applied by divines to the pardon procured to the sins of the penitent by the merit of Christ's death. See the article CHRISTIANITY.

EXPIRATION, in *Medicine*. See EXSPIRATION.

EXPIRATION, is also used figuratively, for the end of a term of time granted, agreed on, or adjudged.

EXPLICIT, in the schools, something clear, distinct, formal, and unfolded.

EXPLOSION, in *Natural Philosophy*, a sudden and violent expansion of an aerial or other elastic fluid, by which it instantly throws off any obstacle that happens to be in the way, sometimes with incredible force, and in such a manner as to produce the most astonishing effects upon the neighbouring objects.

Difference between explosion and expansion.

General causes of explosions.

Explosion differs from expansion, in that the latter is a gradual and continued power, acting uniformly for some time, whereas the former is always sudden, and only of momentary duration. The expansions of solid substances do not terminate in violent explosions, on account of their slowness, and the small space through which the metal, or other expanding substance, moves; though their strength may be equally great with that of the most active aerial fluids. Thus we find, that though wedges of wood, when wetted, will cleave solid blocks of stone, they never throw them to any distance, as is the case with gunpowder. On the other hand, it is seldom that the expansion of any elastic fluid bursts a solid substance without throwing the fragments of it to a considerable distance, the effects of which are often very terrible. The reasons of this may be comprised in the two following particulars: 1. The immense velocity with which the aerial fluids expand, when affected by a considerable degree of heat; and, 2. Their celerity in acquiring heat and being affected by it, which is much superior to that of solid substances. Thus air, heated as much as iron when brought to a white heat, is expanded to four times its bulk; but the metal itself will not be expanded the 500th part of the space. In the case of gunpowder, which is a violent and well known explosive substance, the velocity with which the flame moves is calculated by Mr Robins, in his Treatise upon Gunnery, to be no less than 7000 feet in a second, or little less than 79 miles per minute. Hence the impulse of the fluid is inconceivably great, and the obstacles on which it strikes are hurried off with vast velocity, though much less than that just mentioned; for a cannon bullet, with the greatest charge of powder that can be conveniently given, does not move at a greater rate than 2400 feet per second, or little more than 27 miles per minute. The velocity of the bullet again is promoted by the sudden propagation of the heat through the whole body of air, as soon as it is extricated from the materials of which the gunpowder is made; so that it is enabled to strike all at once, and thus greatly to augment the momentum of the ball. It is evident that this contributes very much to the force of the explosion, by what happens when powder is wetted or mixed with any substance, which prevents it from taking fire all at once. In this case the force of the explosion, even when the same quantity of powder is made use of, cannot be compared to that of dry powder.

Electric explosions the strongest of all.

Upon these principles we may conclude that the force of an explosion depends, 1. On the quantity of elastic fluid to be expanded; 2. On the velocity it acquires by a certain degree of heat; and, 3. On the celerity with which the degree of heat affects the whole of the expansive fluid. These three take place in the greatest perfection where the electric fluid is concerned: as in cases of lightning, earthquakes, and volcanoes. This fluid, as is shewn in many parts of this work, differs not from elementary fire or the light of the sun; it pervades the whole system of nature; its expansion is nothing else than its motion from a centre towards a circumference, for it does not seem capable of any proper expansion by a separation of its parts like any other fluid. Hence, when it begins to expand in this manner, the motion is propagated through it with a velocity far exceeding that of any other fluid whatever. Thus, even when the quantity is excessively small, as when an electric spark is sent through a glass full of water or of oil, the expansion is so violent as to dissipate the glass into innumerable fragments, with great danger to the bystanders, as is observed under the article ELECTRICITY. In violent lightning, where the electric fluid collects itself into balls, the strength of the explosion is proportionable to the quantity. Every one has heard of the prodigious effects of lightning when it happens to strike buildings, trees, or even the most solid rocks; and in some cases, where the quantity of electricity is still greater than in any flash of lightning, we hear of still more tremendous consequences ensuing. Dr Priestley gives an instance of a large fire ball (undoubtedly a quantity of electric matter) rolling on the surface of the sea, which after rising up to the top-mast of a ship of war, burst with such violence that the explosion resembled the discharge of hundreds of cannon fired at once. Great damage was done by it; but there is not the least doubt that most of its force was spent on the air, or carried down to the sea by the mast and iron work of the ship. Indeed, considering that in all cases a great part of the force of electric explosions is dissipated in this manner, it may justly be doubted whether they can be measured by any method applicable to the mensuration of other forces. Even in artificial electricity the force is prodigiously great; insomuch that Dr Van Marum calculated that of the great battery belonging to the machine in Teyler's museum to be upwards of 900 pounds.

Volcanic explosions next in strength.

In those cases where the electrical matter acts like common fire, the force of the explosions, though exceedingly great, is capable of mensuration by comparing the distances to which the bodies are thrown with their weight. This is most evident in volcanoes, where the projections of the burning rocks and lava manifest

In what manner aerial explosions take place.

Explosion of gunpowder explained.

Of pulvis fulminans, &c.

the greatness of the power, at the same time that they afford a method of measuring it. These explosions, as is shown under the article VOLCANO, are owing to extrication of aerial vapours, and their rarefaction by intense heat. In all of them the air is originally in a state of decomposition, viz. its invisible and solid part is joined with some terrestrial substances. Thus, when fixed air, for instance, is exposed to any pure earth which attracts it, as calcined magnesia, a decomposition instantly takes place. All these vapours are composed of elementary fire and some invisible substance capable of assuming a solid form. The decomposition just mentioned is therefore easily explained; the solid part of the air joins itself to the magnesia, while the elementary fire or latent heat is dissipated, and passes through the sides of the vessel. Were it now in our power suddenly to restore the latent heat to the whole of the fixed air, so that it would at once assume its former expansion, a violent explosion would follow. This seems to be precisely the case with the volcanic explosions. An immense quantity of the fixed part of different aerial fluids is united to the various substances found below the surface of the earth. By means of the electric fire which kindles the volcanoes, the aerial fluids are suddenly restored to their elastic state; and not only so, but their natural elasticity is greatly augmented, so that the explosions take place with great violence. The case is the same with gunpowder; only that the condensed air in this case is at first of the dephlogisticated kind, but is quickly phlogisticated by reason of the combustible matters mixed with the nitre, while the heat produced by the inflammation augments the elasticity of the generated air to four times what it usually is, so that the whole force of the explosion is calculated at 1000 times the pressure of the common atmosphere *. Thus the explosions of gunpowder and of volcanoes are essentially the same. The reason of the extreme quickness of those of gunpowder is, that it takes fire so readily by the intimate mixture and combustibility of all the materials. In volcanoes the explosions likewise follow one another very quickly, and are by no means inferior in strength to those of gunpowder: but here the quantity of vapour makes up for the comparative slowness with which it is affected by the heat. Thus, though we could not by any means contrive to fire cannon in quick succession by means of calcareous earth as we can do with gunpowder, yet in the huge furnace of a volcano the elastic matter is supplied in such quantities, that the explosions are in a manner unremitting; and even in ordinary experiments the confinement of aerial vapours has often occasioned violent explosions in chemical vessels. In one case too the extraction of fixed air adds excessively to the force of an explosion, viz. in that of pulvis fulminans. This is compounded of sulphur, saltpetre, and salt of tartar. The latter we know contains much fixed air: and it is probable that the violence of the explosion is occasioned by this air; for the greater quantity of it that the alkaline salt contains, the greater force does it explode with. Fulminating gold emits a quantity of phlogisticated air, to which its explosive power is supposed to be owing, as is explained under the article CHEMISTRY; but that of fulminating silver is so extraordinary, that scarce any force of aerial vapour that can be extricated is likely to produce it, and it seems probable that electricity itself is concerned.

Explosions by aqueous vapours.

Violent explosion of water with melted copper.

Probably owing to a decomposition of the water.

Particularly explained.

Next in strength to the aerial vapours are those of aqueous and other liquids. The most remarkable effects of these are observed in steam engines; but there is one particular case from which it has been inferred that aqueous steam is vastly stronger than the flame of gunpowder. This is when water is thrown upon melted copper; for here the explosion is so strong as almost to exceed imagination; and the most terrible accidents have been known to happen from such a slight cause as one of the workmen spitting in the furnace where copper was melting. Here, however, it is most probable that a decomposition of the water takes place. That this element can be decomposed, or resolved into elastic vapours, has been completely established by the most satisfactory experiments, and is now, we believe, universally admitted by chemical philosophers. See WATER, CHEMISTRY *Index*. The position is indeed denied by the phlogistians; but their arguments appear not to be conclusive; nor is it a fact which militates in the least against their principles. On the supposition that the water is decomposed in the present case, however, the phenomenon in question is easily solved. The water being thrown in substance upon the melted copper, is decomposed by the violent heat; and one part of it adheres to the metal, thus converting it into a calx, or oxide, while the other is converted into inflammable air, or hydrogen gas, which expanding suddenly, throws the melted metal all about with the greatest violence by means of its reaction.

To understand the manner in which this is accomplished, we must consider some of the principles of GUNNERY laid down by Mr Robins, and related under that article. One of these is, that though the air, in cases of ordinary velocity, makes no great resistance, it is far otherwise where the velocity of the moving body becomes very great. In all cases of explosion also there is in the first instance a resisting vacuum made by the exploding fluid; and consequently the weight of the atmosphere is to be overcome, which amounts to about 14 pounds on every square inch of surface. Supposing the surface of the exploding fluid, then, on that of melted copper, to contain an area of 4 square inches, it meets with a resistance of 60 pounds from the atmosphere, and consequently communicates an equal pressure to the fluid metal. Even this must of consequence throw it about, unless the same pressure was exactly diffused over every part of the surface. But much more must this effect be increased by the immense velocity with which the fluid moves, and by which the resistance of the atmosphere is augmented in a prodigious degree, as is explained under the article GUNNERY. The elastic fluid generated is then confined not only by the fluid metal and sides of the furnace, but by the air itself, which cannot get out of the way; so that the whole resembles a cannon closed at the mouth, and filled with inflamed gunpowder. Hence not only the melted metal, but the furnace itself and the adjacent walls of the building, are hurried off as they would be by the firing of a great quantity of gunpowder in a small space, and which is well known to produce analogous effects.

In explaining the phenomenon in question, Dr Black supposes that the mere heat of the metal applied to the

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* See the article *Gunnery*.

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aqueous steam produces the explosion; and in proof of this alleges, that copper imbibes a greater quantity of heat during fusion than any other metal. Aqueous steam, however, seems to be too slow for producing such sudden and violent effects. Explosions, it is true, will be occasioned by it, but then it must be confined for a very considerable time; whereas the effects of water thrown upon melted copper are instantaneous.

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It may now be asked, Why such explosions do not take place with any other metal, iron for instance, when water is thrown upon its surface in fusion? In answer to this we must observe, That though water is decomposed by being applied to red-hot iron in the form of steam, yet there is a possibility, that when the same element is applied in substance to the fluid metal, no decomposition may ensue. Something like this indeed happens with copper itself; for, notwithstanding the violent effects which take place on the contact of water in substance with the melted metal, no explosion happens though aqueous steam be blown upon its surface. On the contrary, the upper part of the metal is thus cooled, and forms itself into cakes, which are afterwards taken off, and new ones formed in the same manner; neither does aqueous steam affect red-hot copper in the manner that it does iron in the same state. A decisive proof that the explosion is not occasioned by the mere heat of the aqueous steam may be deduced from the example of melted glass, which produces no explosion though we pour water upon it in that state; and yet the heat of melted glass is undoubtedly equal at least to that of melted copper. It must be observed, however, that in all cases where a very hot body is thrown upon a small quantity of water in substance, an explosion will follow; but here the water is confined and suddenly rarefied into steam, which cannot get away without throwing off the body which confines it. Examples of this kind frequently occur where masons or other mechanics are employed in fastening cramps of iron into stones, where, if there happens to be a little water in the hole into which the lead is poured, the latter will fly out in such a manner as sometimes to burn them severely. Terrible accidents of this kind have sometimes happened in founderies, when large quantities of melted metal have been poured into wet moulds. In these cases, the sudden expansion of the aqueous steam has thrown out the metal with violence; and if any decomposition has taken place at the same time, so as to convert the aqueous into an aerial vapour, the explosion must be still greater.

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To this last kind of explosion we must refer that which takes place on pouring cold water into boiling or burning oil or tallow. Here the case is much the same whether we pour the oil on the water, or the water on the oil. In the former case, the water which lies at the bottom is rarefied into steam, and explodes; in the latter, it sinks down through the oil by its superior specific gravity, and explodes as it passes along. In either case, however, the quantity of aqueous fluid must be but small in proportion to that of the oil: a very great quantity would put out the flame, or destroy the heat, in whatever way we applied it.

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Another kind of explosion is that which takes place in solid substances, where we can scarcely suppose either aqueous or aerial vapours to be concerned. The most remarkable of these are the *volcanic bombs* mentioned by Sir William Hamilton in the great eruption of Vesuvius in 1779. They were large pieces of lava which burst in pieces like bombs as they fell to the ground; but he does not inform us whether their bursting was attended with any great violence or not. Indeed, amidst such scenes of horror, and the continual tremendous explosions of the volcano, smaller phenomena of this kind would probably be overlooked. Other examples are the *Glass Tears*, of which an account is given under that article; the bursting of electrical globes, when put in motion; of other glass vessels spontaneously, and seemingly without any cause; and lastly, the bursting of large cast metal vessels in the act of cooling. These are all so similar to one another, that it is probable they depend on one general cause. All of them agree in this respect, that the extreme parts of them are considerably cooled, while the internal remain very hot. Thus, in the volcanic bombs, the current of air, formed by their swift passage through it in falling, necessarily carries off a great quantity of heat from the parts which are in contact with it, while the rest are scarce at all cooled. The glass tears are artificially cooled on the outside by dropping them upon water; and in consequence of this, their explosion is probably more violent in proportion to their bulk than that of the volcanic bombs. Glass vessels only burst spontaneously when they have not been well annealed; and we know that this bad annealing consists only in applying cold too suddenly to the outside. Something like this probably takes place when cast-iron vessels explode; and we are certain it does so with electrical globes, for these last are not apt to burst if they have been well annealed. In all cases, therefore, there is a remarkable contraction of the outward surface by the cold, while the internal parts remain as much expanded as ever. In this case there must be a continual effort of that subtile fluid called *elementary fire*, from the internal to the external part, as the contraction gradually proceeds the contrary way. Thus, when a volcanic bomb, for instance, is cooled on the outside, its parts are consolidated so that the internal fluid has not such an easy passage through it as is necessary. In consequence of this it makes a greater effort, which is still farther augmented by the cooling and contraction of the internal parts squeezing the fluid out from among themselves, and forcing it to recoil upon that in the centre, as well as to exert itself against the external part; from which united operation the effect already mentioned at last takes place. This explanation, however, does not hold with respect to electrical globes, glass tears, or ill annealed glass: but in order to accommodate it to all these, we have only to remember, that *fire*, and the electric fluid acting from a centre to a circumference, are not in the least different; so that from whatever cause the electric matter is disposed to act in this manner, the same effect will follow, i. e. an explosion will take place if the substance does not afford an equally ready passage through all its parts, and that whether any sensible heat is felt in it or not.

Explosion of hydrogen and oxygen air.

The only other kind of explosion we have to take notice of is that produced by inflammable and dephlogisticated air, or oxygen and hydrogen gases, when mixed together and set on fire. This differs from any of those hitherto considered, because in reality there is an absolute

lute condensation rather than an expansion throughout the whole of the operation; and the result is the formation of water; and could the airs be made to take fire throughout their whole substance absolutely at the same instant, there would be no explosion, but only a sudden production of heat. From this cause also is derived a very singular phenomenon, taken notice of by Dr Priestley in his experiments on that subject, recorded in the Phil. Trans. Having enclosed several quantities of inflammable and dephlogisticated air in a copper vessel, firing them afterwards by the electric sparks, he found that the force of the explosion was directed more towards one part of the vessel than another; least on that part where the electrical discharge was made, and most upon that which was farthest from it. This inequality was very considerable; insomuch that he could not repeat his experiments any number of times without injuring the vessel in that part which was farthest from the discharge. The reason he gives for this is, that the mixture was not fired at the same instant, but first at the place where the discharge was made. This first explosion would have acted equally upon all parts of the vessel, had it not been for the intervention of the air. By the first momentary explosion, however, the air in the farthest part of the vessel was condensed, so that the next explosion was made stronger, while the copper in the fore part of the vessel had the whole of this strong explosion to resist, the hinder part being but little concerned, as the air in it was condensed and reduced almost to a vacuum.

Singular phenomenon observed by Dr Priestley.

Uses to which explosions are applied.

Though the phenomena of explosions are sometimes very destructive, they are likewise of considerable use in life, by removing obstacles which could scarcely be got the better of by any mechanical power whatever. The principal of these are the blowing up of rocks, the separating of stones in quarries, and other purposes of that kind. The destruction occasioned by them in times of war, and the machines formed upon the principle of explosion for the destruction of the human race, are well known; and if we cannot call these *useful*, we must allow them at least to be necessary evils. For the production of explosions, gunpowder is the only substance that has yet been found to answer; nevertheless, as its use is attended with considerable expence, several attempts have been made to find out a cheap substitute for it. One of the most remarkable of these was by mixing small quantities of water, enclosed in little bladders or some easily destructible vehicles, along with a charge of powder. By this contrivance it was hoped that the water being converted into vapour when the powder was inflamed, would augment the force of the explosion: but instead of this, it was found greatly to diminish it. The reason was evident, viz. that the conversion of the water into steam required so much of the latent heat of the inflamed gunpowder, that enough was not left to give the necessary expansion to the aerial fluid produced. A mixture of hydrogen and oxygen gases has also been tried; but the explosion here has always been found too weak. In mines, indeed, very terrible effects are produced by such a mixture, but in these the quantity is immense; so that the comparative weakness of the mixture cannot be discovered. Electricity therefore seems to be the only resource we have; except by adding ingredients to gunpowder which may increase the strength of it. There can be no doubt indeed that the electric fluid is possessed of sufficient strength to perform every thing we could desire; and electricians have supposed, perhaps justly enough, that a cannon charged with water might, by means of electricity, become more dangerous than one charged with gunpowder: but this fluid is so exceedingly capricious, so imperceptible and unmanageable, that the use of it cannot as yet be thought practicable, nor in all probability ever will be so.

Attempts to supersede the use of gunpowder.

Effects of explosions on the atmosphere and electric fluid.

The effects of explosions, when violent, are felt at a considerable distance, by reason of the concussions they give to the atmosphere; for, as has been already hinted, all of them act upon the atmospherical fluid with the very same force they exert upon terrestrial substances subjected to their action. Sir William Hamilton relates, that at the explosions of Vesuvius in 1767, the doors and windows of the houses at Naples flew open if unbolted, and one door was burst open though it had been locked. A great quantity of gunpowder being put into the ditch of a fortified city, and set on fire, destroyed part of the wall, and broke down one of the gates. The blowing up of powder magazines or powder mills will destroy buildings and kill people, though certainly without the reach of the flame, and untouched by any part of the shattered magazine or mill. But the most curious effect is, that they electrify the air, and even glass windows, at a considerable distance. This is always observable in firing the guns of the Tower at London; and some years ago, after an explosion of some powder mills in the neighbourhood of that city, a great number of people were alarmed by a rattling and breaking of their china ware; which by the vulgar was taken for a supernatural phenomenon, but undoubtedly was owing to some commotion in the electrical fluid from the violent concussion of the atmosphere. In this respect, however, the effects of electrical explosions themselves are most remarkable, though not in the uncommon way just mentioned; but it is certain that the influence of a flash of lightning is diffused for a great way round the place where the explosion happens, producing many very perceptible changes both on the animal and vegetable creation.

EXPONENT, in *Algebra*, the same with index. See ALGEBRA.

EXPONENT is also used in arithmetic, in the same sense as index or logarithm.

*EXPONENTIAL Calculus*, the method of differencing, or finding the fluxions of exponential quantities, and of summing up those differences, or finding their fluents.

*EXPONENTIAL Curve*, is that whose nature is defined or expressed by an exponential equation; as the curve denoted by $a^x = y$, or by $x^x = y$.

*EXPONENTIAL Equation*, is one in which is contained an exponential quantity; as the equation $a^x = b$, or $x^x = ab$, &c.

*EXPONENTIAL Quantity*, is that whose power is a variable quantity; as the expression $a^x$, or $x^y$. Exponential quantities are of several degrees and orders, according to the number of exponents or powers, one over another.

EXPORTATION, the shipping and carrying out of the kingdom wares and commodities for other countries. See the articles COMMERCE, TRADE, and SHIPPING.

EXPOSING,

**EXPOSING**, the act of setting a thing to public view. In the Romish church, the sacrament is said to be *exposed* when it is shown in public uncovered on festival days, and during the time of plenary indulgences.

**EXPOSING** is also used with a farther latitude; thus we say, It is prohibited to expose false and clipped money. Such a house stands very high, and has a delicious prospect; but it is exposed to all the four winds. Such a city being on the frontiers, and not fortified, is exposed to the insults of every party of forces.

*Exposing of Children*, a barbarous custom practised by most of the ancients excepting the Thebans, who had an express law to the contrary, whereby it was made capital to expose children; ordaining at the same time, that such as were not in a condition to educate them should bring them to the magistrates, in order to be brought up at the public expence. Among the other Greeks, when a child was born, it was laid on the ground; and if the father designed to educate his child, he immediately took it up; but if he forbore to do this, the child was carried away and exposed. The Lacedæmonians indeed had a different custom; for with them all new-born children were brought before certain triers, who were some of the gravest men in their own tribes, by whom the infants were carefully viewed; and if they were found lusty and well favoured, they gave orders for their education, and allotted a certain proportion of land for their maintenance; but if weakly or deformed, they ordered them to be cast into a deep cavern in the earth, near the mountain Taygetus, as thinking it neither for the good of the children themselves nor for the public interest, that defective children should be brought up. Many persons exposed their children only because they were not in a condition to educate them, having no intention that they should perish. It was the unhappy fate of daughters especially to be thus treated, as requiring more charges to educate and settle them in the world than sons.

The parents frequently tied jewels and rings to the children they exposed, or any other thing whereby they might afterwards discover them, if Providence took care for their safety. Another design in adorning these infants was either to encourage such as found them to nourish and educate them, if alive, or to give them human burial if dead. The places where it was usual to expose children were such as people frequented most. This was done in order that they might be found, and taken up by compassionate persons who were in circumstances to be at the expence of their education. With this intention, the Egyptians and Romans chose the banks of rivers, and the Greeks the high-ways.

**EXPOSITION**, in general, denotes the setting a thing open to public view. See EXPOSING.

**EXPOSITION**, in a literary sense, the explaining an author, passage, writing, or the like, and setting their meaning in an obvious and clear light.

**EXPOSITOR**, or **EXPOSITORY**, a title which some writers have given to a lesser kind of dictionaries or vocabularies, serving to expound or explain the meaning of the obscure or difficult words of a language. It is also used in the same sense with commentary and paraphrase.

**EX-POST-FACTO**, in *Law*, denotes something done after another thing that was committed before. An estate granted may be made good by matter *ex-post-facto*, that was not so at first by election, &c.

**EXPOSTULATION**, in *Rhetoric*, a warm address to a person who has done another some injury, representing the wrong in the strongest terms, and demanding redress.

**EXPOSURE**, in *Gardening*, the situation of a garden wall, or the like, with respect to the points of the compass, as south or east. See GARDENING.

**EXPRESSED OILS**, such oils as are obtained from bodies only by pressing. See CHEMISTRY and MATERIA MEDICA *Index*.

**EXPRESSION**, in *Rhetoric*, the elocution, diction, or choice of words in a discourse. See LANGUAGE, ORATORY, and POETRY.

**EXPRESSION**, in *Music*. See COMPOSITION.

**EXPRESSION**, in *Painting*, a natural and lively representation of the subject, or of the several objects intended to be shown.

The expression consists chiefly in representing the human body and all its parts, in the action suitable to it: in exhibiting in the face the several passions proper to the figures, and observing the motions they impress on the external parts. See PAINTING.

*Expression, Theatrical*. See DECLAMATION, Article iv.

**EXPRESSION**, in *Medicine, Chemistry*, &c. the act of expressing or extracting the juices or oils of plants, fruits, or other matters, by squeezing, wringing, or pressing them in a press. After having let the herbs infuse a due time, their juice must be drawn by expression in a linen cloth or by a press.

**EXPULSION**, in a general sense, the act of violently driving a person out of any city, society, &c.

**EXPULSION**, in *Medicine*, the act whereby any thing is forcibly driven out of the place in which it is: thus we say, the expulsion of the fœtus in delivery.

**EXSICCATION**, (formed of *ex* and *siccus*, "dry,") in *Chemistry*, &c. the act of drying up or evaporating the moisture of a thing.

**EXSPIRATION**, in *Physic*, that part of respiration by which the air is expelled or driven out of the lungs. See ANATOMY *Index* and RESPIRATION.

**EXSUDATION**, or **EXUDATION**, the act of sweating out. In which manner, gums, balsams, &c. are usually produced from trees.

**EXTANT**, something that still subsists, or is in being. It is but part of the history of Livy, of the writings of Cicero, Cæsar, &c. that are extant, the rest are lost. We have nothing extant of Socrates, though he wrote a great deal.

**EXTASY**, a transport which suspends the function of the senses, by the intense contemplation of some extraordinary or supernatural object.

**EXTASY**, in *Medicine*, a species of catalepsy, when a person perfectly remembers, after the paroxysm is over, the ideas he conceived during the time it lasted.

**EXTENSION**, in *Philosophy*, one of the common and essential properties of body; or that by which it possesses or takes up some part of universal space, which is called the place of that body. See METAPHYSICS.

**EXTENSOR**, an appellation given to several muscles,

muscles, from their extending or stretching the parts to which they belong. See ANATOMY, *Table of the Muscles*.

EXTENT, in *Law*, is used in a double sense. Sometimes it signifies a writ or command to the sheriff for the valuing of lands or tenements; and sometimes the act of the sheriff, or other commissioner, upon this writ.

*Old and New* EXTENT, *in Scots Law*. See LAW *Index*.

EXTENUATION, the act of diminishing or lessening the bulk or substance of a thing, especially of the human body. Fevers, agues, long abstinences, &c. occasion great extenuations or emaciations.

EXTENUATION, is also a figure in rhetoric, opposite to the hyperbole. The Greeks call it λιτοτης.

EXTERIOR, or EXTERNAL. See EXTERNAL.

EXTERMINATION, in general, the extirpating or destroying something.

EXTERMINATION or EXTERMINATING, in *Algebra*, is used for taking away. Thus algebraists speak of exterminating surds, fractions, and unknown quantities out of equations. See Maclaur. Algebr. Part I. Chap. 12. where we have some general theorems for the exterminating unknown quantities in given equations.

EXTERNAL, a term of relation applied to the surface or outside of a body, or that part which appears or presents itself to the eye, touch, &c. in contradistinction to internal.

EXTERNAL is also used to signify any thing that is without side a man, or that is not within himself, particularly in his mind; in which sense we say, external objects, &c.

EXTINCTION, in general, denotes the putting out or destroying something, as a fire or flame. See *Extinguishing of* FIRE.

EXTINGUISHMENT, in *Law*, is a consolidation or union, as where one has due to him a yearly rent out of lands, and afterwards purchases the lands out of which the rent arises; in this case, both the property and the rent being united in one possessor, the rent is said to be extinguished.

EXTIRPATION (formed of *ex* and *stirps*, "root,") the act of pulling up or destroying a thing to the very roots. Among the prayers of the Romish jubilee, there is one for the extirpation of heresy.

EXTIRPATION is also used, in *Surgery*, for cutting off any part entirely; as a wen, &c. or the eating it away, as a wart, &c. by corrosive medicines.

EXTISPEX, in antiquity, the person who drew presages from viewing the entrails of animals offered in sacrifice.

EXTORTION, in *Law*, is an illegal manner of wresting any thing from a man, either by force, menace, or authority. It is also the exaction of unlawful usury, winning by unlawful games, and taking more than is due under pretence of right, as excessive tolls in millers, &c.

At the common law, extortion is punishable by fine and imprisonment; and the statute of 3 Eliz. 1. c. 30. has enacted, that officers of justice guilty of extortion for the expedition of business, &c. shall render to the party treble value. There are likewise divers other statutes for punishing extortions of sheriffs, bailiffs, gaolers, clerks of the assize and of the peace, attorneys, solicitors, &c.

EXTRACT, in *Pharmacy*, is a solution of the purer parts of a mixed body inspissated, by distillation or evaporation, nearly to the consistence of honey.

EXTRACT, in matters of literature, is something copied or collected from a book or paper.

EXTRACTION, in *Chemistry* and *Pharmacy*, the operation by which essences, tinctures, &c. are drawn from natural bodies.

EXTRACTION, in *Surgery*, is the drawing any foreign matter out of the body by the hand, or by the help of instruments. See SURGERY.

EXTRACTION, in genealogy, implies the stock or family from which a person is descended. See DESCENT.

*EXTRACTION of Roots*, in *Algebra*, and *Arithmetic*, the method of finding the roots of given numbers or quantities. See ALGEBRA and ARITHMETIC.

EXTRACTOR, in *Midwifery*, an instrument or forceps for extracting children by the head.

EXTRAJUDICIAL, something done out of the proper court, or the ordinary course of law. As when judgment is given in a cause, or case, not depending in that court where such judgment is given, or wherein the judge has no jurisdiction.

EXTRAORDINARII, amongst the Romans, was a body of men consisting of the third part of the foreign horse and a fifth of the foot, which was separated from the rest of the forces borrowed from the confederate states with great policy and caution, to prevent any design that they might possibly entertain against the natural forces. A more choice body of men were drawn from among the extraordinarii, under the name of *ablecti*. See ABLECTI.

EXTRAORDINARY, something out of the common course.

*EXTRAORDINARY Couriers* are those sent express on some urgent occasion.

*EXTRAORDINARY Ambassador*, or envoy, is such a one as is sent to treat or negotiate some special and important affair, as a marriage, a treaty, confederacy, &c. or even on occasion of some ceremony, as condolence, congratulation, &c.

A gazette, journal, or other newspaper extraordinary is that published after some great and notable event, containing the detail or particulars thereof, which are not found in the ordinary papers.

EXTRAVAGANTES, those decretal epistles which were published from the CLEMENTINES.

They were so called, because at first they were not digested or ranged with the other papal constitutions, but seemed to be, as it were, detached from the canon law. They continued to be called by the same name when they were afterwards inserted in the body of the canon law. The first extravagantes are those of John XXII. successor of Clement V. The last collection was brought down to the year 1483, and was called the *common extravagantes*, notwithstanding that they were likewise incorporated with the rest of the canon law.

EXTRAVASATION, in contusions, fissures, depressions, fractures, and other accidents of the cranium, is when one or more of the blood-vessels, that are distributed

distributed in the dura mater, is broken or divided, whereby there is such a discharge of blood as greatly oppresses the brain, and disturbs its office; frequently bringing on violent pains and other mischiefs; and at length death itself, unless the patient is timely relieved. See Surgery and Medicine *Index*.

**EXTREME**, is applied to the last and outermost part of any thing; or that which finishes and terminates it on that side.

Extremes, in *Logic*, denote the two extreme terms of the conclusion of a syllogism; viz. the predicate and subject. They are called *extremes*, from their relation to another term, which is a medium or mean between them. The predicate, as being likewise had in the first proposition, is called the *majus extremum*, greater extreme; and the subject, as being put in the second or minor proposition, is called the *minus extremum*, lesser extreme. Thus, in the syllogism, "Man is an animal; Peter is a man, therefore Peter is an animal;" the word animal is the greater extreme, Peter the less extreme, and man the medium. See Syllogism.

*Extreme and mean proportion*, in *Geometry*, is when a line is so divided, that the whole line is to the greater segment, as that segment is to the other: Or, as it is expressed by Euclid, when the line is so divided that the rectangle under the whole line, and the lesser segment, is equal to the square of the greater segment.

*Extreme Unction.* See Unction.

**EXTREMITIES** of figures, in *Painting*, is used for the head, hands, and feet. These should be drawn with more nicety and exactness, or more terminated than other parts; and thus help to render the action more expressive.

**EXTRINSIC**, among metaphysicians, is taken in various senses. Sometimes it signifies a thing's not belonging to the essence of another; in which sense the efficient cause and end of a thing are said to be extrinsic. Sometimes it signifies a thing's not being contained within the capacity of another; in which sense, those causes are called extrinsic which introduce something into a subject from without, as when a fire introduces heat. Sometimes it signifies a thing added or applied to another; in which sense accidents and adherents are said to be extrinsic to the subjects to which they adhere. Sometimes the vision is said to be extrinsic from some form which does not exist in that thing, but is adjacent to it, or by some means or other without it.

**EXTUBERANCES**, in *Medicine*, are swellings or risings up in the flesh or other parts of the body.

**EXUBERANCE**, (compounded of *ex* and *uber*, "plentiful"), in *Rhetoric*, a redundancy. See Redundance and Pleonasm.

**EXUDATION.** See Exsudation.

**EXVERRÆ**, in antiquity, a kind of brush used in cleansing houses, out of which a dead person had been carried.

**EXULCERATION**, in *Medicine*, the act of causing or producing ulcers. Thus, arsenic exulcerates the intestines; corrosive humours exulcerate the skin.

Exulceration is sometimes also used for an ulcer itself; but more generally for those beginning erosions which wear away the substance, and form ulcers.

**EXUVIÆ**, among naturalists, denote the cast off parts or coverings of animals, as the skins of serpents, caterpillars and other insects.

Exuviæ is also used for shells and other marine bodies, frequently found in the bowels of the earth; supposed to have been deposited there at the deluge; as being the real spoils of once living creatures. See Deluge, Conchology, and Geology.

**EY**, in our old writers, the same with *insula*, "an island;" from which comes *eyet*, a small island or islet, vulgarly called *eyght*.

**EYCK.** See Bruges, *John of*.

**EYE**, in *Anatomy*. See Anatomy *Index*.

A new born child shall be observed, perhaps, never to keep its eyes fixed on any one object, but continually changing from one to another, and if you put your hand before them, the child will not wink. Hence some have thought, that new-born infants have no sight: but this is a mistake; and the true reason why their eyes are in perpetual motion is, that they have not yet acquired the habit of examining one thing at once with their eyes; their not winking at the approach of the hand, arises from their want of experience how easily their eyes may be hurt; but in a few days they get the habit of winking, so that afterwards their eyes do it spontaneously at the approach of danger.

Artificial eyes are made of concave plates of gold, silver, or glass, and are stained so as to resemble the natural eye. They must, when fixed in the orbit, be taken out and cleaned every night, and replaced in the morning. If no more of a diseased eye is removed than what is preternaturally projected, or if enough is left to preserve the muscles unhurt, the artificial eye will have a little motion from the muscles that remain. If the eye does not fit well, it irritates and inflames the other eye; in which case lay it aside, until one can be had that fits better.

*Bull's Eye*, in *Astronomy*. See Aldebaran.

*Eye of a Block*, in naval affairs, that part of the rope-strop which is fastened to some necessary place in the ship: the strop is a sort of wreath or rope formed into a ring, and fixed round the block for the double convenience of strengthening the block and fastening it in any place where it is wanted.

Eye, in *Agriculture* and *Gardening*, signifies a little bud or shoot, inserted into a tree by way of graft. See Engraftting.

*Eye of a Tree*, a small pointed knot to which the leaves stick, and from which the shoots or sprigs proceed. See Gemma.

Eye, a town of Suffolk, 22 miles from Ipswich and 91 from London. It may be called an island, because it is surrounded by a brook near the borders of Norfolk. It was incorporated by King John; has two bailiffs, 10 principal burgesses, 24 common council, a recorder, and town clerk. It is a mean-built place, with narrow streets. The chief manufacture is bone-lace and spinning. Here is, however, a large handsome church; and near it are the ruinous walls of an ancient castle and monastery. The market is on Saturday, the fair on Whit-Monday. It has only sent members to parliament since the reign of Edward IV. Population 1893 in 1811.

*Eye-Bright.* See Euphrasia, Botany *Index*.

**EYMOUTH**, a town of Scotland in the county of Berwick, formerly fortified to curb the garrison of Berwick, from which place it is distant six miles. W. Long. 1. 50. N. Lat. 55. 50. It gave title of baron in the kingdom of Scotland to Churchill, afterwards the great duke of Marlborough; but he having no male issue, it became extinct. Population 962 in 1811.

EYRAC, or IRAC, ARABIA, a province of Turkey in Asia, 345 miles in length, and 190 in breadth; of which Bagdad is the capital.

*Eyrac Agemi*, the principal province of Persia, anciently called *Parthia*.

EYRE, or EIRE, in *Law*, the court of itinerant justices. See ASSIZE.

EYRIE, in *Falconry*, a brood or nest, a place where hawks build and hatch their young.

EZEKIEL, a canonical book of the Old Testament, referring chiefly to the degenerate manners and corruptions of the Jews of those times. It abounds with fine sentences and rich comparisons, and discovers a good deal of learning in profane matters.

Ezekiel was carried captive to Babylon with Jehoiachin, and began his prophecies in the fifth year of the captivity. He was cotemporary with Jeremiah, who prophesied at the same time in Judea. He foretold many events, particularly the destruction of the temple, the fatal catastrophe of those who revolted from Babylon to Egypt, and the happy return of the Jews to their own land.

EZION-GABER. See ASIONGABER.

EZRA, a canonical book of the Old Testament; comprehending the history of the Jews from the time of Cyrus's edict for their return, to the 20th year of Artaxerxes Longimanus. It specifies the number of Jews who returned, and Cyrus's proclamation for the rebuilding the temple, together with the laying its foundation, the obstruction it met with, and the finishing thereof in the reign of Darius.

The illustrious author of this book was also the restorer and publisher of the canon of the Old Testament. See BIBLE.

The books of Ezra, called in the English version the *First and Second Book of Esdras*, though held by some, particularly the Greeks, for canonical, are thrown by the English church into the number of apocryphal books, being only extant in Greek.

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# F.

F, THE fourth consonant, and sixth letter of the alphabet. The letter F is borrowed from the digamma or double gamma of the Æolians, as is evident from the inscription on the pedestal of the Colossus at Delos; and was undoubtedly formed from the old Hebrew vau: and though this letter is not found in the modern Greek alphabet, yet it was in the ancient one, from whence the Latins received it and transmitted it to us.

It is formed by a strong expression of the breath, and joining at the same time the upper teeth and under lip. It has but one sort of sound, which has a great affinity with *v* and *ph*, the latter being written for it by us in all Greek words, as *philosophy*, &c. though the Italians write it *filosofia*.

The Romans for some time used an inverted F, Ⅎ, instead of V consonant, which had no peculiar figure in their alphabet. Thus, in inscriptions we meet with TERMINAℲIT, DIℲI, &c. Lipsius and others say, that it was the emperor Claudius who introduced the use of the inverted digamma, or Ⅎ: but it did not long subsist after his death; for Quintilian observes, that it was not used in his time.

F, or FA, in *Music*, is the fourth note in rising in this order of the gamut, *ut*, *re*, *mi*, *fa*. It likewise denotes one of the Greek keys in music, destined for the bass.

F, in physical prescription, stands for *Fiat*, or "Let it be done." Thus *f. s. a.* signifies *fiat secundum artem*.

F, was also a numeral letter signifying 40; according to the verse,

*Sexta quaterdenos gerit quæ distat ab alpha.*

And when a dash was added at top, thus, F̄, it signified forty thousand.

F, in the civil law. Two f's joined together thus, *ff*, signify the Pandects. See PANDECTS.

F, in the civil law, a stigma or brand put upon felons with a hot iron, on their being admitted to the benefit of clergy; by stat. 4 Hen. VII. c. 13.

FABA. See VICIA, BOTANY *Index*.

FABAGO, a species of bean-caper. See ZYGOPHYLLUM, BOTANY *Index*.

FABER. See ZEUS, ICHTHYOLOGY *Index*.

FABIAN, ROBERT, an alderman of the city of London, and sheriff in the year 1494, was a person of learning for the times he lived in, a good poet, and author of a Chronicle of England and France, entitled *The Concordance of Stories*, in two volumes folio, beginning with Brute, and ending with the 20th of Henry VII. 1504. It contains several curious particulars relative to the city of London, not elsewhere to be found. Stow calls it "a painful labour, to the great honour of the city, and of the whole realm:" We are told that Cardinal Wolsey caused as many copies of this book as he could procure to be burned, because the author had made too clear a discovery of the large revenues of the clergy. Fabian died in 1512.

FABII, a noble and powerful family at Rome, who derived their name from *faba*, a bean, because some of their ancestors cultivated this pulse. They were once so numerous that they took upon themselves to wage a war against the Veientes. They came to a general engagement near the Cremera, in which all the family, consisting of 306 men, were totally slain, in the year of Rome 277. There only remained one whose tender age had detained him at Rome, and from him arose the noble Fabii in the following ages.

**FABIUS MAXIMUS RULLIANUS**, was the first of the Fabii who obtained the surname of *Maximus*, for lessening the power of the populace at elections. He was master of horse: and his victory over the Samnites in that capacity nearly cost him his life, because he engaged the enemy without the command of the dictator. He was five times consul, twice dictator, and once censor. He triumphed over seven different nations in the neighbourhood of Rome, and rendered himself illustrious by his patriotism.

**FABIUS** *Rusticus*, an historian in the age of Claudius and Nero. He was intimate with Seneca; and the encomiums which Tacitus passed upon his style, make us regret the loss of his compositions.

**Q. FABIUS** *Maximus*, a celebrated Roman, who from a dull and inactive childhood was raised to the highest offices of the state. In his first consulship he obtained a victory over Liguria; and the fatal battle of Thrasymenus occasioned his election to the dictatorship. In this important office he began to oppose Hannibal, not by fighting him in the open field, like his predecessors, but he continually harassed his army by countermarches and ambuscades, from which he received the surname of *Cunctator* or *Delayer*. Hannibal sent him word, "That if he was as great a captain as he would be thought, he ought to come into the plain and give him battle." But Fabius coldly replied, "That if he was as great a captain as he would be thought, he would do well to force him to fight." Such operations for the commander of the Roman armies gave offence to some; and Fabius was even accused of cowardice. He, however, continued firm in his first resolution; and patiently bore to see his master of horse raised to share the dictatorial dignity with himself by means of his enemies at home. When he had laid down his office of dictator, his successors for a while followed his plan; but the rashness of Varro, and his contempt for the operations of Fabius, occasioned the fatal battle of Cannæ. Tarentum was obliged to surrender to his arms after the battle of Cannæ; and on that occasion the Carthaginian army observed that Fabius was the Hannibal of Rome. When he had made an agreement with Hannibal for the ransom of the captives, which was totally disapproved by the Roman senate, he sold all his estates to pay the money, rather than forfeit his word to the enemy. The bold proposal of young Scipio to go and carry the war from Italy to Africa, was rejected by Fabius as chimerical and dangerous. He did not, however, live to see the success of the Roman armies under Scipio, and the conquest of Carthage by measures which he treated with contempt and heard with indignation. He died in the 100th year of his age, after he had been five times consul, and twice honoured with a triumph. The Romans were so sensible of his great merit and services, that the expences of his funeral were defrayed from the public treasury. His son bore the same name, and shewed himself worthy of his noble father's virtues. During his consulship he received a visit from his father on horseback in the camp. The son ordered his father to dismount; and the old man cheerfully obeyed, embracing his son, and saying, "I wished to know whether you knew what it is to be consul." He died before his father, and Cunctator, with the moderation of a philosopher, delivered a funeral oration over the dead body of his son.

**FABIUS**, styled *Pictor*, a Roman general and historian. He first introduced painting at Rome; and having caused the walls of the temple of Health to be painted, some authors have erroneously reckoned him a painter. He died about 216 B. C.

**FABLE**, a tale, or feigned narration, designed either to instruct or divert, disguised under the allegory of an action, &c.

Fables were the first pieces of wit that made their appearance in the world; and have continued to be highly valued, not only in times of the greatest simplicity, but in the most polite ages of the world. Jotham's fable of the trees is the oldest that is extant, and as beautiful as any that have been made since. Nathan's fable of the poor man is next in antiquity. We find Æsop in the most distant ages of Greece; and in the early days of the Roman commonwealth, we read of a mutiny appeased by the fable of the belly and the members. As fables had their rise in the very infancy of learning, they never flourished more than when learning was at its greatest height; witness Horace, Boileau, and Fontaine.

Fable is the finest way of giving counsel, and most universally pleasing, because least shocking; for, in the reading of a fable, a man thinks he is directing himself, whilst he is following the dictates of another, and consequently is not sensible of that which is the most unpleasing circumstance in advice. Besides, the mind is never so much pleased as when she exerts herself in any action that gives her an idea of her own abilities; this natural pride of the soul is very much gratified in the reading of fable.

**FABLE**, is also used for the plot of an epic or dramatic poem; and is, according to Aristotle, the principal part, and, as it were, the soul of the poem. See POETRY.

**FABRI, HONORIUS**, a laborious Jesuit, born in the diocese of Bellay, distinguished himself by his skill in philosophy and the mathematics, and by writing a great number of books; the most curious of which treat of geometry, optics, the loadstone, the motion of the earth, the ebbing and flowing of the sea, &c. He died at Rome in 1688.

**FABRIANO, GENTILE DA**, painter of history, was born at Verona in 1332, and became a disciple of Giovanni da Fiesole. In that early age of painting he rendered himself very famous, and was employed to adorn a great number of churches and palaces at Florence, Urbino, Siena, Perusia, and Rome, but particularly in the Vatican; and one picture of his, representing the Virgin and Child, attended by Joseph, which is preserved in the church of S. Maria Maggiore, was highly commended by Michael Angelo. By order of the doge and senate of Venice, he painted a picture in the great council chamber, which was considered as so extraordinary a performance, that his employers granted him a pension for life, and conferred on him the highest honour of their state, which was, the privilege of wearing the habit of a noble Venetian. He died in 1412.

FABRIC, in general, denotes the structure or construction of any thing; but particularly of buildings, as a church, hall, house, &c. See ARCHITECTURE.

*Fabric Lands*, those formerly given towards rebuilding and repairing of cathedrals and other churches; for anciently almost every body gave more or less, by his will, to the fabric of the parish church where he dwelt.

FABRICIUS, C. a celebrated Roman, who in his first consulship, year of Rome 470, obtained several victories over the Samnites and Lucanians, and was honoured with a triumph. The riches which were acquired in those battles were immense, the soldiers were liberally rewarded by the consul, and the treasury was enriched with 400 talents. Two years after, Fabricius went as ambassador to Pyrrhus, and refused with contempt presents, and heard with indignation offers, which might have corrupted the fidelity of a less virtuous citizen. Pyrrhus had occasion to admire the magnanimity of Fabricius; but his astonishment was more powerfully awakened when he saw him make a discovery of the perfidious offers of his physician, who pledged himself to the Roman general for a sum of money to poison his royal master. To this greatness of soul was added the most consummate knowledge of military affairs, and the greatest simplicity of manners. Fabricius never used rich plate at his table. A small salt-cellar, the feet of which were of horn, was the only silver vessel which appeared in his house. This contempt of luxury and useless ornaments Fabricius wished to inspire among the people; and during his censorship he banished from the senate Cornelius Ruffinus, who had been twice consul and dictator, because he kept in his house more than ten pounds weight of silver plate. Such were the manners of the conqueror of Pyrrhus, who observed that he wished rather to command those that had money, than possess it himself. He lived and died in the greatest poverty. His body was buried at the public charge, and the Roman people were obliged to give a dowry to his two daughters when they had arrived at years of maturity.

Fabricius, *George*, a learned German, born at Chemnitz in Misnia, in 1516. After a liberal education, he visited Italy in quality of tutor to a young nobleman; and, examining all the remains of antiquity with great accuracy, compared them with their descriptions in Latin writers. The result of these observations was his work entitled *Roma*, containing a description of that city. He afterwards settled at Misenum, where he conducted a great school to the time of his death in 1571. He was also the author of a great number of sacred Latin poems, wrote seven books of the *Annals of Misnia*, three of the *Annals of Meissen*, and *Travels*.

Fabricius, *Jerom*, a celebrated physician in the latter end of the 16th century (surnamed *Aquapendente*, from the place of his birth), was the disciple and successor of Fallopius. He chiefly applied himself to surgery and anatomy, which he professed at Padua for 40 years with extraordinary reputation. The republic of Venice settled a large pension upon him, and honoured him with a gold chain and a statue. He died in 1603; leaving behind him several works which are much esteemed.

Fabricius, *John Albert*, one of the most learned and laborious men of his age, was born at Leipsic in 1668. He was chosen professor of eloquence at Hamburgh in 1699, and was made doctor of divinity at Kiel. His works are numerous: and he died at Hamburgh in 1736, after a life spent in the severest literary application to collect and publish valuable remains of ancient learning.

Fabricius, *Vincent*, born at Hamburgh in 1613, was a good poet, a great orator, an able physician, and a learned civilian. He was for some time counsellor to the bishop of Lubec, and afterward burgomaster and syndic of the city of Dantzic; from whence he was 13 times sent deputy into Poland, where he died at Warsaw in 1657, during the diet of that kingdom. The most complete edition of Fabricius's poems and other works was published at Leipsic in 1685, under the direction of his son Frederic Fabricius.

Fabricius, *Baron*, one of the finest gentlemen of his time, and known to the public by his letters relating to the transactions of Charles XII. of Sweden during his residence in the Ottoman empire, was descended from a good family in Germany. He was taken early into the service of the court of Holstein; and was sent in a public character to the king of Sweden whilst he was at Bender; where he soon acquired the good graces of that prince. He accompanied him in his exercises: gave him a turn for reading; and it was out of his hand Charles snatched Boileau's satires, when he tore out those that represented Alexander the Great as a madman. Fabricius was also in favour with Stanislaus, and with our King George I. whom he accompanied in his last journey to Hanover, and was with him when he died. A translation of his letters was published in London 1761.

FABROT, Charles Hannibal, one of the most celebrated civilians of his time, was born at Aix in 1681; and acquired an extraordinary skill in the civil and canon law, and in the belles lettres. He published the *Basilicæ*, or Constitutions of the Emperors of the East, in Greek and Latin, with learned notes, in seven vols. folio; and editions of *Cedrenus*, *Nicetas*, *Anastasius Bibliothecarius*, *Constantine Manasses*, and *Cujas*, with learned and curious notes.

FABULOUS, something consisting of, or connected with, a fable.

*Fabulous Age*, among ancient historians. See Age.

FACE, the surface, or first side which a body presents to the eye. We say, the *face* of the earth, of the waters, &c. Polyhedrons have several *faces*. A die, or cube, has six *faces*.

Face, is particularly used for the visage of an animal, and especially of man; and comprehends, in the latter, all that part of the head which is not covered with the common long hair. The Latins call it *facies*, *vultus*, *os*, &c.

The human face is called the *image of the soul*, as being the seat of the principal organs of sense; and the place where the ideas, emotions, &c. of the soul are chiefly set to view. Pride and disdain are shown in the eyebrows, modesty on the cheeks, majesty in the forehead,

head, &c. It is the face shows the sex, age, temperament, health, or disease, &c.

The face, considered as the index of the passions, habits, &c. of the person, makes the subject of physiognomy. See PHYSIOGNOMY.

FACE, among painters and artists, is used to denote a certain dimension of the human body, adopted for determining the proportion which the several parts should bear to one another. See DRAWING.

FACE, in the military art, a word of command, intimating to turn about: thus, *face to the right*, is to turn upon the left heel a quarter-round to the right; and, *face to the left*, is to turn upon the right heel a quarter-round to the left.

**FACIES HIPPOCRATICA**, in *Medicine*, is when the nostrils are sharp, the eyes hollow, the temples low, the tips of the ears contracted and cold, the forehead dry and wrinkled, and the complexion pale or livid.—The Hippocratic face is chiefly observed towards the period of phthisis pulmonalis, and other consumptions, and is held a sure prognostic of death. If it appear within three days after the attack of an acute disease, it is deemed to indicate death.

**FACTION**, a cabal or party formed in a state, city, or company.

FACTION, in antiquity, a name given to the different companies of combatants in the circus. They were four, viz. the white, the red, the green, and the blue; to which Domitian added another of purple colour. They were so denominated from the colour of the liveries they wore; and were dedicated, according to M. Aur. Cassiodorus, to the four seasons of the year; the green being consecrated to spring, the blue to winter, the red to summer, and the white to autumn. It appears from ancient inscriptions, that each faction had its procurators and physician; and from history, that party rage ran so high among them, that in a dissension between two factions, in the time of Justinian, almost 40,000 men lost their lives in the quarrel.

**FACTITIOUS**, any thing made by art, in opposition to what is the production of nature. Thus, factitious cinnabar is opposed to native cinnabar.

**FACTOR**, in commerce, is an agent employed by merchants residing at other places, to buy or sell goods, or negotiate bills, or transact any kind of business on their account; and entitled to a certain allowance for his trouble.

A supercargo differs from a factor in this: The business of the former is limited to the care of a particular cargo; he goes along with it, and generally returns when his business is completed: the latter has a fixed residence abroad, and executes business for different merchants. But their duties, and the circumstances for which they are accountable, are the same.

The duty of a factor is to procure the best intelligence of the state of trade at his place of residence; of the course of exchange; of the quantity and quality of goods at market, their present price, and the probability that it may rise or fall: to pay exact obedience to the orders of his employers; to consult their advantage in matters referred to his direction; to execute their business with all the dispatch that circumstances admit; to be early in his intelligence, distinct in his accounts, and punctual in his correspondence.

A factor's power is either absolute or limited. Though intrusted with ample discretionary powers, he is not warranted to take unreasonable or unusual measures, or do any thing contrary to his employer's interest; but it is incumbent on the employer, if he challenge his proceedings, to prove that he could have done better, and was guilty of wilful mismanagement.

When a factor's power is limited, he must adhere strictly to his orders. If he exceeds his power, though with a view to his employer's interest, he is liable for the consequence. For example, if he gives credit when not empowered, or longer credit if not empowered, for the sake of a better price, and the buyer proves insolvent, he is liable for the debt. A factor has no power to give credit unless authorized: But if the goods consigned be generally sold on credit at the place of consignation, the factor will be vindicated for selling at the usual credit, unless expressly restricted.

Although opinion will never justify the factor for departing from orders, necessity sometimes will. If he be limited not to sell goods under a certain price, and the goods be perishable, and not in a situation for being kept, he may sell them, to prevent their destruction, even under the price limited.

A factor is never warranted to deal on trust, except with persons in good credit at the time. If the employer challenges the debtors, it is incumbent on him to prove that their bad circumstances were known at the time of sale; and the factor will be vindicated, if he trusted them at the same time for goods of his own.

If the factor sells his employer's goods on trust, and, after the day of payment is elapsed, receive payment from the purchaser for a debt of his own, he becomes liable in equity for the debt.

In case of bankruptcy, the factor ought immediately to lay attachments, and advise his employers; and he cannot withdraw his attachments, nor compound debts, without orders.

If a factor sells goods belonging to different merchants to the same person, and the buyer proves insolvent, they shall bear the loss in equal proportions; and if the buyer has paid part before his insolvency, without specifying for which, the payment ought to be distributed in equal proportions; but, if the days of payment be fixed, and part of the debts only due, the payment ought to be applied, in the first place, to such debts as were due.

If he makes a wrong entry at the custom-house, and the goods be seized in consequence thereof, he must bear the loss, unless the error be occasioned by a mistake in the invoice, or letter of advice.

The owner bears the loss of goods seized when attempted to be smuggled by his orders; but the factor complying with an unlawful order is liable in such penalties as the laws exact.

If a factor saves the duty of goods due to a foreign prince, he shall have the benefit; for, if detected, he bears the loss.

If a factor sells goods bought by his employer's orders for his own advantage, the employer may recover the benefit, and the factor shall be amerced for the same.

If a factor receives bad money in payment, he bears the loss; but if the value of the money be lessened by the government, the employer bears the loss.

A factor is not liable for goods spoiled, robbed, or destroyed by fire.

If a factor receives counterfeit jewels from his employer, and sells them, the employer is liable to indemnify him for any penalties he may incur.

If a factor be ordered to make insurance, and neglect it, and the subject be lost, he is liable to make it good, providing he had effects in his hands.

If a factor buys goods for his employer, his bargain shall be binding on the employer.

In case of a factor's insolvency, the owner may reclaim his goods; and if they be sold on trust, the owner (and not the factor's creditors) shall recover payment of the debts.

Factor, in multiplication, a name given to the multiplier and multiplicand, because they constitute the product. See Arithmetic.

FACTORAGE, called also *commission*, is the allowance given to factors by the merchant who employs them.

A factor's commission in Britain, on most kinds of goods, is 2½ per cent.; on lead, and some other articles, 2 per cent.; in Italy, 2½ per cent.; in France, Holland, Spain, Portugal, Hamburgh, and Dantzic, 2 per cent.; in Turkey, 3 per cent.; in North America, 5 per cent. on sales, and 5 per cent. on returns; in the West Indies, 8 per cent. for commission and storage. In some places, it is customary for the factors to ensure the debts for an additional allowance, generally 1½ per cent. In that case, they are accountable for the debt when the usual term of credit is expired.

Factorage on goods is sometimes charged at a certain rate per cask, or other package, measure, or weight, especially when the factor is only employed to receive or deliver them.

FACTORY is a place where a considerable number of factors reside, to negotiate for their masters or employers. See Factor.

The most considerable factories belonging to the British are those established in the East Indies, Portugal, Turkey, &c. There are also English factories established at Hamburgh, Petersburgh, Dantzic, and in Holland; all endowed with certain privileges.

FACTUM, in *Arithmetic*, the product of two quantities multiplied by each other.

FACULÆ, in *Astronomy*, certain bright and shining parts, which the modern astronomers have, by means of telescopes, observed upon or about the surface of the sun; they are but seldom seen.—The word is pure Latin; being a diminutive of *fax*, "torch;" and supposed to be here applied from their appearing and disappearing by turns.

FACULTY, in *Law*, a privilege granted to a person, by favour and indulgence, of doing what, by law, he ought not to do.

For granting these privileges, there is a court under the archbishop of Canterbury, called the *court of the faculties*. The chief officer of this court is styled *master of the faculties*, and has a power of granting dispensations in divers cases: as to marry without the banns being first published, to eat flesh on days prohibited, to ordain a deacon under age, for a son to succeed his father in his benefice, a clerk to hold two or more livings, &c.

Faculty, in the schools, a term applied to the different members of an university, divided according to the arts and sciences taught there: thus in most universities there are four faculties, viz. 1. Of arts, which include humanity and philosophy. 2. Of theology. 3. Of physic. And, 4. Of civil law.

*Faculty of Advocates*. See Advocates.

Faculty is also used to denote the powers of the human mind, viz. understanding, will, memory, and imagination. See Metaphysics.

FÆCES, in *Chemistry*, the gross matter, or sediment, that settles at the bottom after distillation, fermentation, and the like.—The fæces of wine are commonly called Lees.

Fæces, in *Medicine*, the excrements voided by stool. See Excrements.

FÆCULENT, in general, is applied to things abounding with fæces or dregs: thus the blood and other humours of the human body are said to be fæculent, when without that purity which is necessary to health.

FAENSA, a city and bishop's see of Italy, situated in the pope's territories, about 30 miles east of Bologna. E. Long. 12. 38. and N. Lat. 44. 30.

FAENZA, a city of Romagna in Italy with a bishop's see. It is an ancient place, and has undergone various revolutions. The river Amona washes its walls, and passes between the city and the suburbs, which are joined by a stone bridge defended by two good towers. The city is remarkable for its earthen ware, which is the best in all Italy.

FAERNUS, Gabriel, a native of Cremona in Italy, was an excellent Latin poet and critic of the 16th century. He was so skilled in all parts of polite literature, that the cardinal de Medicis, afterwards Pope Pius IV. was particularly fond of him. He was the author of some Latin elegies; of 100 Latin fables, selected from the ancients, written in iambic verse; and of several pieces of criticism, as *Censura emendationum Livianarum*, *De Metris Comicis*, &c. He was remarkably happy in deciphering manuscripts, and restoring ancient authors to their purity: he took such pains with Terence in particular, that Bentley has adopted all his notes in the edition he gave of that writer. He died at Rome in 1561; and Thuanus, who wrote his eloge, says that the learned world was greatly obliged to him; yet had been still more so, if, instead of suppressing the then unknown fables of Phædrus, for fear of lessening the value of his own Latin fables, written in imitation of Æsop, he had been content with imitating them. M. Perrault, however, who translated Faernus's fables into French, has defended him from this imputation, by affirming that the first MS. of Phædrus's fables, found in the dust of an old library, was not discovered till about 30 years after Faernus's death.

FAGARA, Iron Wood; a genus of plants belonging to the tetrandria class, and in the natural method ranking under the 43d order, *Dumosæ*. See Botany *Index*.

FAGE, Raimond de la, an excellent designer and engraver, highly esteemed by Carlo Maratti, was born at Toulouse in 1648. He applied himself to designing, through inclination, in spite of his parents; and had no master nor any assistance: but his superior talents supplied the want of them, and he became one of the best designers in Europe; his performances on licentious

centious subjects are the most esteemed. It is reported of this artist, that he never made use of money, but contracted debts; and when the accounts were brought him, he made some design upon the back of the bills, and bid the owners sell the drawings to connoisseurs for the amount, by which they were generally great gainers. Several of those drawings are yet in the cabinets of the curious. He led a loose, depraved life; and his repeated debaucheries put an end to it at the age of 42.

**FAGGOT**, in times of Popery here, was a badge worn on the sleeve of the upper garment of such persons as had recanted or abjured what was then termed *heresy;* being put on after the person had carried a faggot, by way of penance, to some appointed place of solemnity. The leaving off the wear of this badge was sometimes interpreted a sign of apostasy.

**FAGGOTS**, among military men, persons hired by officers, whose companies are not full, to muster and hide the deficiencies of the company; by which means they cheat the king of so much money.

**FAGIUS, PAUL**, *alias* **BUCHLIN**, a learned Protestant minister, born at Rheinzabem in Germany in 1504. He was a schoolmaster at Isna; but afterwards became a zealous preacher, and wrote many books. The persecution in Germany menacing danger to all who did not profess the Romish doctrines, he and Bucer came over to England in 1549, at the invitation of Archbishop Cranmer, to perfect a new translation of the Scriptures. Fagius took the Old Testament, and Bucer the New, for their respective parts; but the design was at that time frustrated by the sudden deaths of both. Fagus died in 1550, and Bucer did not live above a year after. Their bodies were dug up and burned in the reign of Queen Mary.

**FAGONIA**, a genus of plants belonging to the decandria class, and in the natural method ranking under the 14th order, *Gruinales*. See BOTANY *Index*.

**FAGOPYRUM**, or **BUCK-WHEAT**. See POLYGONUM, BOTANY *Index*.

**FAGUS**, the BEECH TREE; a genus of plants belonging to the monœcia class, and in the natural method ranking under the 50th order, *Amentaceæ*. See BOTANY *Index*.

The *chesnut tree*, one of the species belonging to this genus, sometimes grows to an immense size. The largest in the known world are those which grow upon Mount Ætna in Sicily. At Tortworth in Gloucestershire, is a chesnut tree 52 feet round. It is proved to have stood there ever since the year 1150, and was then so remarkable, that it was called the *great chesnut of Tortworth*. It fixes the boundary of the manor, and is probably near 1000 years old. As an ornamental, the chesnut, though unequal to the oak, the beech, and the esculus, has a degree of greatness belonging to it which recommends it strongly to the gardener's attention. Its uses have been highly extolled; and it may deserve a considerable share of the praise which has been given it. As a substitute for the oak, it is preferable to the elm. For door-jambs, window-frames, and some other purposes of the house carpenter, it is nearly equal to oak itself; but it is very apt to be shakey, and there is a deceitful brittleness in it which renders it unsafe to be used as beams, or in any other situation where an uncertain load is required to be borne. It is universally allowed to be excellent for liquor casks; as not being liable to shrink nor to change the colour of the liquor it contains; it is also strongly recommended as an underwood for hop-poles, stakes, &c. Its fruit too is valuable, not only for swine and deer, but as a human food: Bread is said to have been made of it. Upon the whole, the chesnut, whether in the light of ornament or use, is undoubtedly an object of the planter's notice.

**FAINT ACTION**, in *Law*, a feigned action, or such as, although the words of the writ are true; yet for certain causes, the plaintiff has no title to recover thereby.

*FAINT Pleader*, in *Law*, a covinous, false, or collusory manner of pleading, to the deceit of a third person.

**FAINTING.** See LIPOTHYMIA, MEDICINE *Index*.

**FAINTS**, in the distillery, the weak spirituous liquor that runs from the still in rectifying the low wines after the proof-spirit is taken off.

FAINTS are also the last runnings of all distilled spirits. The clearing the worm of these is so essential a point in order to the obtaining a pure spirit by the subsequent distillation, that all others are fruitless without it.

**FAIR**, a greater kind of market, granted to a town, by privilege, for the more speedy and commodious providing of such things as the place stands in need of.

The word fair, is formed from the French *foire*, which signifies the same thing; and *foire* is by some derived from the Latin *forum*, "market;" by others from the Latin *feriæ*, because anciently fairs were always held in the places where the wakes, or feasts of the dedications of churches, called *feriæ*, were held. See FERIÆ.

It is incident to a fair, that persons should be free from being arrested in it for any other debt or contract than what was contracted in the same; or, at least, promised to be paid there. These fairs are generally kept once or twice a-year; and, by statute, they shall not be held longer than they ought by the lords thereof, on pain of their being seized into the king's hands, &c. Also proclamation is to be made, how long they are to continue; and no person shall sell any goods after the time the fair is ended, on forfeiture of double the value, one-fourth to the prosecutor and the rest to the king. There is a toll usually paid in fairs on the sale of things, and for stallage, picage, &c.

Fairs abroad are either free, or charged with toll and impost. The privileges of free fairs consist chiefly, first, in that all traders, &c. whether natives or foreigners, are allowed to enter the kingdom, and are under the royal protection, exempt from duties, impositions, tolls, &c. Secondly, that merchants, in going or returning, cannot be molested or arrested, or their goods stopped. They are established by letters-patent from the prince. Fairs, particularly free fairs, make a very considerable article in the commerce of Europe, especially that of the Mediterranean, and inland parts of Germany, &c.

The most celebrated fairs in Europe are those, 1. Of Frankfort, held twice a-year, in spring and autumn: the first commencing the Sunday before Palm-Sunday, and the other on the Sunday before the eighth of September. Each lasts 14 days, or two weeks; the first of which is called the *week of acceptance*,

*tance*, and the second the *week of payment*. They are famous for the sale of all kinds of commodities; but particularly for the immense quantity of curious books nowhere else to be found, and whence the booksellers throughout all Europe used to furnish themselves. Before each fair, there is a catalogue of all the books to be sold thereat, printed and dispersed, to call together purchasers: though the learned complain of divers unfair practices therein; as fictitious titles, names of books purely imaginary, &c. beside great faults in the names of the authors, and the titles of the real books. —2. The fairs of Leipsic, which are held thrice a-year; one beginning on the first of January; another three weeks after Easter; and a third after Michaelmas. They hold 12 days a-piece; and are at least as considerable as those of Francfort. 3. The fairs of Novi, a little city in the Milanese, under the dominion of the republic of Genoa. There are four in the year, commencing on the second of February, the second of May, the first of August, and second of September. Though the commodities bought and sold here be very considerable; yet, what chiefly contributes to render them so famous, is the vast concourse of the most considerable merchants and negotiants of the neighbouring kingdoms, for the transacting of affairs and settling accounts. 4. The fairs of Riga, whereof there are two in the year; one in May and the other in September. They are much frequented by the English, Dutch, and French ships, as also from all parts of the Baltic. The best time for the sale of goods at Riga is during the fairs. Since the building of the famous city of Petersburgh, these fairs have suffered some diminution. 5. Fairs of Archangel, during which all the trade foreigners have with that city is managed. It holds a month, or six weeks at most, commencing from the middle of August. The Muscovite merchants attend here from all parts of that vast empire; and the English, Dutch, French, Swedish, Danish, and other ships in the port of that city, on this occasion, ordinarily amount to 300. But this is no free fair as the rest are: The duties of exportation and importation are very strictly paid, and on a very high footing. 6. The fair of St Germain, one of the suburbs of Paris, commencing on the third of February, and holding till Easter; though it is only free for the first 15 days. 7. The fairs of Lyons, which Mons. du Chesne, in his Antiquity of Cities, would insinuate, from a passage in Strabo, were established by the Romans; though it is certain, the fairs, as they now stand, are of a much later date. There are three in the year, each lasting 20 days, and free for ever. They begin on Easter Monday, the 26th of July, and the first of December. 8. Fair of Guibray, a suburb of the city of Falaise in the Lower Normandy. It is said to have been established by our William the Conqueror, in consideration of his being born at Falaise. It commences on the 16th of August; and holds 15 days free by charter, and longer by custom. 9. Fair of Beauçaire, held partly in a city of that name, in Languedoc, and partly in the open country, under tents, &c. It commences on the 22d of July, and only holds for three days; yet it is the greatest and most celebrated of all the fairs in that part of Europe, both for the concourse of strangers from all parts of the world, and for the traffic of all kinds of goods: the money returned in these three days amounting sometimes to above six millions of livres.

The fairs of Porto Bello, Vera Cruz, and the Havannah, are the most considerable of all those in America. The two first last as long as the flota and galleons continue in those ports; and the last is opened as soon as the flota or galleons arrive there upon their return for Spain; this being the place where the two fleets join. See Flota and Galleons.

The principal British fairs are, 1. Sturbridge fair, near Cambridge, by far the greatest in Britain, and perhaps in the world. 2. Bristol has two fairs, very near as great as that of Sturbridge. 3. Exeter. 4. West Chester. 5. Edinburgh. 6. Wheyhill; and 7. Burford fair; both for sheep. 8. Pancras fair, in Staffordshire, for saddle-horses. 9. Bartholomew fair, at London, for lean and Welsh black cattle. 10. St Faith's, in Norfolk, for Scotch runts. 11. Yarmouth fishing fair for herrings; the only fishing fair in Great Britain. 12. Ipswich butter fair. 13. Woodborough-hill, in Dorsetshire, for west country manufactures, as kerseys, druggets, &c. 14. Two cheese fairs at Chipping Norton: with innumerable other fairs, besides weekly markets, for all sorts of goods as well our own as of foreign growth.

Fair, in sea-language, is used for the disposition of the wind, when it is favourable to a ship's course, in opposition to that which is contrary or foul. The term *fair* is more comprehensive than *large*, and includes about 16 or 18 points of the compass; whereas large is confined to the beam or quarter, that is, to a wind which crosses the keel at right angles, or obliquely from the stern, but never to one right a-stern.

Fair Isle, a small island lying between Orkney and Shetland, 10 or 12 leagues E. N. E. from the former; and seven, eight, or 10 leagues S. W. from the latter. It is three miles long, and scarcely half a mile broad, very craggy, with three high rocks which are visible both from Orkney and Shetland. It contains a small quantity of arable land, which is very fruitful and well manured; excellent pasturage for sheep; and affords great plenty of sea and water fowl, and all kinds of fish upon the coasts. There is in effect no port, though they have two that are nominally so; one at the south end, which is full of rocks, where only small boats can lie; the other at the north-east end, larger and safer in summer, so that it serves commodiously enough for their fishery. The duke of Medina Sidonia, when commander of the famous Spanish armada in 1588, was wrecked on the east coast of this island. The ship broke to pieces, but the duke and 200 made their escape. They lived here so long, that both they and the inhabitants were almost famished. At length the duke and the poor remains of his people were carried over to the main land of Shetland, and thence to Dunkirk, by one Andrew Humphry, for which service Andrew was rewarded with 3000 merks. This island produced to its former proprietor between 50 and 60l. sterling. It was sold at Edinburgh in 1766, for about 850l. to James Stewart of Burgh, Esq.

*Fair-curve*, is a winding line, used in delineating ships, whose shape is varied, according to the part of the ship which it is intended to describe.

*Fair-way*, in sea language, the path or channel of a narrow bay, river, or haven, in which ships usually advance

advance in their passage up and down; so that if any vessels are anchored therein, they are said to lie in the fair-way.

**FAIRFAX, Edward**, natural son of Sir Thomas Fairfax, was an English poet who lived in the reigns of Elizabeth and James I. He wrote several poetical pieces, and was an accomplished genius. Dryden introduces Fairfax with Spenser, as the leading writers of the times; and even seems to give the preference to the former in the way of harmony, when he observes that Waller owned himself indebted for the harmony of his numbers to Fairfax's *Godfrey of Boulogne*. He died about the year 1632, at his own house called *Newhall*, in the parish of Fuyston, between Denton and Knaresborough, and lies under a marble stone.

**Fairfax**, *Sir Thomas*, general of the parliamentary forces against Charles I. in 1644. See (*History of*) Britain, N° 127. *et seq.* He resigned in 1650; after which he lived privately, till he was invited by General Monk to assist him against Lambert's army. He cheerfully embraced the occasion; and, on the third of December 1659, appeared at the head of a body of gentlemen of Yorkshire; when, upon the reputation of his name, a body of 12,000 men forsook Lambert and joined him. He was at the head of the committee appointed by the house of commons to attend King Charles II. at the Hague, to desire him speedily to return to England; and having readily assisted in his restoration, returned again to his seat in the country; where he lived in a private manner till his death, which happened in 1671, in the 60th year of his age.—He wrote, says Mr Walpole, Memorials of Thomas Lord Fairfax, printed in 1699; and was not only an historian, but a poet. In Mr Thoresby's museum were preserved in manuscript the following pieces: The Psalms of David, the Canticles, the Songs of Moses, and other parts of Scripture, versified, a poem on Solitude; Notes of Sermons, by his lordship, by his lady daughter of Horace Lord Vere, and by their daughter Mary the wife of George second duke of Buckingham; and a Treatise on the Shortness of Life. But of all Lord Fairfax's works, says Mr Walpole, the most remarkable were the verses he wrote on the horse on which Charles II. rode to his coronation, and which had been bred and presented to the king by his lordship. How must that merry monarch, unapt to keep his countenance on more serious occasions, have smiled at this awkward homage from the old victorious hero of republicanism and the covenant! He gave a collection of manuscripts to the Bodleian library.

**FAIRFORD**, a town in Gloucestershire, with a market on Thursdays. It is remarkable for the church, which has curious painted glass windows. They are said to have been taken in a ship by John Tame, Esq. towards the end of the 15th century, who built the church for their sake. They are preserved entire, and the figures are extremely well drawn and coloured. They represent the most remarkable histories in the Old and New Testament. They are frequently visited by travellers, and many go on purpose to view them, as one of the greatest curiosities in England. The painter was Albert Durer. Population 1442 in 1811. W. Long. 1. 46. N. Lat. 51. 42.

**FAIRY**, in ancient traditions and romances, signifies a sort of deity, or imaginary genius, conversant on the earth, and distinguished by a variety of fantastical actions either good or bad.

They were most usually imagined to be women of an order superior to human nature, yet subject to wants, passions, accidents, and even death; sprightly and benevolent while young and handsome; morose, peevish, and malignant, if ugly, or in the decline of their beauty; fond of appearing in white, whence they are often called the *white ladies*.

Concerning these imaginary beings, no less a person than Jervaise of Tilleberry, marshal of the kingdom of Arles, who lived in the beginning of the 13th century, writes thus in a work inscribed to the emperor Otho IV. "It has been asserted by persons of unexceptionable credit, that fairies used to choose themselves gallants from among men, and rewarded their attachment with an affluence of worldly goods; but if they married, or boasted of a fairy's favours, they as severely smarted for such indiscretion." The like tales still go current in Languedoc; and throughout the whole province, there is not a village without some ancient seat or cavern which had the honour of being a fairy's residence, or at least some spring where a fairy used to bathe. This idea of fairies has a near affinity with that of the Greeks and Romans, concerning the nymphs of the woods, mountains, and springs; and an ancient scholiast on Theocritus says, "The nymphs are demons which appear on the mountains in the figure of women:" and what is more surprising, the Arabs and other orientals have their *ginn* and *peri*, of whom they entertain the like notions.

But fairies have been likewise described as of either sex, and generally as of minute stature, though capable of assuming various forms and dimensions. The most charming representation imaginable of these children of romantic fancy, is in the *Midsummer Night's Dream* of Shakespeare; in referring to which, we no doubt have been anticipated by the recollection of almost every reader.

Spenser's Faery Queene is an epic poem, under the persons and characters of fairies. This sort of poetry raises a pleasing kind of horror in the mind of the reader, and amuses his imagination with the strangeness and novelty of the persons who are represented in it; but, as a vehicle of instruction, the judicious object to it, as not having probability enough to make any moral impression.

The belief of fairies still subsists in many parts of our own country. The

"Swart fairy of the mine"

(of German extraction), has scarce yet quitted our subterraneous works; (*vid.* next article. *Puck*, or *Robin Goodfellow*, still haunts many of our villages. And in many parts of Scotland, new-born children are watched till the christening is over, lest they should be stolen or changed by some of these fantastical existences.

***Fairy of the Mine***; an imaginary being, an inhabitant of mines. The Germans believed in two species; one fierce and malevolent: the other a gentle race, appearing like little old men dressed like the miners, and not much above two feet high. These wander about the drifts and chambers of the works; seem perpetually employed,

employed, yet do nothing; some seem to cut the ore, or fling what is cut into vessels, or turn the windlass: but never do any harm to the miners, unless provoked; as the sensible Agricola, in this point credulous, relates in his book *de Animantibus Subterraneis*.

*FAIRY Circle* or *Ring*, a phenomenon pretty frequent in the fields, &c. supposed by the vulgar to be traced by the fairies in their dances. There are two kinds of it; one of about seven yards in diameter, containing a round bare path, a foot broad, with green grass in the middle of it. The other is of different bigness, encompassed with a circumference of grass. Mess. Jessop and Walker, in the Philosophical Transactions, ascribe them to lightning; which is thought to be confirmed by their being most frequently produced after storms of that kind, as well as by the colour and brittleness of the grass roots when first observed. Lightning, like all other fires, moves round, and burns more in the extremity than in the middle: the second circle arises from the first, the grass burnt up growing very plentifully afterwards. Others maintain that these circles are made by ants, which are frequently found in great numbers therein.—Mr Cavallo, in his treatise on electricity, does not think that lightning is at all concerned in the formation of them: "They are not (says he) always of a circular figure; and, as I am informed, they seem to be rather beds of mushrooms than the effects of lightning.

We have frequently observed beds of mushrooms arranged in a circular form like what are called fairy rings; but it will be difficult to account for the mushroom seed being disposed in this manner. It is probable that the seed is dispersed over the whole field, and remains dormant till it is acted on by some stimulus to excite its vegetating powers. Perhaps this stimulus is atmospheric electricity, which acting on particular spots only, produces on them an abundant crop of mushrooms, while none appear in other places.

**FAITH**, in *Philosophy* and *Theology*, that assent which we give to a proposition advanced by another, the truth of which we do not immediately perceive from our own reason or experience; or it is a judgment or assent of the mind, the motive whereof is not any intrinsic evidence, but the authority or testimony of some other who reveals or relates it. Hence, as there are two kinds of authorities and testimonies, the one of God, and the other of man, faith becomes distinguished into divine and human.

*Divine FAITH*, is that founded on the authority of God; or it is that assent we give to what is revealed by God.

The objects of this faith, therefore, are matters of revelation. See REVELATION and RELIGION.

*Human FAITH*, is that whereby we believe what is told us by men. The object hereof is matter of human testimony and evidence. See METAPHYSICS.

FAITH, in practical theology, makes the first of the theological virtues or graces.

Faith in God, in this sense, denotes such a conviction of his being, perfections, character, and government, as produces love, trust, worship, obedience, and resignation.

Faith in Christ, as it has been defined by some, is a mere assent to the gospel as true; according to others, it signifies such a persuasion that he is the Messiah, and such a desire and expectation of the blessings which he has promised in his gospel to his sincere disciples, as engage the mind to fix its dependence upon him, and subject itself to him in all the ways of holy obedience. See THEOLOGY.

Faith, likewise, in respect to futurity, is a moral principle, implying such a conviction of the reality and importance of a future state, as is sufficient to regulate the temper and conduct.

*FAITH*, or *Fidelity* (*Fides*), was deified by the ancient Romans, and had a temple in the Capitol consecrated to her by Attilius Catalinus. Her priests wore white veils: unbloody sacrifices were offered to her, and the greatest oaths were taken in her name. Horace clothes her in white, places her in the retinue of Fortune, and makes her the sister of Justice, *Od.* 24, 35. l. i. Public Faith is represented in a great number of medals; sometimes with a basket of fruit in one hand, and some ears of corn in the other; and sometimes holding a turtle-dove. But the most usual symbol is two hands joined together. The inscriptions are generally, *Fides Augusti*, *Fides Exercitus*, or *Fides Militum*, &c.

**FAITHFUL**, an appellation assumed by the Mahometans. See MAHOMETANS.

**FAITHORN**, WILLIAM, an ingenious English artist, a native of London, was the disciple of Peak the painter, and worked with him three or four years. At the breaking out of the civil war, Peak espoused the cause of his sovereign: and Faithorn, who accompanied his master, was taken prisoner by the rebels at Baringhouse, from whence he was sent to London, and confined in Aldersgate. In this uncomfortable situation he exercised his graver; and a small head of the first Villars duke of Buckingham, in the style of Melan, is reckoned among his performances at that time. The solicitations of his friends in his favour at last prevailed; and he was released from prison, with permission to retire to the continent. In France he found encouragement and protection from the Abbé de Marolles; and it was at this time that he formed an acquaintance with Nanteuil, from whose instructions he derived very considerable advantages. About the year 1650 he returned to England, and soon after married the sister of a Captain Cround. By her he had two sons; Henry, who was a bookseller, and William an engraver in mezzotinto. Faithorn opened a shop near Temple-Bar, where he sold not only his own engravings, but those of other English artists, and imported a considerable number of prints from Holland, France, and Italy. About the year 1680, he retired from his shop, and resided in Printing-House Yard; but he still continued to work for the booksellers, especially Royston, Martin, and Peak the younger, his former master's brother. He painted portraits from the life in crayons; which art he learned of Nanteuil during his abode in France. He also painted in miniature; and his performances in both these styles were much esteemed. His spirits were broken by the indiscretion and dissipation of his son William; and a lingering consumption put an end to his life in 1691. He wrote a book *Upon Drawing, Graving, and Etching*, for which he was celebrated by his friend Thomas Flatman the poet.

**FAKIRS**, Indian monks or friars. They outdo the

the severity and mortification of the ancient Anchorets or Solitaries. Some of them make a vow of continuing all their lifetime in one posture, and keep it effectually. Others never lie down; but continue in a standing posture all their lives, supported only by a stick, or rope under their arm pits. Some mangle their bodies with scourges and knives. They look upon themselves to have conquered every passion, and triumphed over the world; and accordingly scruple not, as if in a state of innocence, to appear entirely naked in public.

The common people of East India are thoroughly persuaded of the virtue and innocence of the fakirs; notwithstanding which, they are accused of committing the most enormous crimes in private.

They have also another kind of fakirs, who do not practise such severities: these flock together in companies, and go from village to village; prophesying, and telling fortunes. They are wicked villains, and it is dangerous for a man to meet them in a lone place: nevertheless the Indian idolaters have them in the utmost veneration. They make use of drums, trumpets, and other musical instruments, to rouse their souls, and work themselves up to an artificial ecstasy, the better to publish their pretended prophecies.

Some of the votaries of these sages most devoutly kiss their privy parts; and they receive this monstrous declaration of respect with a kind of ecstatic pleasure. The most sober and discreet Indians consult them in this preposterous attitude; and their female votaries converse with them a considerable time with the most indecent freedom.

The fire they burn is made of cows dung, dried in the sun. When they are disposed to sleep, they repose themselves on cows dung, and sometimes on ordure itself. They are so indulgent towards every living creature, that they suffer themselves to be overrun with vermine, or stung by insects, without the least reluctancy or complaint.

It is more than probable, those Indian friars have some secret art to lull their senses asleep, in order to render themselves in a great measure insensible of the excessive torments they voluntarily undergo. Ovington assures us, that "as he was one day in an assembly of fakirs, he observed, that they drank opiates infused in water; the intoxicating virtue thereof was enough to turn their brain."

The garment of the chief fakirs consists of three or four yards of orange-coloured linen, which they tie round them, and a tiger's skin, which hangs over their shoulders. Their hair is woven in tresses, and forms a kind of turban. The superior of the fakirs is distinguished from the rest by having a greater number of pieces in his garment, and by a chain of iron, two yards long, tied to his leg. When he designs to rest in any place, a garment is spread upon the ground; on which he sits and gives audience, whilst his disciples publish his virtues.

Some persons of quality in India have become fakirs: among others, five great lords belonging to the court of Schah Gehan, Mogul of the Indies. It is said, there are about two millions of fakirs in the East Indies.

**FALASHA**, a people of Abyssinia, of Jewish origin, described by Mr Bruce, who was at great pains to acquaint himself with their history by cultivating the friendship of the most learned persons among them he could meet with.

According to the accounts received from them, the Falasha are the descendants of those Jews who came from Palestine into Ethiopia, as attendants of Menilek the son of the queen of Sheba or Saba by Solomon. They agree in the relation given by the Abyssinians of that princess, but deny that the posterity of those who came with Menilek ever embraced the Christian religion, as the Abyssinians say they did. They say, that at the decline of the Jewish commerce, when the ports of the Red sea fell into the hands of other nations, and no intercourse took place betwixt them and Jerusalem, the Jewish inhabitants quitted the sea coasts and retired into the province of Dembea. While they remained in the cities on the Red sea, they exercised the trades of brick and tile making, pottery, thatching houses, &c. and after leaving these coasts, they chose the country of Dembea on account of the plenty of materials it afforded for exercising the trades they professed. Here they carried the art of pottery to a great degree of perfection, multiplied exceedingly, and became very numerous and powerful about the time that the Abyssinians were converted to Christianity. As this event was accounted by them an apostasy from the true religion, they now separated themselves from the Abyssinians, and declared one Phineas, of the line of Solomon, their king. Thus, they say, they have still a prince of the house of Judah for their sovereign, though their assertion is treated with contempt, and a nickname bestowed on the Falashan family by the other Abyssinians. About the year 960 the queen of this people, after extirpating the Abyssinian princes on the rock Damo, assumed the sovereignty of the whole empire, which they retained for some time; but their power being by degrees reduced, they were obliged to take up their residence among the rugged mountains of Samen; one of which they chose for their capital, and which has ever since been called the *Jew's Rock*. About the year 1600, they were almost entirely ruined by an overthrow from the Abyssinians, in which both their king and queen were slain; since which time they have been in subjection to the emperors of that country, but are still governed by their own princes. When Mr Bruce was in Abyssinia they were supposed to amount to about 100,000 effective men. Gideon and Judith were the names of the king and queen at that time; and these, according to our author, seem to be preferred to others for the royal family.

The language of this people is very different from the Hebrew, Samaritan, or any other which the Jews ever spoke in their own country. On being interrogated concerning it by Mr Bruce, they said, that it was probably one of those spoken by the nations on the Red sea, among whom they had settled at their first coming. They arrived in Abyssinia, speaking Hebrew, and with the advantage of having books in that language; but had now forgot it, which indeed is not to be wondered at, as they had lost their Hebrew books, and were entirely ignorant of the art of writing. At the time of their leaving Jerusalem, they were in possession both of the Hebrew and Samaritan copies of the law; but when their fleet was destroyed in the time of Rehoboam, and no farther communication with Jerusalem took place, they were obliged to use translations of the Scriptures, or those copies which were in possession of the shepherds, who, they say, were all Jews before the time of Solomon. On being asked, however, where the shepherds got their copy, and being told, that, notwithstanding the invasion of Egypt by Nebuchadnezzar, there was still a communication with Jerusalem by means of the Ishmaelite Arabs through Arabia, they frankly acknowledged that they could not tell: neither had they any memorials of the history either of their own or any other country; all that they believed in this case being derived from mere tradition, their histories, if any existed, having been destroyed by the famous Moorish captain Gragné. They say that the first book of Scripture they received was that of Enoch; and they place that of Job immediately after it, supposing that patriarch to have lived soon after the flood. They have no copy of the Old Testament in the Falasha language, what they make use of being in that of Geez. This is sold to them by the Abyssinian Christians, who are the only scribes in that country. No difference takes place about corruptions of the text; nor do the Falasha know any thing of the Jewish Talmud, Targum, or Cabala. See ABYSSINIA.

**FALCADE**, in the manege, the motion of a horse when he throws himself upon his haunches two or three times, as in very quick curvets; which is done in forming a stop and half stop. See STOP.

**FALCATED**, something in the form of a sickle: thus the moon is said to be *falcated* when she appears horned.

**FALCO**, the eagle and hawk, a genus of birds belonging to the order of accipitres. See ORNITHOLOGY *Index*.

**FALCON**, or FAUCON, a bird of prey of the hawk kind, superior to all others for courage, docility, gentleness, and nobleness of nature[*]. Several authors take the name *falcon* to have been occasioned by its crooked talons or pounces, which resemble a falx or sickle. Giraldus derives it *à falcando*, because it flies in a curve.

The falcon, or falcon gentle, is both for the fist and for the lure. In the choice, take one that has wide nostrils, high and large eyelids, a large black eye; a round head, somewhat full on the top; barb feathers on the clap of the beaks, which should be short, thick, and of an azure colour; the breast large, round and fleshy; and the thighs, legs, and feet, large and strong, with the sear of the foot soft and bluish: the pounces should be black, with wings long and crossing the train, which should be short and very pliable.

The name *falcon* is restrained to the female: for the male is much smaller, weaker, and less courageous than the female; and therefore is denominated *tassel*, or *tircelet*. The falcon is excellent at the river, brook, and even field; and flies chiefly at the larger game, as wild goose, kite, crow, heron, crane, pye, shoveler, &c. For further particulars, see FALCONRY and HAWKING.

The custom of carrying a falcon extended to many countries, and was esteemed a distinction of a man of rank. The Welsh had a saying, That you may know a gentleman by his hawk, horse, and greyhound. In fact, a person of rank seldom went without one on his hand. Harold, afterwards king of England, is painted going on a most important embassy, with a hawk on his hand and a dog under his arm. Henry VI. is represented at his nuptials, attended by a nobleman and his falcon. Even the ladies were not without them in earlier times; for in an ancient sculpture in the church of Milton Abbas, in Dorsetshire, appears the consort of King Athelstan with a falcon on her royal fist tearing a bird.

**FALCONER**, a person who brings up, tames, and makes, that is, tutors and manages, birds of prey; as falcons, hawks, &c. See FALCONRY.

The grand signior, it is said, usually keeps 6000 falconers in his service.—The French king had formerly a grand falconer, which was an office dismembered from that of great hunter, *grand veneur*. Historians take notice of this post as early as the year 1250.

A falconer should be well acquainted with the quality and mettle of his hawks, that he may know which of them to fly early and which late. Every night after flying he should give them casting; one while plumage, sometimes pellets of cotton, and at another time physic, as he finds necessary. He ought also every evening to make the place clean under the perch, that by her casting he may know whether she wants scouring upwards or downwards. Nor must he forget to water his hawk every evening, except on such days as she has bathed; after which, at night, she should be put into a warm room, having a candle burning by her, where she is to sit unhooded, if she be not ramage, that she may pick and prune herself.—A falconer should always carry proper medicines into the fields, as hawks frequently meet with accidents there. Neither must he forget to take with him any of his hawking implements; and it is necessary he should be skilful in making lures, hoods of all sorts, jesses, bewets, and other furniture. Neither ought he to be without his coping irons, to cope his hawk's beak when overgrown, and to cut her pounces and talons as there shall be occasion: nor should his cauterizing irons be wanting.

FALCONER, *William*, an ingenious Scots sailor, who, about the year 1762, came up to London with a pretty pathetic poem, called the *Shipwreck*, founded on a disaster of his own experience. The publication of this piece recommended him to the late duke of York; and he would in all probability have been suitably preferred, if a second shipwreck, as may be supposed, had not proved fatal to him, and to many gentlemen of rank and fortune with whom he sailed. In 1770, he went out a volunteer in the Aurora frigate, sent to carry Messrs Vansittart, Scrafton, and Ford, the supervisors appointed to regulate our East India settlements; which vessel, after it had touched at the Cape of Good Hope, was never more heard of. Before his departure, he published a very useful Marine Dictionary, in one volume 4to.

**FALCONRY**, a kind of sport or amusement, respecting the antiquity of which different opinions have been entertained by the learned. It is denied by Blondus, Laurentius Valla, and others, that the ancient Greeks knew any thing about falconry; but the learned Professor Beckmann, on the most unequivocal authority, maintains that they did. He admits that they might be ignorant of the art of hawking, or of

[*] See *Falco*.

chasing game with birds trained for that purpose; but he contends that they employed some species of the most rapacious of the winged tribe in hunting and fowling. In the days of Ctesias, the Indians hunted hares and foxes by means of rapacious birds; and Aristotle says expressly, "In Thrace, the men go out to catch birds with hawks. They beat the reeds and bushes which grow in marshy places, in order to raise the small birds, which the hawks pursue and drive to the ground, where the fowlers kill them with poles."

Respecting Thrace, which is situated above Amphipolis, a wonderful circumstance is related, which to many may appear almost incredible. We are informed that boys went into the fields, and pursued birds by the assistance of hawks. When they found a convenient place for their purpose, they called their hawks by their particular names, which came immediately on hearing their voices, and pursued the birds into the bushes, where the boys killed them with sticks, and thus made them their prey. When the hawks themselves laid hold of any birds, they threw them to the fowlers, and received, for their fidelity, a share of the game. If we add the spaniel, now employed to find out the game, the hood placed upon the head of the hawk, and the thong for holding it, we may clearly perceive in these ancient accounts the practice of modern times. Falconers still give a portion of the game to the hawk, as was the usual practice of the boys in Thrace.

According to the testimony of Philo, Pliny, Ælian, and others, the birds were sometimes driven into nets by the hawks employed in these sports. From India and Thrace, therefore, it seems manifest, that the Greeks obtained their first information as to the method of fowling with birds of prey; but they themselves do not appear to have adopted the practice at a very early period. In Italy, however, it must have been extremely well understood, since it is mentioned by Martial and Apuleius as a thing everywhere known. After being once known, it was never totally forgotten; but it shared the fate of other inventions in this respect, that it was originally admired, and afterwards much neglected, by which means it received no material improvements for a considerable time; yet it was at length brought to the utmost perfection. We find mention made of this sport in the Roman laws, and in many authors of the fourth and subsequent century. In the time of Constantine the Great, Julius Firmicus Maternus assures us, according to the superstitious notions of that period, that such as are born under certain signs, will become great sportsmen, and keep hounds and falcons. Sidonius, who flourished about the end of the fifth century, praises Herdicius, the brother of his wife, because he was the first in his territories who practised hunting and fowling with dogs and hawks.

Falconry appears to have been carried to the greatest perfection, and to have been much esteemed at the chief courts of Europe, so early as the 12th century, for which reason some have ascribed the invention to the emperor Frederic I. whereas he appears to have been only the first who introduced the practice into Italy, according to the testimony of Rodericus and Collenuccio; and Frederic II. wrote a book entitled, *De arte venandi cum avibus*, to which the practice has been much indebted. Falconry has had a number of admirers among the fair sex, perhaps in a superior degree to any other sport or amusement whatever of a similar nature; but their attachment was destroyed by the invention of gunpowder, which was accompanied both with alarm and danger. We conclude our remarks on the history of falconry with an observation of Demetrius, who flourished in the 13th century, and who expressly wrote at large on this subject. He desires sportsmen to say their prayers (Τον Θεον επικαλεσαντες) before they go out to the field, which appears wholly incompatible with the practice of modern times, and seems as impious as to crave assistance of God when preparing for a piratical expedition.

FALCONRY, the art of training all manner of hawks, but more especially the larger ones called *falcons*, to the exercise of hawking. See HAWKING.

When a falcon is taken, she must be seeled in such a manner, that, as the seeling slackens, she may see what provision lies before her; but care ought to be taken, not to seel her too hard. A falcon or hawk newly taken should have all new furniture, as new jesses of good leather, mailled leashes with buttons at the end, and new bewets. There should also be provided a small round stick, to stroke the hawk; because, the oftener this is done, the sooner and better will she be manned. She must also have two good bells, that she may be found when she scattereth. Her hood should be well fashioned, raised, and embossed against her eyes, deep and yet strait enough beneath, that it may fasten about her head without hurting her; and her beak and talons must be a little coped, but not so near as to make them bleed.

If it be a soar-falcon, which had already passed the seas, she will indeed be harder to reclaim, but will prove the best of falcons. Her food must be good and warm, and given her twice or thrice a-day till she be full gorged: the best for this purpose is pigeons, larks, or other live birds; because she must be broken off by degrees from her accustomed feeding. When she is fed, you must hoop and lure, as you do when you call a hawk, that she may know when you intend to give her meat. On this occasion she must be unhooded gently; and after giving her two or three bits, her hood must be put on again, when she is to get two or three bits more. Care must be taken that she be close seeled; and after three or four days, her diet may be lessened: the falconer setting her every night to perch by him, that he may awaken her often in the night. In this manner he must proceed, till he find her to grow tame and gentle; and when she begins to feed eagerly, he may give her a sheep's heart. He may now begin to unhood her in the day time; but it must be far from company, first giving her a bit or two, then hooding her gently, and giving her as much more. When she is sharp set, he may now unhood her, and give her some meat just against his face and eyes, which will make her less afraid of the countenance of others. She must be borne continually on the fist, till she is properly manned, causing her to feed in company, giving her in the morning, about sunrise, the wing of a pullet; and in the evening the foot of a hare or coney, cut off above the joint, flayed and laid in water, which being squeezed, is to be given her with the pinion of a hen's wing. For two or three days give her washed meat, and then plumage in more or less quantity as she is thought to be more or less foul within. After this, being hooded again, she is is to get nothing till she has gleamed and cast, when a little hot meat may be given her in company; and, towards evening, she may be allowed to plume a hen's wing in company also. Cleanse the feathers of her casting, if foul and slimy; if she be clean within, give her gentle castings; and when she is reclaimed, manned, and made eager and sharp set, he may venture to feed her on the lure.

However, three things are to be considered before the lure be showed her: 1. That she be bold and familiar in company, and not afraid of dogs and horses. 2. Sharp set and hungry, having regard to the hour of morning and evening, when you would lure her. 3. Clean within, and the lure well garnished with meat on both sides; and when you intend to give her the length of a leash, you must abscond yourself.

She must also be unhooded, and have a bit or two given her on the lure as she sits on your fist; afterwards take the lure from her, and hide it that she may not see it; and when she is unseeled, cast the lure so near her, that she may catch it within the length of her leash, and as soon as she has seized it, use your voice as falconers do, feeding her upon the lure, on the ground, with the heart and warm thigh of a pullet.

Having so lured your falcon, give her but little meat in the evening; and let this luring be so timely, that you may give her plumage, and a juck of a joint next morning on your fist. When she has cast and gleamed, give her a little reaching of warm meat. About noon, tie a creance to her leash; and going into the field, there give her a bit or two upon her lure: then unwind the creance, and draw it after you a good way; and let him who has the bird hold his right hand on the tassel of her hood, ready to unhood her as soon as you begin to lure; to which if she come well, stoop roundly upon it, and hastily seize it, let her cast two or three bits thereon. Then, unseizing and taking her off the lure, hood her and give her to the man again; and, going farther off, lure and feed her as before.

In this manner is the falconer to proceed, luring her every day farther and farther off, till she is accustomed to come freely and eagerly to the lure; after which she may be lured in company, taking care that nothing affright her. When she is used to the lure on foot, she is to be lured on horseback; which may be effected the sooner, by causing horsemen to be about her when she is lured on foot.

When she has grown familiar to this way, let somebody on foot hold the hawk, and he on horseback must call and cast the lure about his head, the holder taking off the hood by the tassel; and if she seize eagerly on the lure without fear of man or horse, then take off the creance, and lure her at a greater distance. And if you would have her love dogs as well as the lure, call dogs when you give her her living or plumage. See HAWKING.

FALERII, in *Ancient Geography*, a town of Etruria, on the west or right side of the Tiber; Falisci, the people of the town and territory. The territory was famous for its rich pastures; hence the *gramen Faliscum* in authors. Eutropius and Frontinus call the town *Falisci;* which, according to the last, was surnamed *Colonia Junonia.* The Falisci are called *Æqui* by Virgil; because they afforded supplemental laws to the 12 tables, (Servius). Here they made an excellent sausage, called *Venter Faliscus* (Martial).

When the Falisci were besieged by Camillus, a schoolmaster went out of the gates of the city with his pupils, and proposed to betray them into the hands of the Roman enemy, that by such a possession he might easily oblige the place to surrender. Camillus heard the proposal with indignation, and ordered the man to be stripped naked, and whipped back to the town by those whom his perfidy wished to betray. This instance of generosity operated upon the people so powerfully that they surrendered to the Romans.

FALERNUS, *Mons Massicus* so called, (Martial); Falernus ager, a district at the foot of Mount Massicus in Campania; famous for its generous wines, (Horace, Pliny). Now called *Monte Massico.*

FALISCI. See FALERII.

FALKIA, a genus of plants belonging to the hexandria class. See BOTANY *Index.*

FALKIRK, a town of Stirlingshire in Scotland, situated in W. Long. 3. 48. N. Lat. 56. 20. It is a large ill-built place, and is supported by great fairs for black cattle from the Highlands. A great deal of money is also got here by the carriage of goods landed at Carron wharf to Glasgow. The population of the town and parish, in 1811, was 9929. This town is remarkable for a battle fought in its neighbourhood between Edward I. of England, and the Scots commanded by the steward of Scotland, Cummin of Badenoch, and Sir William Wallace. The latter had been invested with the supreme command; but perceiving that this gave umbrage to the nobility, he resigned his power into the hands of the noblemen above mentioned, reserving to himself only the command of a small body who refused to follow another leader. The Scots generals placed their pikemen along the front, and lined the intervals between the three bodies of which their army was composed, with archers: and dreading the great superiority of the English cavalry, endeavoured to secure their front by pallisadoes tied together with ropes. The battle was fought on the 22d of July 1298. The king of England divided his army likewise into three bodies; and by the superiority of his archers, defeated the Scots with great slaughter. Wallace alone preserved entire the troops he commanded; and retiring behind the Carron, marched leisurely along the banks of that river, which protected him from the enemy. In this battle fell John de Graham, a gentleman much celebrated for his valour, and styled the *right hand* of the gallant Wallace. His epitaph is still to be seen on a plain stone in the churchyard of Falkirk. On the 18th of January 1746, a battle was fought here between the king's forces commanded by General Hawley, and the Highlanders headed by Charles Stuart. The former was seized with a panic, and fled: but Colonel Husk with two regiments, who kept their ground, prevented the Highlanders from pursuing their victory. Extensive ruins are perceived in the neighbourhood of this town, supposed by some antiquarians to have been the capital of the Pictish government; but others believe them to be the remains of some Roman stations.

FALKLAND, a small town of Fifeshire in Scotland, made a royal burgh by James II. in 1458. Here stood one of the seats of the Macduffs earls of Fife. On the attainder of Munro Stewart, the 17th earl, it became forfeited to the crown in 1424. James V. who grew very fond of the place, enlarged and improved it. The remains evince its former magnificence and elegance, and the fine taste of the princely architect. The gateway is placed between two fine round towers; on the right hand joins the chapel, whose roof is of wood, handsomely gilt and painted, but in a most ruinous condition. Beneath are several apartments. The front next to the court was beautifully adorned with statues, heads in bass relief, and elegant columns not reducible to any order, but of fine proportion, with capitals approaching the Ionic scroll. Beneath some of these pillars was inscribed I. R. M. G. 1537. or *Jacobus Rex, Maria de Guise.*—This place was also a favourite residence of James VI. on account of the fine park and plenty of deer. The east side was accidentally burnt in the time of Charles II. and the park ruined during Cromwell's usurpation, when the fine oaks were cut down in order to build the fort at Perth.—This place gives title of viscount to the English family of Carey; Sir Henry Carey being so created by James VI. 1620. His son was the celebrated Lucius, who sacrificed his life in a fit of loyal despair at the battle of Newbury, and from whom the present family is lineally descended.

FALKLAND, *Lord.* See CAREY.

FALL, the descent of a heavy body towards the centre of the earth. It is also the name of a measure of length used in Scotland, containing six ells.

*FALL of Man*, in sacred history, that terrible event by which sin and death were introduced into the world. See ADAM, and ANTEDILUVIANS, and *Original SIN.* The account which Moses gives of this transaction is extremely brief and concise. The serpent, he informs us, being more subtile than any beast of the field, asked the woman, whether it was true that God had not granted her and her husband leave to eat of every tree in the garden? She answered, That God had allowed them to eat of all, except only the fruit of the tree in the midst of the garden; which he commanded they should not taste, nor so much as touch, lest they should die. The serpent replied, That they should not die; for God knew the virtue of the tree; and that so soon as they ate of it, their eyes would be opened, and they would become like gods, knowing good and evil. Eve, seeing the fruit tempting to the view, took of the fruit and ate; and gave also to her husband of it, and he did eat. Immediately the eyes of both were opened; when perceiving they were naked, they sewed fig leaves together and made themselves aprons. Adam and Eve, hearing the voice of God walking in the garden in the cool of the day, hid themselves among the trees; but, on God's calling for Adam, he excused himself for not appearing, because he was naked. God demanded of him, who it was that told him he was naked; and whether he had disobeyed his command in eating the forbidden fruit? Adam confessed that the woman had offered him the fruit, and he had tasted it. She being examined likewise, acknowledged what she had done; but said, the serpent had seduced and deceived her. God then proceeded to judgment; he first cursed the serpent above all beasts, and condemned him to go on his belly, and eat the dust; adding, that he would put enmity between him and the woman, and their offspring; that the seed of the woman should bruise the serpent's head, who should bruise the other's heel. The woman was subjected to the pains of childbirth, as well as the dominion of her husband; and as to the man, God cursed the ground for his sake, declaring that it should bring forth thorns and thistles, and he should earn his bread by the sweat of his brow, till he returned to the dust, from whence he was taken. At last, having clothed them both with skins, he turned them out of the garden, lest they should take of the tree of life, and eat, and live for ever: then, to prevent any attempt to return to their former habitation, he placed cherubims at the east of the garden, and a flaming sword which turned every way, to guard the passage to the tree of life.

This concise account being, at first view, encumbered with some difficulties, several learned and pious men have been inclined to believe the whole ought to be taken in an allegorical sense, and not according to the strictness of the letter: they allege, that the ancients, and particularly the eastern nations, had two different ways of delivering their divinity and philosophy, one popular, and the other mysterious; that the Scripture uses both occasionally; sometimes accommodating itself to the capacities of the people, and at other times to the real but more veiled truth; and that, to obviate the many difficulties which occur in the literal history of this sad catastrophe, the safest way is to understand it as a parabolical story, under which the real circumstances are disguised and concealed, as a mystery not fit to be more explicitly declared.

Though it cannot be denied that some of the ancient philosophers affected such an allegorical way of writing, to conceal their notions from the vulgar, and keep their learning within the bounds of their own school; yet it is apparent Moses had no such design; and as he pretends only to relate matters of fact, just as they happened, without art or disguise, it cannot be supposed but that this history of the fall is to be taken in a literal sense, as well as the rest of his writings. It is generally agreed, that the serpent which tempted Eve was the devil, who envying the privileges of man in innocence, tempted him, and was the cause of his forfeiting all those advantages which he had received from God at his creation; and that to this end he assumed the form of a serpent. These interpretations are supported by many passages of Scripture, where the devil is called the *serpent*, and the *old serpent*, (See John viii. 44. 2 Cor. xi. 3. and Rev. xii. 9.). Some believe that the serpent had then the use of speech, and conversed familiarly with the woman, without her conceiving any distrust in him; and that God, to punish the malice with which he had abused Eve, deprived him of the use of speech. Others maintain, that a real serpent having eaten of the forbidden fruit, Eve from thence concluded, that she too might eat of it without danger; that in effect she did eat of it, and incurred the displeasure of God by her disobedience. This, say these last authors, is the plain matter of fact which Moses would relate under the allegorical representation of the serpent conversing with Eve.

The opinion of such as believe this was not a real serpent, but only the devil under that name, is no less liable

liable to exception than any of the rest. For though the devil is frequently styled in Scripture the *serpent* and the *old serpent*, yet why he should be called the *most subtile beast of the field*, we cannot conceive; neither will the punishment inflicted on the serpent suffer us to doubt, but that a serpent's body at least was employed in the transaction.

The nature of the forbidden fruit is another circumstance in this relation that has occasioned no less variety of conjectures. The Rabbins believe it was the vine; others that it was wheat; and others, from the circumstance of Adam and Eve's covering themselves with fig leaves immediately after their transgression, tell us, that this fruit must have been the fig; some think it was the cherry; and the generality of the Latins will have it to be the apple.

Those who admire allegorical interpretations, will have the forbidden fruit to have been no other than the sensual act of generation, for which the punishment inflicted on the woman was the pain of child-bearing. But this opinion has not the least foundation in the words of Moses, especially if we consider that Adam knew not his wife till after their expulsion out of Paradise.

Many have been the suppositions and conjectures upon this subject in general; and some have so far indulged their fancy in the circumstances of the fall, that they have perverted the whole narration of Moses into a fable full of the most shameful extravagances.

FALLACY, a deception, fraud, or false appearance.

The Epicureans deny that there is any such thing as a fallacy of the senses: for according to them, all our sensations and perceptions, both of sense and phantasy, are true; whence they make sense the primary criterion of truth.

The Cartesians, on the other hand, maintain, that we should suspect as false, or at most as dubious, every thing that presents itself to us by means only of the external senses, because they frequently deceive us. They add, that our senses, as being fallacious, were never given us by nature for the discovery of truth, or the contemplation of the principles of things; but only for pointing out to us what things are convenient or hurtful to our bodies.

The Peripatetics keep a middle course. They say, that if a sensible object be taken in its common or general view, the sense cannot be deceived about it; but that if the object be taken under its specific view, the sense may be mistaken about it, from the want of the dispositions necessary to a just sensation, as a disorder in the organ, or any thing uncommon in the medium: thus, in some disorders of the eye, all objects appear yellow; a stick in water appears broken or crooked, &c.

FALLING SICKNESS, or EPILEPSY. See MEDICINE *Index*.

FALLING-STARS. See STAR.

FALLOPIAN TUBES, in *Anatomy*, two ducts arising from the womb, one on each side of the fundus, and thence extended to the ovaries, having a considerable share in conception. They are called *tubæ*, from their form, which bears some resemblance to a trumpet; and their denomination *Fallopianæ*, they take from Gabriel Fallopius, mentioned in the next article. See ANATOMY *Index*.

FALLOPIUS, GABRIEL, a most celebrated physician and anatomist, was born at Modena in Italy, in the year 1523, and descended of a noble family. He made several discoveries in anatomy, one of which was that of the tubes, called from him the *Fallopian tubes*. He travelled through the greatest part of Europe, and obtained the character of being one of the ablest physicians of his age. He was made professor of anatomy at Pisa in the year 1548, and at Padua in the year 1551: here he died in 1562, aged 39. His writings, which are numerous, were first printed separately, and afterwards collected under the title of "Opera genuina omnia, tam practica quam theoretica, in tres tomes distributa." They were printed at Venice in 1585 and in 1606, at Francfort in 1600, *cum operum appendice*; and in 1606, in folio.

FALLOW, a pale red colour like that of brick half burnt; such is that of a fallow deer.

*FALLOW Field*, or *Fallow ground*; land laid up, or that has been untilled for a considerable time.

FALLOWING *of* LAND, a particular method of improving land. See AGRICULTURE *Index*.

FALMOUTH, a port town of Cornwall in England, situated in W. Long. 5. 30. N. Lat. 50. 15. on a fine bay on the English channel. It is the richest and most trading town in the county, and larger than any three of its boroughs that send members to parliament. It is so commodious a harbour, that ships of the greatest burden come up to its quay. It is guarded by the castle of St Mawes and Pendennis, on a high rock at the entrance: and there is such shelter in the many creeks belonging to it, that the whole royal navy may ride safe here in any wind, it being next to Plymouth and Milford-Haven, the best road for shipping in Great Britain. It is well built; and its trade is considerably increased since the establishment of the packet-boats here for Spain, Portugal, and the West Indies, which not only bring vast quantities of gold in specie and in bars, on account of the merchants in London; but the Falmouth merchants trade with the Portuguese in ships of their own, and they have a great share also in the gainful pilchard trade. The custom-house for most of the Cornish towns, as well as the head collector, is settled here, where the duties, including those of the other ports, are very considerable. The number of houses in 1664 amounted to 200; in 1801, they amounted to 468; in 1811, 478, and at this last period the number of inhabitants was 3933.

FALSE, in general, something contrary to truth, or not what it ought to be: thus we say a false action, false weights, false claim, &c.

*FALSE Action*, if brought against one whereby he is cast into prison, and dies pending the suit, the law gives no remedy in this case, because the truth or falsehood of the matter cannot appear before it is tried; and if the plaintiff is barred, or non-suited at common law, regularly all the punishment is amercement.

*FALSE Imprisonment*, is a trespass committed against a person, by arresting and imprisoning him without just cause, contrary to law; or where a man is unlawfully detained without legal process: and it is also used for a writ which is brought for this trespass. If a person be any way unlawfully detained, it is false imprisonment; and considerable damages are recoverable in those actions.

*False News, spreading of,* in order to make discord between the king and nobility, or concerning any great man of the realm, is punishable by common law with fine and imprisonment; which is confirmed by statutes Westm. 1. 3 Edw. I. cap. 34. 2 Rich. II. stat. 1. cap. 5. and 12 Rich. II. cap. 11.

*False Oath.* See Perjury.

*False Prophecy.* See Prophecy.

*False Quarter,* in *Farriery.* See Quarters, Farriery *Index.*

*False Bay,* a bay lying to the eastward of the Cape of Good Hope; frequented by vessels during the prevalence of the north-westerly winds, which begin to exert their influence in May, and render it dangerous to remain in Table bay. It is terminated to the eastward by False Cape, and to the westward by the Cape of Good Hope. It is 18 miles wide at its entrance, and the two capes bear due east and west from each other.

FALSI crimen, in the civil law, is fraudulent subornation or concealment, with design to darken or hide the truth, and make things appear otherwise than they are. The *crimen falsi* is committed, 1. By words, as when a witness swears falsely. 2. By writing, as when a man antedates a contract, or the like. 3. By deed, as when he sells by false weights and measures.

FALSIFY, in *Law,* is used for proving any thing to be false. Hence we find,

Falsifying a record, for showing it to be erroneous. Thus lawyers teach, that a person purchasing land of another, who is afterwards outlawed of felony, &c. may falsify the record, not only as to the time wherein the felony is supposed to have been committed, but also as to the point of the offence. But where a man is found guilty by verdict, a purchaser cannot falsify as to the offence; though he may for the time, where the party is found guilty generally in the indictment, because the time is not material upon evidence.

FALSTAFF. See Fastolff.

FALX, in *Anatomy,* a part of the dura mater, descending between the two hemispheres of the brain, and separating the fore part from the hinder. It is called *falx,* i. e. "sickle," because of its curvature, occasioned by the convexity of the brain. It divides the brain as low as the corpus callosum.

FAMA clamosa, in the judicial procedure of the church of Scotland, a ground of action before a presbytery against one of its members, independent of any regular complaint by a particular accuser. See Presbytery.

Any person who is of a good character, may give to the presbytery a complaint against one of their members; but the presbytery is not to proceed to the citation of the person accused, until the accuser under his hand gives in the complaint, with some account of its probability, and undertakes to make out the libel, under the pain of being considered as a slanderer. When such an accusation is brought before them, they are obliged candidly to examine the affair. But, besides this, the presbytery considers itself obliged to proceed against any of its members, if a fama clamosa of the scandal is so great that they cannot be vindicated unless they begin the process. This they can do without any particular accuser, after they have inquired into the rise, occasion, and authors, of this report. It is a maxim of the kirk of Scotland, that religion must suffer if the scandalous or immoral actions of a minister are not corrected. And wherever a minister is reputed guilty of any immorality (although before the most popular preacher in the kingdom), none almost will attend upon his ministry. Therefore the presbytery, for the sake of religion, is obliged to proceed against a minister in case of a fama clamosa. This, however, is generally done with great tenderness. After they have considered the report raised against him, then they order him to be cited, draw out a full copy of what is reported, with a list of the witnesses names to be led for proving this allegation. He is now to be formally summoned to appear before them; and he has warning given him, at least 10 days before the time of his compearance, to give in his answers to what is termed the *libel;* and the names of the witnesses ought also to be sent him. If at the time appointed the minister appear, the libel is to be read to him, and his answers are also to be read. If the libel be found relevant, then the presbytery is to endeavour to bring him to a confession. If the matter confessed be of a scandalous nature, such as uncleanness, the presbytery generally depose him from his office, and appoint him in due time to appear before the congregation where the scandal was given, and to make public confession of his crime and repentance. If a minister absent himself by leaving the place, and be contumacious, without making any relevant excuse, a new citation is given him, and intimation is made at his own church when the congregation is met, that he is to be holden as confessed, since he refused to appear before them; and accordingly he is deposed from his office.

FAME, a heathen goddess, celebrated chiefly by the poets. She is feigned to have been the last of the race of Titans produced by the earth, to have her palace in the air, and to have a vast number of eyes, ears, and tongues. She is mentioned by Hesiod, and particularly described by Ovid and Virgil.

FAMES canina. See Bulimia, Medicine *Index.*

FAMIA, or Afamia, the modern name of one of the ancient Apameas. See Apamea.

FAMILIARS of the Inquisition, persons who assist in apprehending such as are accused, and carrying them to prison. They are assistants to the inquisitor, and called *familiars,* because they belong to his family. In some provinces of Italy they are called *cross-bearers,* and in others the *scholars of St Peter the martyr;* and they wear a cross before them on the outside garment. They are properly bailiffs of the inquisition; and the vile office is esteemed so honourable, that noblemen in the kingdom of Portugal have been ambitious of belonging to it. Nor is this surprising, when it is considered that Innocent III. granted very large indulgencies and privileges to these familiars; and that the same plenary indulgence is granted by the pope to every single exercise of this office, as was granted by the Lateran council to those who succoured the Holy Land. When several persons are to be taken up at the same time, these familiars are commanded to order matters, that they may know nothing of one another's being apprehended; and it is related, that a father and his three sons, and three daughters, who lived together in the same house, were carried prisoners to the inquisition without knowing any thing of one another's being there till seven years afterwards, when they that were alive were released by an act of faith.

FAMILY denotes the persons that live together in one house, under the direction of one head or chief manager. It also signifies the kindred or lineage of a person; and is used by old writers for a hide or portion of land sufficient to maintain one family. See HIDE.

FAMILY, in *Natural History*, a term used to express any order of animals, or other natural productions, which exhibit certain affinities, or the same characters.

FAMINE, dearth, or scarcity of food. For preservatives against hunger in times of famine, see the article HUNGER.

FAN, a machine used to raise wind, and cool the air by agitating it.

That the use of the fan was known to the ancients is very evident from what Terence says,

> *Cape hoc* flabellum, *et ventulum huic sic facito;*

and from Ovid, Art. Amand. I. 161.

> *Profuit et tenues ventos movisse* flabello.

The fans of the ancients were made of different materials; but the most elegant were composed of peacocks feathers, or perhaps painted so as to represent a peacock's feather.

The custom which now prevails among the ladies of wearing fans, was borrowed from the east, where the hot climate renders the use of fans and umbrellas almost indispensable.

In the east they chiefly use large fans made of feathers, to keep off the sun and the flies. In Italy and Spain they have a large sort of square fans, suspended in the middle of their apartments, and particularly over the tables: these, by a motion at first given them, and which they retain a long time on account of their perpendicular suspension, help to cool the air and drive off flies.

In the Greek church, a fan is put into the hands of the deacons in the ceremony of their ordination, in allusion to a part of the deacon's office in that church, which is to keep the flies off the priests during the celebration of the sacrament.

What is called a *fan* amongst us and throughout the chief parts of Europe, is a thin skin, or piece of paper, taffety, or other light stuff, cut semicircularly, and mounted on several little sticks of wood, ivory, tortoiseshell, or the like. If the paper be single, the sticks of the mounting are pasted on the least ornamented side: if double, the sticks are placed between them. Before they proceed to place the sticks, which they call *mounting the fan*, the paper is to be plaited in such a manner, as that the plates may be alternately inward and outward.

It is in the middle of each plait, which is usually about half an inch broad, that the sticks are to be pasted; and these again are to be all joined and rivetted together at the other end; they are very thin, and scarcely exceed one-third of an inch in breadth; and where they are pasted to the paper, are still narrower, continuing thus to the extremity of the paper. The two outer ones are bigger and stronger than the others. The number of sticks rarely exceeds 22. The sticks are usually provided by the cabinet-makers or toymen; the fan-painters plait the papers, paint, and mount them.

The common painting is either in colours or gold leaf, applied on a silvered ground, both prepared by the goldbeaters. Sometimes they paint on a gold ground, but it is rarely; true gold being too dear, and false too paltry. To apply the silver leaves on the paper, they use a composition, which they pretend is a great secret, but which appears to be no other than gum arabic, sugar-candy, and a little honey, melted in common water, and mixed with a little brandy. This composition is laid on with a sponge; then laying the silver leaves thereon, and pressing them gently down with a linen ball stuffed with cotton, they catch hold, and adhere together. When, instead of silver, gold ground is laid, the same method is observed. The ground being well dried, a number of the papers are well beaten together on a block, and by this means the silver or gold get a lustre as if they had been burnished.

FAN is also an instrument to winnow corn. The machine used for this purpose by the ancients seems to have been of a form similar to ours. The fan, which Virgil calls *mystica vannus Iacchi*, was used at initiations into the mysteries of the ancients: For as the persons who were initiated into any of the mysteries, were to be particularly good, this instrument, which separates the wheat from the chaff, was the fittest emblem that could be of setting apart the good and virtuous from the vicious and useless part of mankind. It is figuratively applied in a similar manner in Luke iii. 17.

FANATICS, wild, enthusiastic, visionary persons, who pretend to revelation and inspiration.

The ancients called those *fanatici* who passed their time in temples (*fana*), and being often seized with a kind of enthusiasm, as if inspired by the divinity, showed wild and antic gestures. Prudentius represents them as cutting and slashing their arms with knives. Shaking the head was also common among the fanatici; for Lampridius informs us, that the emperor Heliogabalus was arrived at that pitch of madness, as to shake his head with the gashed fanatics. Hence the word was applied among us to the Anabaptists, Quakers, &c. at their first rise, and is now an epithet given to the modern prophets, Muggletonians, &c.

FANCY, or imagination. See IMAGINATION.

FANIONS, in the military art, small flags carried along with the baggage.

FANNERS, a machine for winnowing corn, or for separating the chaff from the grain. See, for its description, MECHANICS.

FANSHAW, SIR RICHARD, famous for his embassies and writings, was the tenth and youngest son of Sir Henry Fanshaw of Ware Park in Hertfordshire, where it is supposed he was born about the year 1607. He distinguished himself so early by his abilities, that in 1635 he was taken into government employments by King Charles I. and sent resident to the court of Spain; whence being recalled in the beginning of the troubles in 1641, he adhered to the royal interest, and was employed in several important matters of state. During his vacant hours he wrote several poems, and made several translations. At the Restoration it was expected he would have been made one of the secretaries of state: however, he was made master of the requests; a station in those times of considerable profit. Afterwards, on account of his skill in the Latin language, he was made secretary for that tongue. In 1661, he was sent envoy to the king of Portugal. In 1662, he was again sent to that court with the title of *ambassador*, and negotiated the marriage of his master King Charles II. with the infanta Donna Catherina. Upon his return he was made one of the privy council. In 1664, he was sent ambassador to both the courts of Spain and Portugal; at which time the foundation of peace betwixt those crowns and England was laid by him. His conduct during his former employments in those courts gained him such high esteem there, that his reception was magnificent, exceeding all that were before, which those kings declared was not to be a precedent to succeeding ambassadors. He died at Madrid in 1666, on the very day he had fixed for setting out on his return to England. Besides some original poems, and other translations, he published a translation of Bathista Guarini's *Pastor Fido*, and another of the *Lusiad* of Camoens. Among his posthumous publications are, "Letters during his embassies in Spain and Portugal; with his life prefixed.

FANTASIA, in the Italian music, signifies *fancy;* and is used for a composition, wherein the composer ties himself to no particular time, but ranges according as his fancy leads, amidst various movements, different airs, &c. This is otherwise called the *capricious style:* before sonatas were used, there were many of this kind, some of which remain even now.

FANUM, among the Romans, a temple or place consecrated to some deity. The deified men and women among the heathens had likewise their *fana;* even the great philosopher Cicero erected one to his daughter Tullia.

*Fanum Vacunæ*, in *Ancient Geography*, a village of the Sabines, situated between Cures and Mandela; where stood the temple of Vacuna, goddess of the idle or unemployed, in an old decayed state: and hence the epithet *putre*, used by Horace. Now called *Vocone*, in the Ecclesiastic State.

FARANDMAN, a traveller, or merchant stranger, to whom, by the laws of Scotland, justice ought to be done with all expedition, that his business or journey be not hindered.

FARCE, was originally a droll, petty show, or entertainment, exhibited by charlatans, and their buffoons, in the open street, to gather the crowd together. —The word is French, and signifies literally, "forcemeat or stuffing." It was applied on this occasion, no doubt, on account of the variety of jests, gibes, tricks, &c. wherewith the entertainment was interlarded. Some authors derive farce from the Latin *facetia;* others from the Celtic *farce*, "mockery;" others from the Latin *farcire*, "to stuff."

At present it is removed from the street to the theatre: and instead of being performed by merry-andrews to amuse the rabble, is acted by comedians, and become the entertainment of a polite audience. Poets have reformed the wildness of the primitive farces, and brought them to the taste and manner of comedy. The difference between the two on our stage is, that comedy keeps to nature and probability, and therefore is confined to certain laws prescribed by ancient critics; whereas farce disallows of all laws, or rather sets them aside on occasion. Its end is purely to make merry; and it sticks at nothing which may contribute thereto, however wild and extravagant. Hence the dialogue is usually low, the persons of inferior rank, the fable or action trivial or ridiculous, and nature and truth everywhere heightened and exaggerated to afford the more palpable ridicule.

FARCIN, or Farcy, a disease in horses, and sometimes in oxen, &c. somewhat of the nature of a scabies or mange. See Farriery *Index*.

FARDING-deal, the fourth part of an acre of land. See Acre.

FARE, most commonly signifies the money paid for a voyage, or passage by water; but, in London, it is what persons pay for being conveyed from one part of the town to another in a coach or chair.

FAREWELL-cape, the most southerly promontory of Greenland, in W. Long. 50°, and N. Lat. 60°.

FARIN, or Farm. See Farm.

FARINA, a Latin term signifying meal, or the flour of corn. See Corn.

*Farina Fœcundans*, among *Botanists*, the supposed impregnating meal or dust on the apices or antheræ of flowers. See Pollen.

The manner of gathering the farina of plants for microscopical observations is this: Gather the flowers in the midst of a dry sunshiny day when the dew is perfectly off, then gently shake off the farina, or lightly brush it off with a soft hair pencil, upon a piece of white paper; then take a single talc or isinglass between the nippers, and, breathing on it, apply it instantly to the farina, and the moisture of the breath will make the light powder stick to it. If too great a quantity be found adhering to the talc, blow a little of it off; and, if there is too little, breathe upon it again, and take up more. When this is done, put the talc into the hole of a slider, and, applying it to the microscope, see whether the little grains are laid as you desire; and if they are, cover them up with another talc, and fix the ring; but be careful that the talcs do not press upon the farina in such a manner as to alter its form.

FARLEU, money paid by the tenants in the west of England, in lieu of a heriot. In some manors of Devonshire, farleu is often distinguished to be the best goods, as heriot is the best beast, payable at the death of a tenant.

FARM, Farin, or *Ferm*, (*Firma*), in *Law*, signifies a little country messuage or district, containing house or land, with other conveniences; hired, or taken by lease, either in writing, or parole, under a certain yearly rent. See Lease.

This in divers parts is differently termed: in the north, it is a *tack;* in Lancashire, *fermeholt;* in Essex, a *wike*, &c.

In the corrupted Latin, *firma* signified a place inclosed or shut in: whence, in some provinces, Menage observes, they call *closerie*, or *closure*, what in others they call a *farm*. Add, that we find *locare ad firmam*, to signify to let to *farm*; probably on account of the sure hold the tenant here has in comparison of tenants at will.

Spelman and Skinner, however, choose to derive the word *farm* from the Saxon *fearme*, or *feorme*, that is, *victus*, "provision;" by reason the country people and tenants anciently paid their rents in victuals and other necessaries, which were afterwards converted into the payment of a sum of money. Whence a *farm* was originally a place that furnished its landlord with provisions. And among the Normans they still distinguish between farms that pay in kind, i. e. provisions, and those which pay in money; calling the former simply *fermes*, and the latter *blanche ferme*, "white farm."

Spelman shows, that the word *firma*, anciently signified not only what we now call a *farm*, but also a feast or entertainment, which the farmer gave the proprietor or landlord, for a certain number of days, and at a certain rate, for the lands he held of him. Thus *fearme* in the laws of King Canute is rendered by Mr Lambard, *victus*: and thus we read of *reddere firmam unius noctis*, and *reddebat unum diem de firma*; which denote provision for a night and day, the rents about the time of the Conquest being all paid in provisions; which custom is said to have been first altered under King Henry I. We also say *to farm* duties, imposts, &c.

*Culture of a* FARM. See AGRICULTURE.

FARM, as connected with gardening, and susceptible of embellishment. See GARDENING.

In speculation, it might have been expected that the first essays of improvement should have been on a farm, to make it both advantageous and delightful; but the fact was otherwise; a small plot was appropriated to pleasure, the rest was reserved for profit only. And this may, perhaps, have been a principal cause of the vicious taste which long prevailed in gardens. It was imagined that a spot set apart from the rest should not be like them: the conceit introduced deviations from nature, which were afterwards carried to such an excess, that hardly any objects truly rural were left within the enclosure, and the view of those without was generally excluded. The first step, therefore, towards a reformation, was by opening the garden to the country, and that immediately led to assimilating them; but still the idea of a spot appropriated to pleasure only prevailed, and one of the latest improvements has been to blend the useful with the agreeable; even the ornamental farm was prior in time to the more rural; and we have at last returned to simplicity by force of refinement.

Of a pastoral farm.

1. The ideas of pastoral poetry seem now to be the standard of that simplicity; and a place conformable to them is deemed a farm in its utmost purity. An allusion to them evidently enters into the design of the Leasowes (A), where they appear so lovely as to endear the memory of their author; and justify the reputation of Mr Shenstone, who inhabited, made, and celebrated the place: it is a perfect picture of his mind, simple, elegant, and amiable; and will always suggest a doubt, whether the spot inspired his verse, or whether, in the scenes which he formed, he only realized the pastoral images which abound in his songs. The whole is in the same taste, yet full of variety; and, except in two or three trifles, every part is rural and natural. It is literally a grazing farm lying round the house; and a walk, as unaffected and as unadorned as a common field-path, is conducted through the several enclosures. But for a detail of the plan and scenery, as illustrative of the present subject, the reader is referred to the particular description of the Leasowes published by the late Mr Dodsley. We shall only take notice of one or two circumstances independent on the general delineation.

The art with which the divisions between the fields are diversified is one of them. Even the hedges are distinguished from each other: a common quickset fence is in one place the separation: in another, it is a lofty hedge-row, thick from the top to the bottom; in a third, it is a continued range of trees, with all their stems clear, and the light appearing in the intervals between their boughs, and the bushes beneath them; in others, these lines of trees are broken, a few groupes only being left at different distances; and sometimes a wood, a grove, a coppice, or a thicket, is the apparent boundary, and by them both the shape and the style of the enclosures are varied.

The inscriptions, which abound in the place, are another striking peculiarity: they are well known and justly admired; and the elegance of the poetry, and the aptness of the quotations, atone for their length and their number. But, in general, inscriptions please no more than once: the utmost they can pretend to, except when their allusions are emblematical, is to point out the beauties, or describe the effects, of the spots they belong to; but those beauties and those effects must be very faint, which stand in need of the assistance. Inscriptions, however, to commemorate a departed friend, are evidently exempt from the censure; the monuments would be unintelligible without them; and an urn, in a lonely grove, or in the midst of a field, is a favourite embellishment at the Leasowes: they are indeed among the principal ornaments of the place; for the buildings are mostly mere seats, or little root-houses; a ruin of a priory is the largest, and that has no peculiar beauty to recommend it: but a multiplicity of objects are unnecessary in the farm; the country it commands is full of them; and every natural advantage of the place within itself has been discovered, applied, contrasted, and carried to the utmost perfection, in the purest taste, and with inexhaustible fancy.

Among the ideas of pastoral poetry which are here introduced, its mythology is not omitted: but the allusions are both to ancient and to modern fables; sometimes to the fairies; and sometimes to the naiads and muses. The objects also are borrowed partly from the scenes which this country exhibited some centuries ago, and partly from those of Arcadia: the priory,

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(A) In Shropshire, between Birmingham and Stourbridge.

priory, and a Gothic seat, still more particularly characterised by an inscription in obsolete language and the black letter, belong to the one; the urns, Virgil's obelisk, and a rustic temple of Pan, to the other. All these allusions and objects are indeed equally rural: but the images in an English and classical eclogue are not the same; each species is a distinct imitative character. Either is proper; either will raise the farm it is applied to above the ordinary level; and within the compass of the same place both may be introduced; but they should be separate: when they are mixed, they counteract one another; and no representation is produced of the times and the countries they refer to. A certain district should therefore be allotted to each, that all the fields which belong to the respective characters may lie together, and the corresponding ideas be preserved for a continuance.

f an an-
ent farm.

2. In such an assortment, the more open and polished scenes will generally be given to the Arcadian shepherd; and those in a lower degree of cultivation, will be thought more conformable to the manners of the ancient British yeomanry. We do not conceive that the country in their time was entirely cleared, or distinctly divided; the fields were surrounded by woods, not by hedges; and if a considerable tract of improved land lay together, it still was not separated into a number of inclosures. The subjects, therefore, proper to receive this character, are those in which cultivation seems to have encroached on the wild, not to have subdued it; as the bottom of a valley in corn, while the sides are still overgrown with wood; and the outline of that wood indented by the tillage creeping more or less up the hill. But a glade of grass, thus circumstanced, does not peculiarly belong to the species; that may occur in a park or pastoral farm; in this, the pastures should rather border on a waste or common: if large, they may be broken by straggling bushes, thickets, or coppices; and the scattered trees should be beset with brambles and briars. All these are circumstances which improve the beauty of the place; yet appear to be only remains of the wild, not intended for embellishment. Such interruptions must, however, be less frequent in the arable parts of the farm; but there the opening may be divided into several lands, distinguished, as in common fields, only by different sorts of grain. These will sufficiently break the sameness of the space; and the tillage does not furnish a more pleasing scene, than such a space so broken, if the extent be moderate, and the boundary beautiful.

As much wood is essential to the character, a spot may easily be found, where turrets rising above the covert, or some arches seen within it, may have the resemblance of a castle or an abbey. The partial concealment is almost necessary to both; for to accord with the age, the buildings must seem to be entire; the ruins of them belong to later days: the disguise is, however, advantageous to them as objects; none can be imagined more picturesque, than a tower bosomed in trees, or a cluster appearing between the stems and the branches. But the superstitions of the times furnish other objects which are more within compass: hermitages were then real; solitary chapels were common; many of the springs of the country being deemed holy wells, were distinguished by little Gothic domes built over them; and every hamlet had its cross, even this, when perfect, set on a little rustic pillar, and that raised upon a base of circular steps, may in some scenes be considerable: if a situation can be found for a May-pole, whence it would not obtrude itself on every view, that also might not be improper; and an ancient church, however unwelcome it may be when it breaks into the design of a park or a garden, in such a farm as this would be a fortunate accident: nor would the old yew in the church-yard be indifferent; it would be a memorial of the times when it was useful.

Many other objects, significant of the manners of our ancestors, might perhaps, upon recollection, occur; but these are amply sufficient for a place of considerable extent; and cottages must abound in every age and every country; they may therefore be introduced in different forms and positions. Large pieces of water are also particularly proper; and all the varieties of rills are consistent with every species of farm. From the concurrence of so many agreeable circumstances in this, be the force or the effect of the character what it may, a number of pleasing scenes may be exhibited, either in a walk or riding, to be contrasted to those which in another part of the place may be formed on Arcadian ideas; or even to be substituted in their stead, if they are omitted.

Of a simple
farm.

3. A part may also be free from either of these imitative characters, and laid out in a common simple farm. Some of the greatest beauties of nature are to be found in the fields, and attend an ordinary state of cultivation: wood and water may there be exhibited in several forms and dispositions; we may enlarge or divide the inclosures; and give them such shapes and boundaries as we please; every one may be an agreeable spot; together, they may compose beautiful views; the arable, the pasture, and the mead, may succeed one another; and now and then a little wild may be intermixed without impropriety; every beauty, in short, which is not unusual in an inclosed country, whether it arises from neglect or improvement, is here in its place.

The buildings, also, which are frequent in such a country, are often beautiful objects; the church and the mansion are considerable: the farm-yard itself, if an advantageous situation be chosen for it; if the ricks, and the barns, and the out-houses, are ranged with any design to form them into groups, and if they are properly blended with trees; may be made a picturesque composition. Many of them may be detached from the group, and dispersed about the grounds: the dove-cot, or the dairy, may be separated from the rest; they may be elegant in their forms, and placed wherever they will have the best effect. A common barn, accompanied by a clump, is sometimes pleasing at a distance; a Dutch barn is so when near; and a hay-stack is generally an agreeable circumstance in any position. Each of these may be single; and besides these, all kinds of cottages are proper. Among so many buildings, some may be converted to other purposes than their construction denotes; and, whatever be their exterior, may within be made agreeable retreats, for refreshment, indulgence, or shelter.

With such opportunities of improvements, even to decoration within itself, and with advantages of prospect into the country about it, a simple farm may undoubtedly be delightful. It will be particularly acceptable

ceptable to the owner, if it be close to his park or his garden: the objects which constantly remind him of his rank, impose a kind of constraint; and he feels himself relieved, by retiring sometimes from the splendor of a seat into the simplicity of a farm: it is more than a variety of scene; it is a temporary change of situation in life, which has all the charms of novelty, ease, and tranquillity, to recommend it. A place, therefore, can hardly be deemed perfect, which is not provided with such a retreat. But if it be the whole of the place, it seems inadequate to the mansion: a visitor is disappointed; the master is dissatisfied; he is not sufficiently distinguished from his tenants; he misses the appendages incidental to his seat and his fortune; and is hurt at the similarity of his grounds with the country about them. A pastoral or an ancient farm is a little above the common level; but even these, if brought close up to the door, set the house in a field, where it always appears to be neglected and naked. Some degree of polish and ornament is expected in its immediate environs; and a garden, though it be but a small one, should be interposed between the mansion and any species of farm.

Of an ornamented farm.

4. A sense of the propriety of such improvements about a seat, joined to a taste for the more simple delights of the country, probably suggested the idea of an *ornamental farm*, as the means of bringing every rural circumstance within the verge of a garden. This idea has been partially executed very often; but nowhere, perhaps, so completely, and to such an extent, as at Woburn farm, near (Weybridge in Surry). The place contains 150 acres: of which near 35 are adorned to the highest degree; of the rest, about two-thirds are in pasture, and the remainder is in tillage. The decorations are, however, communicated to every part: for they are disposed along the sides of a walk, which, with its appendages, forms a broad belt round the grazing-grounds; and is continued, though on a more contracted scale, through the arable. This walk is properly garden; all within it is farm; the whole lies on the two sides of a hill, and on a flat at the foot of it: the flat is divided into corn fields; the pastures occupy the hill; they are surrounded by the walk, and crossed by a communication carried along the brow, which is also richly dressed, and which divides them into two lawns, each completely encompassed with garden.

These are in themselves delightful; the ground in both lies beautifully: they are diversified with clumps and single trees; and the buildings in the walk seem to belong to them. On the top of the hill is a large octagon structure; and, not far from it, the ruin of a chapel. To one of the lawns the ruin appears, on the brow of a gentle ascent, backed and grouped with wood; from the other is seen the octagon, upon the edge of a steep fall, and by the side of a pretty grove, which hangs down the declivity. The lawn is further embellished by a neat Gothic building; the former by the house, and the lodge at the entrance; and in both, other objects of less consequence, little seats, alcoves, and bridges, continually occur.

The buildings are not, however, the only ornaments of the walk; it is shut out from the country, for a considerable length of the way, by a thick and lofty hedge-row, which is enriched with woodbine, jessamine, and every odoriferous plant whose tendrils will entwine with the thicket. A path, generally of sand or gravel, is conducted in a waving line, sometimes close under the hedge, sometimes at a little distance from it; and the turf on either hand is diversified with little groups of shrubs, of firs, or the smallest trees, and often with beds of flowers: these are rather too profusely strewed, and hurt the eye by their littlenesses; but then they replenish the air with their perfumes, and every gale is full of fragrancy. In some parts, however, the decoration is more chaste; and the walk is carried between larger clumps of evergreens, thickets of deciduous shrubs, or still more considerably open plantations. In one place it is entirely simple, without any appendages, any gravel, or any sunk fence to separate it from the lawn; and is distinguished only by the richness of its verdure, and the nicety of its preservation. In the arable part it is also of green sward, following the direction of the hedges about the several inclosures: these hedges are sometimes thickened with flowering shrubs; and in every corner or vacant space, is a rosary, a close or an open clump, or a bed of flowers: but if the parterre has been rifled for the embellishment of the fields, the country has on the other hand been searched for plants new in a garden; and the shrubs and the flowers which used to be deemed peculiar to the one, have been liberally transferred to the other; while their number seems multiplied by their arrangement in so many and such different dispositions. A more moderate use of them would, however, have been better; and the variety more pleasing, had it been less licentious.

But the excess is only in the borders of the walk; the scenes through which it leads are truly elegant, everywhere rich, and always agreeable. A peculiar cheerfulness overspreads both the lawns, arising from the number and splendor of the objects with which they abound, the lightness of the buildings, the inequalities of the ground, and the varieties of the plantations. The clumps and the groves, though separately small, are often massed by the perspective, and gathered into considerable groups, which are beautiful in their forms, their tints, and their positions. The brow of the hill commands two lovely prospects: the one gay and extensive, over a fertile plain, watered by the Thames, and broken by St Anne's Hill and Windsor Castle; a large mead, of the most luxuriant verdure, lies just below the eye, spreading to the banks of the river; and beyond it the country is full of farms, villas, and villages, and every mark of opulence and cultivation. The other view is more wooded: the steeple of a church, or the turrets of a seat, sometimes rise above the trees; and the bold arch of Walton bridge is there a conspicuous object, equally singular and noble. The inclosures on the flat are more retired and quiet; each is confined within itself; and altogether they form an agreeable contrast to the open exposure above them.

With the beauties which enliven a garden are everywhere intermixed many properties of a farm: both the lawns are pastured; and the lowings of the herds, the bleating of the sheep, and the tinklings of the bell-wedder, resound through all the plantations: even the clucking of poultry is not omitted; for a menagerie of a very simple design is placed near the Gothic building;

a small serpentine river is provided for the water-fowl; while the others stray among the flowering shrubs on the banks, or straggle about the neighbouring lawn: and the corn fields are the subjects of every rural employment which arable land from seed-time to harvest can furnish. But though so many of the circumstances occur, the simplicity of a farm is wanting; that idea is lost in such a profusion of ornament; a rusticity of character cannot be preserved amidst all the elegant decorations which may be lavished on a garden.

**FARMER**, he that tenants a farm, or is lessee thereof. Also generally every lessee for life, years, or at will, is called *farmer*. As this word implies no mystery, except it be that of husbandry, husbandman is the proper addition for a farmer.

**Farmer**, *Hugh*, an English clergyman and a man of literature, belonging to the protestant nonconformists, was descended from people of respectability in North Wales, and drew his first breath at Shrewsbury, in the year 1714. Dr Charles Owen was for some time his tutor, and prior to that period he was educated at a school in Llanegrin. His parents from the first having designed him for the ministry, he was sent to prosecute his studies under the justly celebrated Dr Doddridge at Northampton, in 1730. Here, by the rectitude of his conduct and wonderful proficiency, he gained the esteem of that great man, who always spoke of him in the most respectful terms. Having completed his academical studies, Mr Farmer became the chaplain of William Coward, Esq. of Walthamstow, in the county of Essex, and was at the same time chosen minister to a dissenting congregation in that village. Notwithstanding the gratitude with which Mr Coward ought to be remembered by many for his charitable institutions, he had certain peculiarities of temper which rendered him a very disagreeable domestic. His doors were shut at an uncommonly early hour of the night, and neither visitor nor constant resident could afterwards obtain admission. Mr Farmer having one evening been detained a little beyond that hour, found the doors shut against him, and was under the necessity of applying to a William Snell, Esq. solicitor, a man of eminence, and possessed of many excellent qualifications, in whose family he remained for 30 years, living in the greatest friendship and intimacy. In this gentleman's house he gradually prepared those valuable treatises and dissertations which were afterwards given to the public, and acquired him so much celebrity as a man of letters. He also continued to discharge the duties of his ministerial function to the people of Walthamstow.

When a day of thanksgiving was appointed for the fortunate suppression of the rebellion in 1745, Mr Farmer preached a sermon on that occasion which was published the following year. His next work was of considerably greater importance, and was entitled, "An Inquiry into the Nature and Design of our Lord's temptation in the wilderness," 8vo. In this work it was the design of Mr Farmer to prove that the whole was transacted in vision, the different stages of which were intended to point out to him the difficulties and duties of his subsequent ministry. The originality of thought and profound erudition which this work displayed, soon gave it a very extensive circulation, and called forth the exertions of those who were of an opposite opinion. It received one reply under the title of "Christ's temptations real facts," which possessed considerable merit, but much inferior to Mr Farmer's for energy of expression, depth of thinking, and force of argument. But the most masterly, perhaps, of all Mr Farmer's literary productions, was his "Dissertation on Miracles, designed to shew that they are arguments of a divine interposition, and absolute proofs of the mission and doctrine of a prophet." Some have believed, and perhaps not without reason, that this work has no proper rival, notwithstanding the many able treatises upon that subject which have made their appearance in different ages. It was first published in the year 1771. But as great talents are frequently envied, and as this infernal principle is the prolific source of calumny and detraction, so this supereminent work of Mr Farmer was declared to have been chiefly borrowed from M. le Moine on the same subject; a slander which Mr Farmer refuted in a very able and satisfactory manner. In the year 1775, he published his celebrated "Essay on the Demoniacs of the New Testament," which may be considered as a masterly completion of the design he had in view by his dissertation on miracles. The hypothesis he adopted had been formerly defended with great ability by Mede, Sykes, Lardner, and others; but it was reserved for the critical acumen of Mr Farmer to free it completely from those difficulties which still hung around it. His essay on demoniacs was successively attacked by Dr Worthington and Mr Fell, both of them men of considerable erudition, but much inferior to their able antagonist.

Mr Farmer having continued for several years the sole pastor of the congregation at Walthamstow, an able colleague was appointed him in 1761, in consequence of which he became the afternoon preacher to the congregation of Salter's-hall, in the city of London, and soon after the Tuesday lecturer at the same place. He resigned his ministerial employments as he advanced in years, which the people committed to his charge very much regretted. In the year 1785 his eyes gave him very much trouble, of the sight of which he was nearly deprived, but by means of a surgical operation, he was for some time enabled to resume his studies. But mortality is the inevitable lot of all men, and the growing infirmities of Mr Farmer brought him to the grave in 1787, in the 73d year of his age.

By his last will he had ordered all his manuscripts to be burnt after his death, a circumstance which men of letters have just reason to lament. It is no doubt the duty of executors to pay attention to the will of the deceased; yet for the benefit of the Christian world they would have been justified in taking a certain latitude in the explanation of his meaning; as it does by no means appear probable that he meant to consign to the flames his manuscript entitled, "A Dissertation on the story of Balaam," which appeared written in a fair hand, as if manifestly intended for the press. When we say that Mr Farmer was a consummate scholar, we trust that his numerous and able works will fully justify the assertion; and his talents as a preacher were equally conspicuous. His voice was remarkable for its clearness and harmony, and his whole manner was peculiarly impressive. His piety was not morose, his conversation was lively, and his whole deportment was a beautiful transcript of his moral injunctions.

**Farmer**, *Richard*, D. D. a scholar and critic of

considerable

considerable eminence, was the son of a hosier at Leicester, at which place he was born in the year 1735. Here he received the rudiments of his education, and was afterwards a student at Cambridge, and pensioner of Emanuel college. He was considered as a young man well acquainted with books, was much esteemed among his friends, and looked upon as possessed of lively parts, even before he acquired any extraordinary reputation as a scholar. He was made B. A. in 1757, and M. A. in 1760. Several years after this period, having been for some time a curate, he took the degree of B. D. and became a preacher at Whitehall. Besides the attention he paid to the Grecian and Roman authors, he prosecuted the study of books in his own language, printed on black-letter, which laid the foundation of a work that added more to his literary reputation than any other performance. This was "An Essay on the learning of Shakespeare," which he published in 1766. Men of letters had long turned their attention to the learning of Shakespeare, in order to ascertain its real extent. It could not be questioned that he was acquainted with the history and mythology of the ancients, but it was still a matter of dispute from what sources that acquaintance was derived. To obviate this difficulty, Mr Farmer's knowledge of books enabled him to demonstrate, that translations of the far greater part of classical authors were to be met with in the time of the celebrated dramatist; and as he proved that Shakespeare had even copied the blunders and errors of such translations, he made it manifest beyond the possibility of a rational doubt, that he was wholly incapable of consulting the originals. This essay passed through three editions in a very short time; was much admired for the sprightliness of its composition, and the generality were persuaded that he had fully established his point.

This performance brought him so much into notice, as to become extremely favourable to his professional advancement. By the influence of Bishop Hurd, he procured the chancellorship and a prebend in the cathedral of Lichfield, and in 1775 he was elected master of Emanuel college, and took the degree of D. D. He was soon after constituted principal librarian to the university, and served in turn the office of vice-chancellor. He was made prebendary of Canterbury by Lord North, at that time prime minister, and Mr Pitt made him twice an offer of a bishopric; but the constraints and solemnity of the episcopal character were not congenial to his natural temper, on which account he declined the offer, and having resigned his office as prebendary, he accepted of a residentiaryship of St Paul's. This obliged him to reside three months annually in London, which he spent with pleasure and advantage in the company of literary characters. From nature he inherited a fund of good humour, and was of such an obliging turn, that he buried party spirit in the satisfaction which he found in the performance of beneficent actions. Though in general an enemy to reforms of any kind, and anxious to preserve *things as they were*, both in the church and state, he was instrumental in amending the police of Cambridge, especially as it related to the paving and lighting of the streets. At his instigation also, monumental sculpture was admitted into the cathedral of St Paul's, which will continue to exhibit a striking proof of national gratitude, and serve to cover the nakedness of the walls.

It was at one time the intention of Dr Farmer to publish a history of the town and antiquities of Leicester, the expences to be defrayed by subscription; but either his independent circumstances, or a degree of native indolence, made him relinquish the design, and the few materials he had collected were given to Mr John Nichols, at that time engaged in an elaborate work on the same subject. After a painful illness of some length, Dr Farmer died at Emanuel college in the month of September, 1797, in the 62d year of his age. Dr Parr wrote an epitaph for his tombstone, in which we find the following testimony to his worth. "Vir facetus et dulcis, festique sermonis, Græcè et Latinè doctus, in explicanda veterum Anglorum poësi subtilis et elegans." He had a considerable library, in which were a vast number of books purchased at the stalls of London, and afterwards disposed of for much more than they cost.

FARMER, in mining, is the lord of the field, or one that farms the lot and cope of the king.

FARN ISLANDS, two groups of little islands and rocks, 17 in number, lying opposite to Bamborough castle in Northumberland. At low water the points of several others are visible besides the 17 just mentioned. The nearest island to the shore is called the *House-island*, and lies exactly one mile and 68 chains from the coast. The most distant is about seven or eight miles. Their produce is kelp, feathers, and a few seals, which the tenant watches and shoots for the sake of the oil and skins. Some of them yield a little grass that may serve to feed a cow or two; which the people transport over in their little boats. The largest or House-island is about one mile in compass, and has a fort and a lighthouse. It contains about six or seven acres of rich pasture; and the shore abounds with good coals which are dug at the ebb of tide. St Cuthbert is said to have passed the two last years of his life on this island. A priory of Benedictines was afterwards established here, for six or eight monks, subordinate to Durham. A square tower, the remains of a church, and some other buildings, are still to be seen on this island; and a stone coffin, which is pretended to be that of St Cuthbert. At the north end of the isle is a deep chasm, from the top to the bottom of the rock, communicating with the sea; through which, in tempestuous weather, the water is forced with great violence and noise, and forms a fine jet d'eau of 60 feet high. It is called by the inhabitants of the opposite coast, the *Churn*. One of the islands in the most distant group is called the *Pinnacles*, from some vast columnar rocks at the south end, even at their sides, flat at the tops, and entirely covered with guillemots and shags. The fowlers pass from one to the other of these columns by means of a board, which they place from top to top, forming a narrow bridge over such a dreadful gap that the very sight of it strikes one with horror.

FARNABIE, THOMAS, son of a carpenter at London, born in 1575, staid a short while at Oxford; where being enticed to abandon his religion, he went to Spain, and was there educated in a college belonging to the Jesuits. Being weary of their severe discipline, he went with Sir John Hawkins and Sir Francis Drake in their last voyage in 1595. He was afterwards a soldier in the Low Countries: but being reduced

ced to great want, returned to England, where wandering about for some time under the name of *Thomas Bainrafe*, the anagram of his name, he settled at Mattock in Somersetshire, and taught a grammar-school with good reputation. He removed to London, and opened a school with large accommodations for young gentlemen. While he taught this school, he was made master of arts at Cambridge, and incorporated into the university of Oxford. Thence he removed, in 1636, to Seven-oaks in Kent; and taught the sons of several noblemen and gentlemen, who boarded with him, with great success, and grew rich. His works gained him reputation. Upon the breaking out of the civil commotions in 1641, he was cast into prison. It was debated in the house of commons, whether he should be sent to America; but this motion being rejected, he was removed to Ely-house in Holborn, and there he died in 1647. Mr Farnabie was a very eminent grammarian; and many writers have spoken with great approbation of his labours. Mr Bayle in particular says, "His notes upon most of the ancient Latin poets have been of very great use to young beginners; being short, learned, and designed chiefly to clear up the text."

FARNHAM, or FERNHAM; a town of Surry, and capital of the hamlet of its own name, 41 miles from London on the Winchester road. It is a large populous place, situated on the river Wey, and supposed to have its name from the fern which abounded here. It was given by the West Saxon king Ethelbald to the see of Winchester; the bishops of which have generally resided in the castle here, in the summer time, ever since the reign of King Stephen, whose brother, its then bishop, first built it. It was a magnificent structure, with deep moats, strong walls and towers at proper distances, and a fine park; but it is much decayed. The town, which contains 437 houses, and 2508 inhabitants, is governed by 12 masters or burgesses, of whom two are bailiffs, (chosen annually). They have the profit of the fairs and markets, and the assize of bread and beer; and hold a court every three weeks, which has power of trying and determining all actions under 40s. From Michaelmas to Christmas here is a good market for oats; and one of the greatest wheat markets in England, especially between All-Saints day and mid-summer. The toll-dish here was once reckoned worth 200l. a year; but it is much diminished, since the people about Chichester and Southampton began to send their meal to London by sea. But this loss is amply made up by the vast growth of hops, of which there are 300 or 400 acres of plantations about this town, and they are said to excel the Kentish hop-yards both in quantity and quality. This town sent members to parliament in the reign of Edward II. but never since. The magistrates have their privileges from the bishop of Winchester, to whom they pay an acknowledgement of 12d. a-year. The market is on Thursday: and there are three fairs annually, and a great market for Welsh hose.

FARNOVIANS, in ecclesiastical history, a sect of Socinians, so called from Stanislaus Farnovius, who separated from the other Unitarians in the year 1568, and was followed by several persons eminent for their learning. This sect did not last long; for having lost their chief, who died in 1615, it was scattered abroad and reduced to nothing. Farnovius was engaged by Gonesius to prefer the Arian system to that of the Socinians, and consequently asserted, that Christ had been produced out of nothing by the Supreme Being before the creation of this terrestrial globe. His sentiments concerning the Holy Ghost are not certainly known; however, it appears that he warned his disciples against paying the tribute of religious worship to the Divine Spirit.

FARQUHAR, GEORGE, an ingenious poet and dramatic writer, the son of a clergyman in Ireland, was born at Londonderry in 1678. He was sent to Trinity College, Dublin; but his volatile disposition not relishing a college life, he betook himself to the stage; where, having dangerously wounded a brother actor in a tragic scene, by forgetting to change his sword for a foil, it shocked him so much that he left the Dublin theatre and went to London. Here he procured a lieutenant's commission by the interest of the earl of Orrery; which he held several years, and gave many proofs both of courage and conduct. In 1698, he wrote his first comedy called Love and a Bottle; which for its sprightly dialogue and busy scenes, was well received. In the beginning of the year 1700, which was the jubilee year at Rome, he brought out his Constant Couple, or a Trip to the Jubilee: and suited Mr Wilks's talents so well in the character of Sir Harry Wildair, that the player gained almost as much reputation as the poet. This tempted him to continue it in another comedy called Sir Harry Wildair, or The sequel of the Trip to the Jubilee; in which Mrs Oldfield acquired great applause. In 1702, he published his Miscellanies, which contain a variety of humorous sallies of fancy. In 1703, appeared the Inconstant, or the Way to Win him: in 1704, a farce called the Stage-coach; in 1705, the Twin Rivals; and in 1706, the Recruiting Officer, founded on his own observations while on a recruiting party at Shrewsbury. His last comedy was the Beaux Stratagem, of which he did not live to enjoy the full success. Mr Farquhar married in 1703. Before that time his manner of life had been rather dissipated. The lady, therefore, who afterwards became his wife, having fallen violently in love with him, but judging that a gentleman of his humour would not easily be drawn into the trammels of matrimony, contrived to have it given out that she was possessed of a large fortune; and finding means afterwards to let Mr Farquhar know her attachment to him, interest and vanity got the better of his passion for liberty, and the lady and he were united in the hymeneal bands. But how great was his disappointment when he found all his prospects overclouded so early in life (for he was then no more than 24), by a marriage from which he had nothing to expect but an annual increase of family, and an enlargement of expence in consequence of it far beyond what his income would support. Yet, to his honour be it told, though he found himself thus deceived in a most essential particular, he never was known once to upbraid his wife with it; but generously forgave an imposition which love for him alone had urged her to, and even behaved to her with all the tenderness and delicacy of the most indulgent husband. Mrs Farquhar, however, did not very long enjoy the happiness she had purchased by this stratagem; for the circumstances that attended this union were in some respects perhaps the

Farquhar. means of shortening the period of the captain's life. For, finding himself considerably involved in debt in consequence of their increasing family, he was induced to make application to a certain noble courtier, who had frequently professed the greatest friendship for him, and given him the strongest assurances of his intended services. This pretended patron repeated his former declaration; but expressing much concern that he had nothing at present immediately in his power, advised him to convert his commission into money to answer his present occasions, and assured him that in a short time he would procure another for him. Farquhar, who could not bear the thoughts of his wife and family being in distress, followed this advice, and sold his commission; but, to his great mortification and disappointment, found, on a renewal of his application to this inhuman nobleman, that he had either entirely forgotten, or had never intended to perform, the promise he had made him. This distracting frustration of all his hopes fixed itself so strongly on our author's mind, that it soon brought on him a sure, though not a very sudden, declension of nature, which at length carried him off the stage of life in 1707, before he arrived at 30 years of age.—His comedies have so much humour, and the characters are so natural, that his plays still continue to be represented to full houses.

Farquhar, Farrier.

**FARRIER**, one whose employment is to shoe horses, and cure them when diseased or lame.

# FARRIERY.

## INTRODUCTION.

1 Origin of the term farriery.

THE term *farrier* is probably a corruption of *ferrier*, Fr. *ferrans*, from the verb *ferrer*, *to shoe a horse*; all these words being derived from the Latin *ferrum*, "*iron*." There is no doubt that the word *farrier* was at first used to denote a person who shod horses: but as these persons were for a long period the only *horse-doctors*, the term was soon used in the more extensive sense of *horse-doctor* or *horse-leech*; and hence *farriery* came to signify the *art of curing the diseases of horses*.

There can be little doubt that the word *farrier* was originally spelt *ferrier* or *ferrer*; as we meet with this latter orthography in some of our older writers. Thus Blundeville, who wrote in the time of Queen Elizabeth, in his "Address to the Gentlemen of England," book iv. has the following sentence.

"All horses, for the most part, do come into their decay, sooner than they should do, by one of these four waies; that is to say, either for lacke of being well bred, or through the rashness of the rider, the negligence of the keeper, or else through the unskilfulnesse of the *ferrer*."

Again, the same author mentions "Martin Ghelly of Aston, called Martin Alman, chiefe *ferrer* to the queen's magistie."

2 Veterinary art.

*Farriery*, in the usual acceptation of the word, forms only a part of the more general art, which has been commonly called the *veterinary art*; by which is understood the art of medicine as applied to the inferior animals, which has been long called by the French *l' art veterinaire*, or *medicine veterinaire*. This word *veterinary* is of very ancient date, being derived from the Latin *veterinarius*, which is used by Columella to denote a *horse-doctor* or *cattle-doctor*. The term *veterinary*, being derived from *veterinus*, qu. *veheterinus*, à *vehendo*, *carrying*, is properly applicable only to beasts of burden; but *veterinary medicine* is now commonly employed in a more comprehensive sense, to denote the art of curing the diseases of *domestic animals* in general.

3 Term extended.

The French, who appear to have first used the term in this general sense, usually distinguish that part of the art which we call *farriery*, by the appellation of *Hippiatrique* from *ἵππος*, *a horse*, and *ἰατρὸς*, *physician*. Thus, they have a *Cours d'Hippiatrique*, a *Dictionnaire d'Hippiatrique*, &c.

As there are considerable advantages attending the consideration of the diseases of the several domestic animals in the same treatise, we propose, in the present article, not to confine ourselves to the medical treatment of the horse, but to extend our views to the diseases of such other of the domestic animals, as are of the most importance to man, particularly the ox, sheep, and dog.

The diseases of the horse, as they are better known, and more interesting, than those of the other domestic animals, will of course occupy the greatest share of our attention. The diseases of the dog have been as yet too little investigated for us to give a very satisfactory account of them; but as the subject of veterinary medicine has of late been much cultivated, it is probable that these, as well as some other obscure diseases of animals, may ere long receive some elucidation. If any considerable improvements or discoveries shall be made before the completion of our work, we shall notice them under VETERINARY medicine.

4 Objections answered.

It may be thought, that, considering veterinary medicine in this extensive point of view, it would have been more correct to defer the subject to the article VETERINARY; but most of our readers who have been accustomed to see in our dictionary the article FARRIERY, will expect an account of, at least, the diseases of the HORSE, under this article, and would probably not be pleased to have this delayed till nearly the end of the work; besides, it is of little importance under which article the diseases of animals are treated of, as, when we have once defined our terms, we cannot be misunderstood, provided we always employ them in the sense of the definition. Again, as the term *veterinary* has departed from its original signification, there can be no objection to our employing the word *farriery*, a term that is more familiar in the same general sense. In fact, it has been so employed by a late writer on the subject, Mr Feron, who has entitled his work, "A new System of Farriery," though he professes to treat in it of the horse, ox, and sheep.

In this article, then, we shall use *farriery* as synonymous with *veterinary art*, and shall consider both as

*the*

Introduction.

*the art of preserving the health and curing the diseases of domestic animals.*

5 Importance of the subject

The study of veterinary medicine must be an interesting object to every person, whose profession, or situation in society, requires him to attend to the comforts and diseases of domestic animals.

6 to the veterinary practitioner.

To the *veterinary practitioner*, the study of the principles of his art, the history of the diseases which he is called on to relieve, and the methods of treating them that have been found most successful, are as essential as the study of the human economy, and the diseases to which it is exposed, are to the medical practitioner. A farrier who has studied his art scientifically, is as much superior to the ignorant empiric, to whose mercy the lives and limbs of horses and cattle are usually intrusted; as the regular physician to the illiterate quack, who puffs off his pernicious nostrums in every newspaper, and enriches himself, by imposing on the credulity and folly of the public. The necessity of a regular education to the farrier, as well as to the surgeon or physician, which had long been seen, has led to the institution of veterinary schools; at first in France, and within these few years in England. Of these we shall presently give an account.

7 To the farmer and country gentleman.

To the *farmer* and *country gentleman* this subject must be highly interesting. They will find their account in being able *themselves* to superintend the management of their horses, dogs, sheep, and cattle, so as best to preserve their health, and relieve their diseases, without relying implicitly on their grooms, huntsmen, and farriers, herdsmen and cattle-doctors, who are probably either notoriously ignorant, or are induced from interested views, or a fellow-feeling, to prolong the cure, and pick the pockets of their masters (A). These gentlemen therefore cannot employ a part of their leisure time to greater advantage than in acquiring a knowledge of the diseases of domestic animals.

8 To the medical practitioner.

The *medical* practitioner who wishes to derive an advantage from analogy in some of the obscure diseases to which the human frame is subject, and which would probably receive considerable elucidation from a comparison with similar diseases that affect the inferior animals, must engage with peculiar interest, in a research that promises so well to repay his labour. "It is not a little remarkable, (say the editors of a well-conducted medical journal), that the diseases of horses, cattle, and sheep, which occur so frequently, and are so seriously lamented, should be so imperfectly understood. No greater benefit could be conferred on physical science than a complete history of the diseases of our domestic animals, especially if given by any one endowed by nature with superior acuteness, and a talent for observation, improved by habit and experience; who could describe the symptoms and appearances of the different disorders, point out the analogies with those incident to the human body, detect those minute circumstances which serve to distinguish them, class them under their proper heads, and correct all the confusion in which they now lie involved. Veterinary medicine has lately occupied some share of attention, chiefly as relating to horses, and as a distinct pursuit from the general study of all the diseases of animals, but considered apart from any relation or inquiry concerning the treatment of the morbid states of the human system. It is in this last point of view, that comparative pathology seems to offer so many subjects worthy investigation; and, when looked upon in this light, it strikes us as one of those studies *quæ ad nos pertinent, et quæ nescire malum est**.

* *Edin. Med. and Sur. Journ.* vol. i. p. 440.

9 Farriery much indebted to medical men.

We shall see, from the historical sketch of farriery, which will immediately be given, that the art never made any considerable progress, or assumed any thing like a scientific form, till it attracted the attention of men who had made the *human* economy their study. Almost the only rational improvements, that have been made in the art, were either suggested or carried into effect by medical men; and nothing will contribute so much to its perfection as the interest which the profession has lately shewed to it, and the attention that has of late been paid to the study of comparative anatomy and pathology.

10 Analogy between the diseases of man and of animals.

The healing art in general must profit by this. There is not only an intimate connection between the structure of man and that of the inferior animals; but, especially in those that have been domesticated, the diseases of both are nearly allied.

The murrains, that in the early part of the last century so frequently attacked the horned cattle throughout almost all Europe, nearly depopulating most of the farms, are very analogous to some of the epidemic diseases of man; and pestilential diseases among cattle, have not unfrequently been the forerunners of similar epidemics among the human race. Homer, in describing the plague that harassed the Grecian camp, in consequence of the affront given by Agamemnon to the priest of Apollo, says that the domestic animals were first affected.

Οὐρῆας μεν πρῶτον ἐπώχετο, και κυνας ἀργούς,
Αὐτὰρ ἔπειτ' αὐτοισι βέλος ἐχεπευκὲς ἐφιεὶς,
Βαλλ'—— *Il.* i. 50.

"On mules and dogs th' infection first began,
"And last the vengeful arrows fix'd in man."
Pope.

The plague of boils that raged among the Egyptians (Exod. ix. 10.) affected both man and beast. Similar instances are related both by sacred and profane historians.

Almost the whole tribe of inflammations, even the gout (according to Van Swieten) are found to affect the domestic animals, are produced by the same causes, and

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(A) It may be thought by some, that we have gone too far in accusing the farriers and grooms, &c. of having a fellow-feeling; but, when it is known, that "a part of every shilling paid to common farriers, is in some shape returned to the groom, as a fee or perquisite;" that "the servant receives at least five per cent. from the farrier on every bill paid by his master;" and that "if a horse dies under the care of a farrier, he generally becomes the property of the groom;" See Veterinary Transactions, N° 1. Introduction); it will be allowed that there is some ground for the surmise.

and yield to the same treatment as in the human system.

Domestic animals are subject to eruptive diseases, both chronic, and such as are attended with fever; and both are very similar to those by which man is affected. It is pretty certain that the smallpox sometimes rages among sheep, as we shall see hereafter; and a complaint very like the measles often attacks swine. Some of them are transferable to man; and to this transference in the case of the cowpox, a blessing which will render immortal the name of **Jenner**, we owe the probable annihilation of one of the most dreadful pests that ever affected the human race.

Scrofula and consumption attack monkeys. Apoplexy, epilepsy, and many others of what are called *nervous* diseases, indigestion, and even mental derangement, are not uncommon among domestic animals; spasmodic affections are very frequent among them; and it is said, that for one case of *tetanus* or *locked jaw* among the human species in these climates, there are ten or twenty among horses.

The analogy might be pursued much farther; but what has been stated is sufficient to shew the advantages that medical men may derive from the study of veterinary medicine. Many obscure and dangerous diseases may thus in time be illustrated or mitigated; and the effect of doubtful remedies may be ascertained by experiments on the inferior animals. For, though there are a few instances of different effects following the exhibition of the same medicines in man and animals; yet, on the whole, the analogy is nearly as complete with respect to remedies as diseases (B).

11
A farrier should be acquainted with medicine.

It will appear, from what has been said, that the reasoning, and much of the treatment, in the diseases of animals must be nearly the same as in man, and, of course, that the veterinary practitioner will gain much by acquiring a knowledge of human medicine. Were the practitioners in farriery generally instructed in the principles of medicine, little more would be required in a treatise on farriery, than to point out the difference in the structure and functions of domestic animals, to describe the diseases peculiar to these, and to mark the varieties that it is necessary to observe in the treatment of disease and the administration of remedies. But, as many of these gentlemen have not the opportunity of attending medical lectures, and most of them have not received an education that would enable them to understand the language in which medical writings are usually composed; it becomes necessary in a treatise of this kind to accommodate the language to the taste and capacity of general readers, and to introduce much that will be found in other articles on subjects connected with medicine. To prevent repetition, as much as possible, and to avoid swelling this article to a greater length than is necessary, we shall, however, where the similarity of the subject will admit of it, occasionally refer to some of the medical articles in this dictionary.

12
Knowledge requisite for the veterinary practitioner.

The successful practice of farriery, like that of medicine in general, requires that the practitioner should possess a considerable share of knowledge. It is not sufficient to have been long in the habit of managing horses and cattle; this indeed, to a person of a strong mind, and attentive observation, will furnish a considerable number of facts, with respect to the symptoms and progress of the diseases to which domestic animals are subject. But to mark the minute differences between such as resemble each other, to investigate their causes, and to contrive a rational mode of treatment, requires a much greater share of abilities, and much more extensive information, than we can expect to find among grooms and shepherds, or falls to the lot of most of those who call themselves farriers and cattle-doctors.

13
Anatomy and physiology.

It must be obvious to every thinking mind, that no practice either in medicine or farriery can be rational, but such as is founded on a comprehensive knowledge of the structure and functions of those animals, the treatment of whose diseases is the object of that practice. The first thing, therefore, necessary to the veterinary practitioner is, to acquire some idea of the anatomical structure of the domestic animals. We have already, in the second part of the article **Anatomy**, given a general account of the structure of quadrupeds; and in exemplifying this, in the chapter on *the anatomy of a dog*, we pointed out the most striking peculiarities that are to be found in this animal; as we have done with respect to ruminating animals, viz. the cow and sheep, in the succeeding chapter of that part. To that article we must refer our readers for the anatomical part of our subject, as far as relates to the ox, the sheep, and the dog. It will naturally be expected, that a description of the structure of the horse should be given in this article; but this description must, in general, be concise, as the nature of our plan prevents us from enlarging on the subject, excepting in those parts where a pretty minute knowledge appears to be necessary.

Those who wish to study the anatomy of the horse minutely, may consult Viter's Medicine Veterinaire, tom. i.; Blaine's Outlines, and Stubb's elegant work on the anatomy of the horse.

The practitioner should take every opportunity of inspecting the bodies of those animals that die of diseases, which are very important, or which are not very well understood. Morbid dissections often throw considerable light on the nature and treatment of diseases; and it fortunately happens, that with respect to domestic animals, these dissections are very easy, and are not obstructed by those absurd prejudices which, especially in this country, are opposed to the dissection of human bodies. In treating of the diseases of domestic animals, in a

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(B) One of the most remarkable cases of anomaly in the effect of remedies is that of arsenic, which, in the quantity of a few grains will prove a deadly poison to man and most animals, but may be given with impunity to horses to the amount of two drams or more. The story of the different effects of *antimony*, on hogs and *monks*, is well known. See **Antimony**. As to the example of *white vitriol* (sulphate of zinc), which proves emetic in the human subject, but produces no such effect in the horse; it is owing to the different structure of the stomach in this animal, by which he is incapable of vomiting. Colocynthis, or *bitter apple*, is well known to be a most violent purgative to *man*, but in the *horse* it has produced no effects in the enormouse dose of *four ounces*.

a future part of this article, we shall give a concise view of the appearances on dissection, as far as they have been ascertained, whenever they tend to illustrate the nature, causes, or treatment of the disease under consideration.

The study of the functions of domestic animals ought to go hand in hand with that of their structure; and the student will find it of considerable advantage, to compare the functions of these animals with those of man. This comparative view will be given in some future article. In the present treatise, we can only speak of the functions of domestic animals, as far as it is necessary to illustrate the nature or the treatment of their diseases.

14
Natural history.

The natural history of these animals ought to form a part of the studies of the veterinary practitioner. It is a subject that is not only highly curious and interesting, but extremely useful. We find, that these animals, in their native fields, enjoy a state of health and vigour, which is interrupted only by those accidents to which a life of liberty and wildness may expose them. It is only when they are received under the protection of man, that they become subject to disease. It is therefore an interesting inquiry, to examine into their native habits; as, in our endeavours to preserve their health, we should, as nearly as is compatible with convenience and economy, imitate the habits that are found to prevail amongst these animals in a state of nature. It is the province of the naturalist to describe the external conformation of these animals, and the advantages, and defects dependant on it, that fit or disqualify them for the various purposes for which they are destined under the service of man; it is his business to describe the methods of breeding these animals in a state of nature, and how far this may be improved for the purposes of domestication, and to detail the method of training and managing them. Many of these circumstances are treated of by some of the writers on the veterinary art, in a complete system of which they ought not properly to be omitted. We shall, however, not treat of them in this article, as, according to the plan of our work, they more properly fall to be considered under the article MAMMALIA, in which will be given the natural history of all quadrupeds.

15
Chemistry.

Chemistry must form a necessary part of the studies of every man who engages in the practice of medicine, whether human or veterinary, as, without a knowledge of its principles, neither the functions of the animal economy, the intimate structure of its component parts, nor the action of many remedies, can be properly understood. In the article CHEMISTRY, we have prepared abundant matter for the reader to make himself acquainted with the elements of that admirable science.

16
Surgery.

The practitioner, whether of human or veterinary medicine, who is a proficient in anatomy, wants but a little manual dexterity, and some practical experience, to make him a tolerable surgeon. The operations to be performed on brutes are few, and these are in general very clumsily executed. Humanity, however, as well as prudence, will readily point out to the farrier the necessity of learning the best methods of performing these operations with dexterity and despatch, so as to give the least pain to the unfortunate animals that are placed under his care. We shall describe the usual operations immediately after treating of the anatomy of the horse.

17
Hygeiology.

It is of considerable consequence, that the person who undertakes the management of domestic animals, should make himself acquainted with those circumstances which experience has shewn to be most favourable to the preservation of their health, and the prevention of their diseases. This subject forms what may be called *veterinary hygeiology*; and will be considered at some length in the fourth part of this article.

18
Materia medica.

Before the practitioner can attempt to remove or alleviate the diseases to which domestic animals are subject, he must acquire a competent knowledge of the remedies employed for that purpose, their nature, uses, and doses, as adapted to the different animals, in various situations, and various diseases; with the methods of preparing and compounding them into the several forms that are usually employed; and with the best means of administering them. This comprehends what is called the *veterinary materia medica*, and will form the subject of our fifth part.

19
Practice.

With this previous knowledge, the veterinary student is prepared to enter on the consideration of the diseases, which will be treated of in the sixth part of our article. He must be particularly attentive to the symptoms of each disease, as, on an accurate knowledge of these, will depend the means of distinguishing those complaints, which upon a superficial view bear considerable resemblance to each other, but which require a very different, and perhaps opposite mode of treatment. He must attend to the greater or less violence of these symptoms, to the nature of the part which they attack, and to the greater or less rapidity of their progress; as these circumstances must considerably influence the judgment he is to form of the danger, and probable termination, of the disease. He must, as far as possible, investigate the causes, that appear to have produced the disease in question, or which seem to aggravate or keep up the morbid symptoms; as on the removal or mitigation of these causes, must depend the only rational and scientific method of cure. Lastly, he must make himself acquainted with the treatment that experience has found most successful in the cure of each particular disease, as well as with that which has been found to be attended with little or no advantage.

As the proper means of attaining the best information is of the greatest importance, we shall here give Mr Blaine's instructions on this point.

"The mode in which any art is attained, must be in a great measure directed by the future views of the learners. It appears to me that there are three distinct classes of persons, who are likely to study this branch of useful knowledge. The first are persons of enlarged minds, and extended fortunes. The second are surgeons, whose situation in country villages may render their services in this art highly useful, upon occasions when no farrier is at hand, or, in the end, in cases in which farriers of the common class are unable to judge. The third are farriers themselves, or persons intending to profess veterinary medicine.

"Gentlemen and amateurs, who wish to accumulate information on this curious and interesting subject, within the reach of the veterinary college, will find their account in attending a course of lectures there; if

Introduction.

not, they should apply themselves to the study of the more general parts of the body, both of the human and animal; the latter, I hope, they may attain by the following sheets. They may direct the collar-maker, huntsman, or tanner, to cut up their dead horses in their presence. They may study physiology in a pleasant and interesting manner, from the ingenious work on this subject by Mr Saumarez. The lighter parts of the veterinary art may be acquired with pleasure, from the elegant publication of Mr Richard Lawrence of Birmingham; and a course of chemistry will amply reward them for their pains in acquiring it.

"A good surgeon has travelled three-fourths of the road towards making a good veterinarian, but he must diligently travel the remainder to arrive at excellence. He must by no means sit down contented with the analogy between the human and brute; which, if he does, will lead him into very great error; for though this analogy is in some cases very striking, yet there are others in which the similarity fails, and he is left to act upon other principles. Hence in those diseases that are conquered or mitigated by vomiting in the human; in the horse he must pursue another mode of treatment. In acute diseases removed by purging in the human, his attempts on the horse would probably fail; as before the effects were produced, the animal might be past relief. It must be remembered that the operations of medicines are very different in the one, and the other. It is not sufficient that a surgeon has an intimate acquaintance with the human frame; he must be equally conversant with the animal he treats, or he will treat in vain; particularly those diseases originating in a peculiarity of form from the human, as all the diseases of the feet. He should make himself particularly conversant with the specific diseases of the horse, which bear no analogy to any thing in the human body; as farcy, glanders, strangles, grease, &c. From the great strength of the arterial system, he must ever be aware how prone the diseases of the horse are to a rapid termination, and hence that his treatment must be decisive and energetic; therefore, in all cases, he must be very attentive to diagnostics. But what will much embarrass a surgeon in practising the veterinary art, will be a want of knowledge of the general usages, nomenclature, and idiom, if I may so express it, among grooms and farriers; without an acquaintance with which, these people at once detect and despise the practitioner. It should be the business therefore of the surgeon, with his other acquisitions, to learn their manners, and to make himself acquainted with their terms. The third class of persons, either farriers already practising, or persons intending to practise, will easily gain that. When it is in their power, I would advise their taking the advantage of the veterinary college; but when they cannot, I would recommend the prosecution of their studies in a regular manner. Begin by first reading some general description of the human body, such as Symond's Anatomy, or the anatomical part of the present work, carefully; let them pay attention to the functions and uses of the parts, particularly where the same uses are brought about by a variation in structure; this enlarges the mind, and prepares it to receive the benefits of dissection, which should now be proceeded to. Any small animal may be first dissected, to enable the learner to use his instruments properly. He may then proceed to dissect the horse with some authorities by him, which will assist him at first to make out parts, but too scrupulous an attention to numerous descriptions will only bewilder. The necessary instructions for dissection, and the preservation of parts, may be gained, by a recourse to Poole's Anatomical Instructor, which is professedly written to instruct the pupil in these particulars. When he is well acquainted with the appearance of the animal in health, he should take every opportunity of examining diseased appearances, which are seldom wanting at the tan-yard or the kennel. He should now make himself acquainted more intimately with physiology, for which purpose he may read Haller's works; there is at present a translation of Cuvier's Treatise on Comparative Anatomy, which he may likewise avail himself of. When he has become acquainted with pathology, as at present received, he may peruse the elder authors on farriery; to this should succeed a knowledge in chemistry, preceded by an acquaintance with the materia medica; the proper works for which he may see by a reference to that article, and nothing will now be wanting, but experience and practice to perfect him *."

Since the establishment of a veterinary school in Britain, little is wanting to promote the progress and improvement of the veterinary art, as far as relates to the diseases of horses. But the art, with respect to the medical treatment of other animals, is still in the most deplorable state of imperfection. Proposals have been made for improving cattle medicine; and among these we think the following of Mr John Lawrence, entitled to attention; though, probably the proposer's list of works may be much improved and enlarged, by referring to the account of authors which will be immediately given.

Mr Lawrence's proposal is simply, "that the affair of providing the country with regular-bred surgeons, for the practice of cattle medicine, be immediately undertaken by the agricultural societies; at least, that the experiment be made by some of the most considerable, each society engaging a gentleman of that description, at a sufficient and respectable annual stipend. The contract may run in such form, that should the surgeon's annual emolument from practice come short of the stipulated sum, the deficiency should annually be made up by his patrons the society. No person to be engaged on any pretence, but who shall have received the usual education of a surgeon, and have attended the hospitals the usual length of time. A selection of *Veterinary text-books* to be made, and the books purchased for the use of the surgeon, but to remain the property of the society. This may consist of Gibson's last edition, two vols. Bracken, Bartlett, Osmer, Layard, with our late writers; and Lafosse and Bourgelat from the French, with whatever may have been published since their time, by authority of the French veterinary schools. All the members of the society and their connections, as far as their influence may extend, to entrust the care of their diseased animals to the surgeon appointed, at a fair and liberal charge for his attendance and medicines. The surgeon to keep a regular history of all the cases which shall come under his inspection, including the presumed causes and symptoms of the disease, with the probable methods of prevention, his mode of treatment, a particular detail of the medicines prescribed, their operation, with every relative and useful remark which may occur.

A clear written copy of such veterinary transactions, to be delivered annually, and on a certain day, to the society, to remain at their disposal *."

22 It is of considerable consequence for the practitioner to be informed of the rise and progress of the art which he professes, and to be acquainted with the principal authors that have written on the subject. We shall here, therefore, give a brief sketch of the history of Farriery, with a concise view of the writings that have appeared from the earliest authentic records to the present time (1806).

Though we shall enumerate all the authors that have written professedly on this subject, who appear deserving of notice, we shall here characterize only the general treatises, reserving our remarks on such works as have appeared on individual diseases, &c. to that part of our treatise, in which we shall consider these subjects.

## PART I. HISTORY.

3 THE early history of farriery, as of every other art and science, is involved in great obscurity. We shall not attempt to penetrate the cloud that hangs over the ancient state of the art, or to supply the want of facts, by conjectures, which, however rational, can lead to no certain or useful conclusions.

There seems no doubt that in the time of Hippocrates, and probably long before, the medical practitioner exercised his office in favour of the domestic animals, as well as of man; and Galen seems to have been well skilled in the knowledge and treatment of some of the diseases of animals.

24 Perhaps the earliest authentic writings on the subject of the veterinary art, now extant, are to be found in the works of Columella, the celebrated Roman author on husbandry, who, in his work *De Re Rustica*, has given many sensible directions for the management of horses and cattle. Columella lived about the second century, under the reign of the Roman emperor Tiberius, or, as some say, of Claudius Cæsar.

5 It is understood that Celsus, the elegant imitator of Hippocrates, who lived some time before Columella, wrote much on the diseases of animals; but none of his writings on this subject have survived the general wreck of science and literature that accompanied the fall of the Roman empire.

6 We have no certain accounts of any author who wrote expressly on this subject earlier than Vegetius, who flourished, as is supposed, some time in the fourth century, and probably during the reign of the emperor Valentinian the third. The work of Vegetius, *De Arte Veterinaria*, is still considered as extremely valuable, as it has handed down to us the only certain account of the opinions and practice of the early practitioners in this art. The body of the work appears to have been compiled from the most celebrated Greek writers on the subject. It is divided into four books; the prefaces or introductory chapters to which are written in very elegant language.

An edition of Vegetius was published at Basil, in 1574; and the work has been translated into several modern languages. Such of our readers as wish for a particular account of the contents of Vegetius's treatise, will find a copious analysis of it, in the third volume of M. Vitet's *Medicine Veterinaire*.

7 A collection of fragments of ancient writers on the veterinary art, was made by Ruellius, physician to Francis I. king of France. It was first published in Latin, in the year 1530; and afterwards, in 1537, the original Greek was published. The writers who contributed to this collection were chiefly Absyrtus, Eumelus, Hierocles, Pelagonius, and Theomestus. Some part of this collection is tolerably good; but, on the whole, it appears to be a strange jumble of good, bad, and indifferent, collected without judgment, and arranged without taste.

It is said that Xenophon, who lived three or four hundred years before the Christian era, wrote a small treatise in twelve chapters, on the training, management, and external figure of horses; but, as he says little or nothing with respect to their diseases, he cannot properly be ranked among the writers on veterinary medicine. 28 Xenophon.

29 Dark ages. A blank of more than a thousand years now occurs in the history of farriery. During this long period of darkness, ignorance, and barbarity, the veterinary art, like most others, rather went back than advanced. During some part of this gloom, however, the art of shoeing horses with iron appears to have been invented; an art which seems to have contributed not a little to throw the management of this noble animal into the hands of a set of errant blackheads, who were now first called farriers. We cannot here enter on a discussion of the medical pretensions of these guardians of the health of horses. They have been amply commented on, by some of the best writers on the subject of farriery, as Gibson, Bracken, Lafosse, and particularly Mr John Lawrence, to whose useful and humane treatise on horses we refer our readers for some very spirited remarks on the subject.

30 Ruini. The first modern writer on farriery, whom we can mention, is Carlo Ruini, an Italian, who, in 1618, published at Venice his Anatomia del Cavallo. This work, of which very few copies are now to be found, is embellished with many copperplates, which, for the time when they were engraved, are very elegant. It is said that many succeeding writers on the anatomy of the horse have been indebted to them for most of their figures.

31 Progress of farriery in France. We now come to a period at which the veterinary art began to assume something of a scientific form. Many writers of eminence began to appear both in France and England, countries which have been the most distinguised for their attention to the management and diseases of domestic animals. As the French writers were the first who did any thing considerable towards the improvement of farriery, we shall trace the progress of the art in that country, before we examine the improvements it has received in England.

32 Solleysel. In 1698 Solleysel published his grand work, "Le

parfait

*parfait Marechal*," the *complete Horseman*, a work which gained its author a high reputation, and was long the only guide, as well in farriery as in the manege.

M. Solleysel was principal riding-master in France, and this situation led him to pay much attention to the diseases of horses; and being a man of considerable abilities, and enlightened understanding, he saw the errors that prevailed in his time; and his genius and experience led him to expose and correct them. His practical observations and remarks, which it would be out of place to particularize in this early part of our article, in general merit considerable attention. His observations on the external figure of the horse, and of his blemishes and defects, are also very valuable. It is much to be regretted that this ingenious author had not studied the anatomy of the horse, as he would then have avoided many errors and much false reasoning, into which his ignorance of anatomy betrayed him. Solleysel's work passed through many editions, and was translated into most of the modern languages. A version of it into English was executed by Sir William Hope, one of his pupils, early in the 18th century.

33 Appearance of the murrain in Europe.

The dreadful havock committed by the murrains or epidemic diseases among horned cattle, that ravaged Europe during the first half of the 18th century, attracted the attention of medical men, and thus led the way to a greater improvement in the veterinary art, than it had ever before experienced. These epidemics were first described by two Italian physicians, Ramazzini, in a treatise *De Contagione Epidemica*; and Lancisi, physician to the pope, in a treatise *De Bovina Peste*. But the most celebrated works on the prevailing epidemic seem to have been written by the faculty in France. Among the first appeared a memoir by M. Hermant, physician to the king.

34 Sauvages.

In 1746 was published a memoir *Sur la Maladie Epidemique des Boeufs du Vivarais*, by the celebrated nosologist Sauvages.

35 Establishment of veterinary schools.

About the middle of this century, the first steps were taken towards the establishment of schools for the public instruction of practitioners in farriery. One of the most celebrated of these was the veterinary college of Lyons.

36 Bourgelat.

Over this institution presided the famous Bourgelat, a name that will be ever respectable in the history of farriery. Besides his office of professor at Lyons, he was inspector general of the veterinary schools in France; commissary general to the royal stables; honorary member of the Royal Academy of Paris, and member of the Royal Academy of Berlin. M. Bourgelat was a voluminous writer, and most of his works are still in much repute. In 1752, he published *Elemens d'Hippiatrique*, " Elements of Farriery," in 3 vols. The first volume is divided into eight chapters, comprehending the knowledge of the horse, as far as regards his external form. The first chapter treats of the denomination and division of the parts that compose the body of this animal; the second treats of the beauties and defects of the fore part of the horse, or what the French writers call *l'Avant Main*; the third treats of the beauties and defects of the several parts of the body; the fourth of the beauties and defects of the hind part of the horse, or *l'Arriere Main*; the fifth, of the different marks of horses; the sixth of the means of ascertaining the age of horses; the seventh, of the geometrical proportions of the horse; and the eighth, of shoeing.

The second volume describes the anatomy of the horse, as far as relates to the bones, the integuments, the muscles, and blood vessels; and the third volume concludes the anatomy with a description of the parts that compose the head and chest.

In 1765, M. Bourgelat's materia medica, for the use of the veterinary pupils, came out. Soon after was published his Elementary Treatise on the Anatomy of the Horse, which is the most complete work of the kind that has ever yet appeared. In 1766 he published his Elementary Botanical Demonstrations, for the use of the pupils of the veterinary college. He likewise gave to the world a treatise on bandages applicable to the horse.

M. Bourgelat also furnished many of the best articles on farriery for the French ENCYCLOPEDIE.

37 Buffon and Daubenton.

About this time appeared a number of works on the manege, and on natural history, particularly a work by M. de la Guerincere, entitled *Ecole de Cavalerie*, and the celebrated natural history by M. de Buffon and Daubenton; but as these works have little connection with the diseases of animals, which they mention only incidentally, we shall not here particularize their contents.

38 Lafosse the Elder.

Contemporary with Bourgelat, and equal to him in celebrity, flourished Lafosse the Elder, a member of the Royal Academy of Sciences at Paris, and farrier to the king of France. He made many discoveries, and introduced several valuable improvements in the art of farriery, particularly an improved method of shoeing, and a treatise on the glanders. These were at first communicated in the form of memoirs to the French academy, and published in their annals. They were afterwards collected in 1754 into one volume, under the title of *Observations et Decouvertes Faites sur des Chevaux*; " Observations and Discoveries on Horses." We shall have occasion, in future parts of our article, to consider the merits of these memoirs, which were well received, and have contributed much to the advancement of farriery.

The elder Lafosse also wrote some of the articles on farriery in the ENCYCLOPEDIE.

39 Lafosse the Younger.

He was soon followed by his son Lafosse the Younger, who occupied the same post as his father, and has acquired much reputation, by following his steps, and extending his improvements. He published in 1766, his *Guide de Marechal*; or " Farrier's Guide;" a work well known in this country, though it has never, we believe, appeared in an English dress. It is divided into five parts, treating, 1st, Of the means of ascertaining the age of horses, and a succinct enumeration of the several parts; 2d, Of the blunders and tricks of farriers; 3d, Of the internal diseases of the horse; 4th, Of the external diseases, and the most important operations; and, 5th, Of shoeing. This work is characterized by M. Vitet, as one of the most accurate, simplest, and most *precise*, that had ever appeared. The anatomical part of the work is short, but comprehensive, and is illustrated by some tolerably good plates. It appears to have been a sort of text-book to a course of lectures on farriery, which were afterwards, in 1772, published in a superb form, with 65 coloured plates, under the title of *Cours de Hippiatrique*; or " Course

History. of Farriery." This work is extremely scarce in Britain, where, according to Mr Blaine, there are only three copies of it; one of which belongs to the Medical Society of Woolwich; another is in the hands of a Mr Mathaisa, ci-devant pupil of the Veterinary College; and he believes Mr Morecroft has a third.

But the principal work of the younger Lafosse is his *Dictionaire d'Hippiatrique*, in four volumes, which is little known in this country, and which we have not seen. Mr Blaine calls it "the best practical system of farriery that had ever appeared."

In 1803 was published an abridgement of M. Lafosse's Guide, of which an English translation has lately appeared under the title of The Veterinarian's Pocket Manual. It is a useful little book, but it is a pity that the author or translator had not observed a more methodical arrangement.

Though, for the sake of uniformity, we have mentioned the younger Lafosse immediately after his father; there were many works published in France between the Memoirs and the Guide.

40 rfault. In 1755, M. Garfault published his *Nouveau parfait Marechal*, an improvement on the *Parfait Marechal* of Solleysel. It is divided into seven treatises; on the Conformation of the Horse; on Haras, or on the Method of Breeding; on Stables; on the Diseases of Horses; on Operations; on Shoeing; and on Horse Medicines. This work is not without defects, but, for the most part, it is very good, and by no means deserves the brief character given of it by Mr Blaine in his History of the Veterinary Art, that it "does not seem to merit any distinction in this place."

41 nden. The articles on farriery in the Encyclopedie that had been written by Bourgelat and Genson, called forth a work from M. Ronden, senior, farrier to the larger stables of the king; who, in 1759, published *Observations sur les Articles de l'Encyclopedie concernant la Marechallerie.* They appear to be ingenious, and contain much practical information.

42 maison tique. In 1763 there appeared at Paris a work on agriculture in two volumes 4to, entitled, *La Nouvelle Maison Rustique*, which contains much useful matter respecting the breeding, management, and diseases of domestic animals, as well fowls as quadrupeds.

The contagious epidemics among horned cattle still appeared occasionally in France and other parts of Europe; and many essays were written on them by various physicians, particularly by M. Bovand of Besançon, in 1766; by M. Leclerc and M. Barbaret, of Paris, in the same year.

In 1768 Daubenton, the celebrated naturalist, already mentioned, published a memoir on the mechanism of rumination in sheep; and in 1769, appeared a small volume entitled *La Medicine des Bêtes a Laine;* "the Medical Treatment of Sheep."

43 it. Between 1776 and 1782, M. Vitet, a physician at Lyons, published his *Medicine Veterinaire*, in 3 vols 8vo. of which the first contains a pretty full account of the anatomy of the horse and ox, with some judicious remarks on the beauties and defects of both, and on some of the more important operations to which they are exposed; the second treats of the diseases of horses, sheep, and cattle; and the third gives an account of the remedies employed in veterinary medicine; and ends with a copious analysis of most of the continental writings, and a few English, that had happened on the subject, from Vegetius to 1770.

M. Vitet's work is, for the most part, a compilation from the best writers who have gone before him; but as he had read much, and appears to have selected with judgment, his book is one of those which may be consulted with advantage. We know that it bears a high character in France, and is often quoted with respect. We are therefore disposed to rate it at a higher value than a late writer has done; and are inclined to suspect that some of those who affect to think lightly of it are indebted to it for much more than the "names of many of those who have written on this subject."

44 Rozier. Much about this time, but in what precise year we cannot say, the abbé Rozier, well known as the editor of the early volumes of the *Journal de Physique*, published his *Cours d'Agriculture et de Medicine Veterinaire;* a work of much reputation in France, but, we believe, little known on this side the water.

45 Paulet. Another work appeared about this time on the epidemics among cattle, entitled *Recherches Historiques et Physiques sur les Maladies Epizootiques;* "Historical and Philosophical Researches respecting Epizootic Diseases," by M. Paulet. It contains an abridgement of almost all that had been written on the subject, and is particularly valuable for the account of the morbid appearances that were discovered on dissection.

We shall finish our account of French writers in the words of Mr Blaine.

46 Huzard and Chabert. "After the death of Bourgelat and Lafosse, we hear of no character of any great eminence for some years; but it appears, that since the revolution, the subject has again been more diligently studied, and the names of Chabert and Huzard stand forward. Soon after, or about the time above alluded to, there appeared a considerable work, called, The Rational Dictionary of Medicine, Surgery, and Farriery, in six volumes; and very soon after, a Veterinary Dictionary, by Buchon; but it has no merit superior to that of Lafosse. In 1787, M. Chabert published a Treatise on the Mange of Horses; since which he has likewise published upon the peripneumonia of black cattle. There has also appeared an Essay on the Grease of Horses, which gained the prize medal of the society for the promoting the health of animals; to which is joined a report on thick wind and on broken wind; but we are not aware who is the author. In 1788, there came out a treatise on the *haras*, with the method of shoeing, cutting, and all the lesser operations, translated from the Spanish of Hartmann, by Huzard. Likewise "Instructions and Observations on Domestic Animals," with remarks on the breeding, rearing, buying and selling; with an analysis of previous authors, by Chabert, Handrin, and Huzard. The above authors have also published, conjointly, a Veterinary Almanack, containing the history and progress of animal medicine, since the establishment of the veterinary schools. In 1791, M. Lampagieu Lapole, veterinary surgeon, published observations on the health of the animals of St Domingo, dedicated to the veterinary college at Alfort. In 1797, M. Chabert and M. Huzard published, by order of government, a treatise on ascertaining the existence of the glanders, the means of preventing it, and destroying the infection.*"

47 Progress of farriery on the continent. Before we detail what has been done in Britain for the advancement of the art, we must take a cursory

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* Blaine's Outlines, vol. i.

view of the principal writings that appeared during the 18th century in the rest of Europe.

48 Goelicke. In 1730, Goelicke, a German, published a treatise in 4to, *De Lue Contagiosa Bovium;* "On the Contagious Disease of Cattle;" in which the symptoms of the murrain that raged in Flanders about that time are well described; and there are added the appearances on dissection.

49 Saunier. In 1734, appeared at the Hague a work entitled *La parfaite Connoissance des Chevaux;* "The Complete Knowledge of Horses;" by John Saunier, and Gaspard his son. The latter boasts of this work, that it was drawn up from the lectures of his father, an experienced man; and that it contains the result of numerous experiments on subjects of every description, and diseases of every species; that it is the labour of the life of two men, the offspring of their continual application and study. After all their boasting, however, the work of Mynheers Saunier is little worth.

In 1745 and 1746, appeared two other treatises on the epidemic of cattle by Mauchard and Ens.

50 Linnæus. In 1749, the illustrious and indefatigable Linné published at Upsal his *Pan Suecicus*, in which there is little that relates to our subject, if we except a table of such plants as are eaten or refused by the domestic animals, which is curious and useful.

51 Hastfer. Some time before 1756, Frederic Hastfer, a Swede, published Instructions for Improving the Breed of Sheep, which was in much repute, and was translated into French.

52 Reynier. In 1762, M. Reynier of Lausanne published a treatise on a contagious inflammatory disorder that raged among horses and cattle, and which the Genevese called *la louvet*. This will be considered hereafter.

In the same year there appeared at Vienna a work on the epidemic of cattle by Dr Pleneiz; and in 1765 Mich. Sagard of the same city published a work on a contagious distemper that the year before attacked the cattle in the circle of Iglaw in Moravia; and was attended with an appearance of aphthous crusts in the mouth.

53 Hartmann. Of late veterinary medicine has been much cultivated in Spain, where the works of Hartmann are held in much esteem. In that country, it is said, a work on farriery in nine volumes has been lately published; but of this we know nothing.

54 Camper. We must not close our account of continental writers without mentioning the name of the illustrious Camper, whose works were lately collected and published at Paris. Besides a long description of the structure of the oran-outang, and some lesser essays on comparative anatomy, these volumes contain an elaborate history of the epizootic disease that raged among the cattle on the continent in the middle of last century, in the form of lectures. We shall speak of this work hereafter.

We have thus brought the history of this art on the continent, in a concise manner, down to the present time; and from it may be learned what improvements have originated there, and at what periods. It would appear, that when the science began to command attention, from the exertions of Francis the First, and Vegetius became studied, had it progressively improved in the degree it might be supposed to be placed by a conversance with this author, it would ere this have been more approximating to perfection: but instead of proceeding on the rational system of Vegetius, it dwindled again into ignorance of barbarity; and the recipes of manege-masters, and the operations of blacksmiths, were the only ostensible marks of its assistance. From this state the practitioner became in some degree roused by the improved system of Solleysel; but he could only combat present errors, he could not point the way to future improvement, for he was ignorant of the groundwork whereon to build it, i. e. the anatomy of the animal. This defect was only in a small degree supplied by the labours of Ruini, and in some measure farther assisted by the demonstrations of Bourgelat. Many of the remaining errors were combated by Lafosse with great advantage; and his experiments and discoveries on glanders, the rationality and improvements of his mode of shoeing, entitle him to great merit. Yet, though by these exertions, and by the establishment of veterinary seminaries, the art assumed a more regular and scientific form, its attainments were by no means adequate to its opportunities; which was almost wholly owing to an obstinate adherence to the humoral pathology, by which the treatment of internal and acute diseases continued inert and unsuccessful. Their prescriptions were filled with decoctions of simples, and they were utterly unacquainted with the medicinal virtues of the more active remedies in use among us. Under an opinion that the blood and humours were the constant seat of disease, they were continually washing them sweet with correctors; entirely ignorant or unmindful of the derangement of the solids, and of the connections between living blood and living vessels. Nor did this influence only their treatment of internal and acute diseases; but even of local and chronic affections: hence their mode of treating farcy, grease, and other complaints of a similar nature, were equally inert, and all evinced an erroneous pathology. Upon a careful and unprejudiced review of the state of farriery among ourselves, and on the continent of Europe, we are not inclined to think it had any advantages of moment at the beginning of the war in their favour; though it must be allowed, we are indebted to them for many improvements, and for the first hints towards the establishment of a regular school of the art among us. Since the war, our means of communication are so few, that we are not aware of what is doing among our neighbours. But though farriery, as a branch of veterinary medicine here, has kept nearly equal pace with its continental improvements, I do not think (says Mr Blaine), the treatment of other animals, particularly of *oxen*, *cows*, and *sheep*, has been equally attended to; and, in this particular, I am disposed to think we are behind hand with them. Their severe visitations of the epizootic distemper have made them more attentive to this branch of the art †."

55 Progress of farriery in Britain. In taking a review of the history of farriery, or veterinary medicine in general, in our own country, it will be seen, that we are much longer in improving the art, and reducing it under a rational and scientific form, than our neighbours on the continent. Our earliest writers on the diseases of horses and cattle, were deplorably ignorant, not only of all principles of general medicine and sound practice, but even frequently of the common appearances of the diseases, which they professed to cure.

56 Blandeville. Our first writers on the treatment of the diseases of horses,

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† Blaine's Outlines.

horses, were, as in France, chiefly riding-masters; and of these, the first that seems worthy of notice is Blundeville, who lived, as we have already observed, in the reign of Queen Elizabeth. His work appears to have been principally compiled from the writings of Vegetius, and other ancient writers; and it contains little that can entitle it to any distinction, as a work of utility. It may, however, be perused as a literary curiosity.

57 The names of many writers, after Blundeville, are mentioned by those who have written on the history of farriery; but they are still inferior to Blundeville, except perhaps Burdon, on whose work notes were written by Dr Bracken.

58 rkham. About the end of the 17th century, lived Gervase Markham, a name in high repute amongst grooms and farriers even to this day. He published a work on Farriery, which is called his *Maister Peece*, and which is one of the strangest compounds of nonsense and absurdity that has ever appeared on the subject.

In the opinion of Mr Lawrence, Markham was nothing more than a mere vulgar and illiterate compiler; and his works, some few things excepted, are stuffed with all the execrable trash that had ever been invented by any writer, or practised by any farrier, ancient or modern, on the subject of horses. It is necessary, however, that we do justice to the character of Gervase Markham; he certainly possessed a species of merit which has not descended to all his successors, the copyists and plagiarists; he very honestly gives the names of those authors from whom he derives his knowledge.

59 et. Some years after Markham, Michael Baret published a book, which he called the *Vineyarde of Horsemanship*. This we have never seen, but it appears to be of some repute. 60 e of wcastle. The next writer on this subject, is the duke of Newcastle, who gave to the world a most superb work on an improved method of breeding and managing horses. This work bears a very high character, not only from the name of the illustrious person by whom it was composed, but from its own intrinsic merit. The duke is quoted with respect by most succeeding writers; and his work has been translated into French, German, Dutch, and Italian. It chiefly relates to horsemanship, but as it contains some excellent observations and maxims on the breeding of horses, it naturally comes to be considered here.

61 e. In the latter end of the 17th century, Andrew Snape, who was farrier to Charles II. published a large work on the anatomy of the horse, illustrated with many copperplates. These plates appear not to have been taken from his own dissection, but are mostly copied from preceding authors, especially from Ruini. Mr Blaine, however, is mistaken in asserting that some of them are copied from Saunier, as Snape's work was published in 1683, whereas Saunier's did not appear (according to Vitet) before 1734. It is said that Snape had projected a larger work on the diseases of horses, but this he did not live to execute.

52 m. Early in the 18th century, farriery experienced a considerable improvement from the writings of Mr William Gibson. This gentleman had been a surgeon in the army, but relinquished that situation for the practice of farriery, which he probably expected to find more profitable. Mr Blaine places this writer in the middle of the last century; but his first work, entitled "The Farrier's New Guide," was certainly published previous to the year 1721, as we have seen a second edition of it advertised in that year. This was the most scientific work on the diseases of horses, that had then appeared in the English, or perhaps any language. The detail of symptoms is in general just, accurate, and the plan of treatment advised is for the most part very judicious. The anatomical part of Mr Gibson's work is not so valuable, being frequently incorrect, and evidently not the result of his own observation. The Farriers Guide was soon followed by The Farriers Dispensatory, containing an account of the remedies employed in farriery, and the means of preparing and exhibiting them. This work is far inferior to the former, and is now of little use. In 1721, Mr Gibson published a small work on The True Method of Dieting Horses, which contains some judicious remarks on the means of preserving the health of this useful animal; as also on the breeding of horses: with some observations on their external form, their sagacity, and habits. This book must have been very valuable at the time of its publication, but is now in a great measure superseded by Clark and other later writers.

About 1750, Mr Gibson published a larger work, On the Diseases of Horses, in which he has brought together the substance of his former works on farriery, with some improvements. There is, we believe, a later edition of it in two vols. Mr Gibson must be considered as one of those to whom farriery is most indebted for its improvements. He was almost the first, at least in this country, to rescue the art from the hands of the illiterate empirics, to point out their blunders and correct their errors. Mr John Lawrence, who has given a very full account of Mr Gibson in the first volume of his treatise on horses, perhaps goes too far in ranking him on an equality with some of our present writers; while these again have erred as much on the other side, in detracting from the merits of a man to whom they are all more or less indebted for much of their most valuable matter.

Gibson was followed in his plan for the improvement of farriery by Dr Bracken, a physician at Lancaster, and a pupil of Boerhaave, who published a work called Farriery Improved. 63 Bracken. "Bracken (says Mr Blaine) was a physician of great abilities and extensive knowledge in his profession; a man of considerable erudition, a sportsman, and a wit of a peculiar cast. His works have by some been as much admired and read for the peculiar style in which they are written, and that peculiar freedom and non-observance of rule or form, as for the real information they contain.

"Though there is great ingenuity in his writings, and though in many respects he improved upon Gibson, yet as a practical work it was much inferior; nor was his information given in a way that could benefit the generality of his readers: independent of his style being too peculiar, and his reasoning too abstruse for farriers, his manner of pursuing his subject was so desultory, that few readers had patience to follow him. Neverthless his works, which were several, and passed through many editions, have raised him a fame that can only die with the science."

These two writers may justly be considered as the fathers of English farriery; they established their system on the only sure foundation, the analogy which prevailed between the structure, economy, and diseases of man and of brutes. The best practice in this country has been derived from their instructions; and their works formed an example, by following which, later writers have greatly improved the art.

64 Bartlet. The next writer of reputation was Mr John Bartlet, also a medical man, who about the middle of the last century published his Gentleman's Farriery, and afterwards his Veterinary Pharmacopeia. Bartlet had formed himself on the model of Gibson and Bracken, the best parts of whose writings he has given in his farriery, condensed into a more compendious view. He also enriched his work by the most material improvements of Lafosse, whose memoirs on shoeing and on glanders, he translated into English.

65 Osmer. Soon after Bartlet, appeared Mr William Osmer, a surgeon and a sportsman, who practised farriery in Oxford-street, London. He was the principal means of introducing into this country the French mode of shoeing, which, in his treatise on the lameness of horses, he adapted to the English manners, so as to render of service, what had been before nearly useless and impracticable. Mr Osmer's mode of shoeing will be mentioned hereafter. From the above works many compilations were soon made; these were generally below mediocrity, amongst which, one called the Farrier's Dictionary, though a very wretched composition, met with a very rapid sale. We must except from these a small treatise by a Mr Blount, surgeon, which is above the common class, and worthy of notice, from an ingenious contrivance, illustrated by a plate, for securing a fractured limb.

66 Brocklesby. In the year 1746, Dr Richard Brocklesby, a friend of Dr Mead, published a pamphlet on the disorder that just before raged among horned cattle. It should seem that this book is very little known beyond the circle of medical men, as we have not seen it referred to by any writer on the diseases of cattle.

67 Layard. Brocklesby was followed on the same subject by Dr Layard. We shall speak particularly of these two authors, when we come to treat of the murrains.

68 Clark. About 30 years ago, Mr James Clark, farrier to his majesty for Scotland, published an ingenious Treatise on Shoeing, and on the Diseases of the Feet of Horses. This was soon followed by his Treatise on the Prevention of Diseases Incidental to Horses. By this latter work Mr Clark has acquired much reputation as a scientific farrier, and a sensible writer. It contains some judicious observations on stables, diet, and exercise, on blood-letting, rowels, and setons; with remarks on the uses and administration of the more common remedies. Mr Clark's book is in general well calculated to produce a more judicious and humane method of treating horses, than usually prevails. But it would have been more useful, had the author omitted much of the theoretic discussion, into which he has entered on some parts of the animal economy, on the nature of disease, and on the action of remedies. Mr Clark is a good practical writer, but his theory is often very lame, or very obscure. He had an easy opportunity of attending the medical lecteres, which were taught at Edinburgh in his youth, when the humoral pathology and the theory of Boerhaave were in full vogue. Mr Clark has here and there interspersed among his practical remarks much of this old leaven. But as he probably had not received such a previous liberal education as might fit him for the judicious application of what he heard, he is often deficient in that theoretical knowledge which he takes so much pains to display.

69 Lord Pembroke. Some years before the publication of Mr Clark's last mentioned treatise, viz. in 1778, Lord Pembroke favoured the public with his excellent dissertation on the management of dragoon horses, with some remarks on shoeing. This work is entitled, Military Equitation, or a Method of Breaking Horses. Though the observations contained in his lordship's work were intended for the use of the British cavalry, they are for the most part applicable to horses in general, and well merit the attention of farriers and others concerned in the management of horses. We do not well understand what Mr Blaine means by asserting that Lord Pembroke derived the principle of his medical hints from Mr Clark. If he means that his lordship borrowed any thing from Mr Clark's treatise on preventing the diseases of horses, he is certainly mistaken, as the first edition of this treatise, which we believe has not been reprinted, appeared in 1788, and in it Mr Clark often quotes Lord Pembroke's work (c).

70 Stubbs. Much about this time Mr Stubbs published his elegant plates of the anatomy of the horse, of which work, as the production of an artist, we cannot speak too highly. Mr Stubbs is a very eminent painter of animals, and to much professional excellence in this capacity, he has added a considerable share of anatomical knowledge. Hence his figures are in general extremely correct, and will be found very useful to those who have not the opportunity of availing themselves of real subjects.

71 Taplin. One of the latest writers on the subject of farriery is Mr Taplin, who for some time enjoyed a considerable reputation, both as a practitioner and as a writer. But this reputation has been materially sullied, since it was discovered, that Mr Taplin is not only ignorant of the anatomy of the horse, but has liberally copied from those very writers whom he takes every opportunity to vilify and abuse. As from his flagrant plagiarism and arrogance, Mr Taplin has well deserved *the dressing* which he has recently received from several late writers, we shall turn him over into the hands of one of his rivals, who does not seem disposed to show him any mercy.

"This gentleman likewise began his career as a surgeon, but turned aside to the then more profitable track of farriery. Mr Taplin set out by decrying all that had gone before him, all that were in practice with him, and in fact every thing that has been done by any one since. Yet Mr Taplin's works are said to be compilations from those very authors whom he abuses; and, in some instances, after abusing egregiously, he copies literally.

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(c) We find that Lord Pembroke's work was first published about 1761. The edition mentioned in the text is, we believe, the second.

ally. Unfortunately for this gentleman, from some late improvements, the people of this country have learned to distinguish in this art, as well as in others, between scientific investigation and verbose quakery. Had Mr Taplin set out by studying the structure and economy of the animal, he might, and undoubtedly would, have proved an ornament to the profession; but when he permits his works to go through so many editions, in the face of criticism from all quarters, with a chapter on diseases of a part that has no existence in the horse, i. e. *the gall bladder*, we must be aware that he is entirely ignorant of that, upon which every pretension to professional merit must be grounded. Mr Taplin indulges himself in the most unrestrained freedoms in speaking of those who have gone before him, yet copies verbatim from them; he cannot wonder, therefore, that he has been treated with considerable severity by later writers; nor can he be surprised that a practice so begun and so continued has ended as it has *."

laine's ines, i. p. 63.

Mr Taplin is the author of several works on farriery. His first publication was, we believe, The Stable Directory, which had a great sale. He next published a larger work, in two volumes; and lately he has sent out a small pamphlet called *Multum in parvo*, which is supposed to be merely intended to advance the sale of his prepared horse medicines.

72 don veary ge. The end of the 18th century will ever be memorable in the history of farriery, for the establishment of an institution for the public teaching of the veterinary art in England, in imitation of those schools in France of which we have already spoken.

73 el. The veterinary college owes its origin to M. St Bel, a French gentleman, born at Lyons, and who was first junior assistant to the professor of the Royal Veterinary College there, and afterwards professor of anatomy at the veterinary college of Montpelier. This gentleman came to Britain in 1788, and published proposals for establishing a veterinary school in this kingdom. These proposals did not, at that time, meet with encouragement; but two years after, when M. St Bel, driven from his native country by the horrors of the revolution, again visited England, his proposals were taken again into consideration by an agricultural society at Ockham in Hampshire. It had been the intention of this society, to send two young men to France, to study the veterinary art scientifically; but on hearing the proposals of M. St Bel, they abandoned this idea, and appointed a committee to consult with him on the best means of forming a school for teaching the art in this kingdom. To this school they gave the name of *the Veterinary College of London*; and M. St Bel was appointed the first professor.

The following gentlemen were appointed to the management of this institution.

His Grace the Duke of Northumberland, President.

Earl Grosvenor,
Earl Morton,
Earl of Oxford,
Lord Rivers,
Sir George Baker, Bart.
Sir T. C. Bunbury, Bart. M. P.
Sir W. Fordyce,
John Hunter, Esq.
} Vice Presid.

Sir John Ingleby, Bart, M. P.
Sir H. P. St John Mildmay, Bart.
G. M. Ascough, Esq.
Mr John Baynes,
Mr J. Burgess,
Rev. T. Burgess,
Rev. J. Cook,
Dr Adair Crauford,
John Gretton, Esq.
Dr Hamilton,
Mr Rennet,
Dr D. Mapleton,
Granville Penn, Esq.
Mr William Stone,
Richard Tophane, Esq.
Dr Williams,
J. Wollaston, Esq.
} Directors.

Messrs Ransom,
Moreland,
and Hammersly,
} Treasurers.

A house was taken, for the purpose of the institution, and pupils were admitted to board in the house.

The success of this institution, at first, by no means answered the expectations of the founders. It appears that M. St Bel was prevented, by the embarrassed state of his circumstances, from executing the office of professor, with that ardour and activity which was necessary to the reputation of the infant school; and indeed it seems, from the specimen he has left us of his professional abilities, that these were not adequate to the office he had undertaken. He possessed considerable industry, and it is probable that, had he lived, he would have succeeded better than his outset had promised. But, in the year 1793, he was attacked with an illness, which proved fatal in about a fortnight.

M. St Bel left behind him several works, viz. An Essay on the Geometrical proportions of Eclipse. Lectures on the Elements of Farriery. The Art of Horseshoeing, with Observations on the Diseases of the Feet. And a volume of posthumous works.

We do not pretend to give our own opinion as to the merits of these works, as we have not seen them. But it is said that the Essay is merely an application of the proportions long ago laid down by Bourgelat in his *Elemens d'Hippiatrique*, to a particular case; and that many of his measurements are incorrect. Mr Blaine roundly taxes him with translating Lafosse to furnish matter for his Elements, and refers for proof of this to the description and treatment of *quittor* in St Bel's Elements, and Lafosse's *Dictionaire d'Hippiatrique*.

Mr Blaine brings many other instances of M. St Bel's want of information and science, for which we must refer our readers to Mr Blaine's Outlines of the Veterinary art.

74 On the death of M. St Bel, there appears to have been a competition for the vacant chair, between two gentlemen, who were both well qualified to fill it, Mr Edward Coleman and Mr Morecroft. Both of these gentlemen had been bred to surgery, and the former had acquired much reputation by an ingenious Essay on Suspended Respiration. The latter was lately returned from France, where he had been studying the veterinary art. We are not acquainted with the particulars,

culars of this competition; but the choice of the subscribers fixed on Mr Coleman, under whose management the college has acquired considerable reputation.

75
Mr Coleman appointed professor.

The election of Mr Coleman was followed by some new regulations. An anatomical theatre was fitted up, with dissecting rooms for the use of the students. A medical committee was also appointed for the purpose of examining the pupils, who had completed their education at the college, previously to their receiving a diploma as veterinary surgeons. This committee, in 1801, was composed of the following gentlemen.

76
Examining committee.

Dr Fordyce, senior physician to St Thomas's hospital.
Dr Relph, physician to Guy's hospital.
Dr Babington, Do.
Dr Bailie, physician to St George's hospital.
Mr Cline, surgeon to St Thomas's hospital.
Mr Home, surgeon to St George's hospital.
Mr Astley Cooper, surgeon to Guy's hospital.
Mr Abernethy, surgeon to Bartholemew's hospital.
Mr Wilson, lecturer on anatomy and surgery, and
Mr Coleman, professor of the college.

77
Regulations of the college.

The following are the regulations of this useful institution as published in the year 1801.

The subscribers of the veterinary college pay two guineas per annum, or twenty guineas for life. For this subscription each subscriber, is entitled to send, when sick or lame, any number of horses to the veterinary stables, where no charges are made for medicines, attendance, or operations. The subscriber pays only for the keeping and shoeing of his horse, which is generally less than the actual expence incurred by the college. A committee of stablers is appointed to examine the quality of the forage, and to regulate the price of the keep of horses. For some years past, the subscribers paid only 2s. 6d. per night; but in consequence of the great advance in hay, corn, and straw, and the college, by this moderate charge, having sustained a considerable loss, the keep of horses is now fixed at 3s. per night. A separate committee inspects the accounts of the college, and three times in the year reports to the general meeting the state of the finances of the college. No horses but those the property of subscribers are admitted into the veterinary stables: but the professor is allowed private practice, and horses not belonging to subscribers may be sent to the college for the professor's opinion.

The horses not intended to be left in the stables of the college may be sent for the professor's advice on Mondays, Wednesdays, and Fridays, from twelve to two o'clock. Where medicines are requisite, they are prepared for subscribers horses at very reduced prices; and the college receives all emoluments which may arise from the sale of horse medicines.

The expences incurred by subscribers, for shoeing, for the keep of horses, or for medicines, must be paid for before the animal be taken from the college. And as some losses have been sustained from the strict letter of this regulation not having been always attended to, the clerk has now received positive orders from the committee, not to allow any horse, before all the expences are paid, to be taken from the college. The horses are placed under the direction of the professor, who resides on the spot, and the medicines he prescribes are compounded by a proper person employed for that purpose.

As the great object of the veterinary establishment is to form a national school for the improvement of farriery, pupils paying twenty guineas are admitted into the college to learn the veterinary art.

Lectures are given by the professor on the formation, economy, and diseases of horses, and other domestic animals; and most of the eminent medical teachers in London, with a liberality peculiar to themselves, have allowed the veterinary pupils to hear their lectures without any fee or reward. The veterinary students attend lectures on human anatomy and physiology, on the principles and practice of surgery, on the materia medica, and chemistry, and practice of physic.

The period requisite for obtaining a competent knowledge of the veterinary art, is regulated by the talents, previous information, and industry of the individual pupil. The students continue to attend the college until they are examined and approved by the medical committee. Those pupils who are duly qualified receive a diploma; but those who are found on examination to be deficient, are rejected. There are four general examinations in the year. When examined and approved, if no objections are made to their conduct, during their study at the veterinary college, they may be recommended to any regiment of cavalry, not already provided with a veterinary surgeon.

No fees of any kind are allowed by the college to any of the servants of subscribers; neither are the servants of the college permitted to receive any perquisites from the subscribers.

A veterinary college has also been established near Birmingham, and it is said that others are in contemplation in other parts of the empire.

The advantages that have already accrued from this establishment, to veterinary medicine in general, and to our national cavalry in particular, are very considerable. Almost every regiment of cavalry has been supplied from the college, with a veterinary surgeon; and many of these gentlemen have published works which, for the most part, do much credit to themselves and their academy.

In 1798, Mr Coleman published the first volume, and in 1802, the second, of Observations on the Structure, Oeconomy, and Diseases of the Foot of the Horse. This is a most useful and valuable work, but it is too splendid and costly, especially the second volume, for general circulation. The first volume contains a very full account of the method of shoeing practised at the veterinary college, of which we shall give an abstract hereafter.

About this period, appeared also a pamphlet by Mr Coleman, On the Formation and Uses of the natural Frog of the Horse, with the description of an artificial Frog.

In 1801, appeared the first number of the Veterinary Transactions, published by order of the subscribers. This pamphlet commences with a long introduction, stating the object of the institution, the progress which it had made, and the causes that tended to prevent its complete success. These originate partly in the party opposition of the common farriers, who deem it their interest to do all in their power to circumvent the views of the subscribers: but they have still more been derived from the underhand malice of grooms and servants, with whose interest the institution, from the liberal manner in

which

which it is conducted, must certainly clash. The body of the pamphlet is occupied with a very neat view of the consequences and treatment of wounds of joints, and other circumscribed cavities, and it is concluded by an account of the regulations of the college (see N° 77), the list of the medical committee, a list of the examined and approved veterinary surgeons that had at that time passed at the college, and lists of the then managers and subscribers to the institution.

78 icey ike. The first pupil of the college, as we believe, who distinguished himself as as author, was Mr Bracey Clarke; who, in the third volume of the Linnæan Transactions, published a very ingenious paper on the *botts* in horses and cattle, of which we shall speak hereafter.

79 ng. About the same time appeared a small volume on Veterinary Pathology, by Mr Riding, veterinary surgeon to the 18th regiment of dragoons.

80 ny. In 1802, Mr John Denny of the 10th dragoons published a small volume on the Diseases of Horses. In this work Mr Denny has in general given the principles and practice of the veterinary college, and has illustrated and confirmed these by his own attentive observations and long experience.

81 te. In the same year appeared a very neat Compendium of the Veterinary Art, by Mr James White, of the 1st dragoons. This is only a pocket volume, and of course is very concise; but the author has given a very comprehensive view of the nature and treatment of diseases, and of the late improvement in the art of shoeing introduced in the veterinary college; and the work will be found an useful companion to the young practitioner. This volume also contains the substance of a former work, by the same author, on the Anatomy and Physiology of the Horse's Foot. In the year 1804, Mr White published the Veterinary Materia Medica, containing a brief description of the various substances employed in farriery, with an account of their particular effects on the body of the horse. He occasionally introduces some pertinent remarks on the diseases of the horse; and in the latter part of the volume, comprising the veterinary pharmacopeia, he has given a number of the best and most scientific recipes that he had seen. This work may be considered as the second volume of Mr White's compendium; and the author considered the two volumes as forming a complete system of the veterinary medicine. Though we are disposed to think very favourably of these volumes, as a practical compendium, we cannot help thinking that Mr White might have contented himself with that modest title without assuming the more pompous one of a system. We must also remark, that the materia medica, which is not large, is unnecessarily swelled by the admission of many articles that seem to have been introduced merely to tell us, that they are never used in the veterinary practice.

Mr White is also the author of an Address to the Royal First Devon Yeoman Cavalry respecting the management of their horses, when employed on actual service.

ie. In the year 1802, or we believe a little earlier, a work of considerable elegance was published by Mr Richard Lawrence, veterinary surgeon at Birmingham. As we have not seen this work, we must copy the following account of it from Mr Blaine. "It is much to be regretted that a gentleman who possesses so much ingenuity, should pass over subjects of such importance in such a light cursory manner. The description and treatment of some diseases occupy fewer lines than (to treat the subject in such a manner as to prove useful) they would require pages. The plates are elegant, and extremely well designed, particularly those that regard the proportions and paces of the horse; those that regard the internal structure and diseases are not so happy. The diction is very superior. As a cabinet work, it is most certainly elegant and interesting; but as a useful assistant to the art itself, it does not rank so high."

83 Boardman. In the same year was published the first part of a dictionary of the veterinary art by Mr Thomas Boardman of the third regiment of dragoons. This work was intended to be completed in sixteen parts. The author seems to have availed himself of the latest and best information on the several articles that compose his work; and he has introduced into it a variety of subjects on the principles of general medicine.

84 Feron. One of the latest publications by pupils of the veterinary college, is a new system of farriery by Mr John Feron, veterinary surgeon to the thirteenth regiment of light dragoons. This work is printed in quarto, and affords a good instance to what extent a small quantity of matter may be carried by the modern typographical improvements of large type, broad margins, wide spaces, and frequent breaks. The work is indeed very elegant both in type and in plates. It also contains some useful information on the external structure of the horse, with a view to point out and illustrate what appeared to the author to be the most perfect form of a blood horse, with the blemishes and defects which appeared most likely to impede his velocity. This appears to be the best part of the work, and is well illustrated by the plates. The latter half of the book is occupied with the consideration of diseases; and here we are led, from the author's title page, to expect an account not only of the diseases of horses, but of the principal epidemics to which cattle, sheep, &c. are subject. These epidemics are however discussed in the course of seventeen pages; but we are given to understand that the author intends in a future publication to give a full comparative description, with the proper mode of treatment of every disease that affects domestic animals. Mr Feron's observations are rendered of less utility than they would otherwise have been, by the want of a table of contents prefixed to the work.

These are, we believe, the principal publications that have proceeded from the pupils of the veterinary college. A few other works on veterinary medicine still remain to be considered. 85 Freeman. In 1796, a very elegant work on horses was published by S. Freeman, Esq. whose character is given by Mr Blaine as an amateur in the manege, and a gentleman of fortune, learning, and great ingenuity. This publication consisted in a *description of the structure and economy of the foot*, accompanied with a set of plates highly finished in Skelton's best style. The subjects were dissected under the inspection of Mr Home, or an assistant; and except some slight errors in the ligaments of the navicular bone, appear very correct. This publication, for the elegance of its engravings, and the general spirit of the whole, will be long without a competitor. It recommends a very ingenious

ous mode of shoeing, and the economy of the foot is likewise very ingenious.

86
John Lawrence.

About the same time Mr John Lawrence published a small volume on horses, chiefly composed of extracts from St Bel, Osmer, Clarke, and Lord Pembroke; and in 1798, this gentleman brought forward his philosophical and practical treatise on horses, a work which is as remarkable for the good sense and humanity of the author, as for the whimsical eccentricity and angry irritability which he occasionally displays. The work embraces a great variety of subjects. It commences with an account of the principal former writers on farriery, in which high eulogies are paid to the memory of Gibson and Bracken, and a very violent attack is made on the ill-starred Mr Taplin. The latter part of the work contains Mr Lawrence's system of veterinary practice, which is chiefly taken from his favourite authors, as Mr Lawrence seems at that time not to have had much practical experience. The work also contains some remarks on the diseases of horned cattle, on the treatment of cows, and on calving.

Mr Lawrence has since, in 1805, published a separate treatise on cattle, in which the management of neat cattle, sheep, and swine, are handled in a masterly manner; and a much fuller account of diseases and their treatment are given than could be expected in his former treatise. We venture to recommend Mr Lawrence's works as among the most instructive and most entertaining we have met with.

87
Downing.

Some years ago there appeared a work on the description and treatment of the diseases of cattle, by a Mr Downing, a professor of cattle medicine; which, though very expensive, sold very fast, and was very generally esteemed among farmers and graziers. We have not seen this work; but from the account of it that is given by Mr Blaine in his outlines, it should seem that it abounds with important errors, and frequently inculcates a dangerous mode of practice. We cannot here enumerate the particular examples brought by Mr Blaine in proof of his assertions, but we shall notice the most important of them under their proper heads.

Perhaps no part of veterinary medicine has been so little cultivated in this country, as that which considers the diseases of cattle. There is scarcely a work on this subject in the English language that is worth perusal. We cannot give a better idea of the little value that must be placed on these works than by the following extract from Mr Lawrence's treatise on cattle.

88
Imperfection of works on cattle medicine.

"I have never yet seen any of these *cattle-doctoring books*, which appeared to me to be written *bona fide*. Well-intentioned ignorance, if not entitled to respect, is at least venial; but the slightest examination of most of these printed guardians of the health of cattle, by a person qualified to judge, will evince, that they are premeditated impostures, goods merely varnished up for sale. They have either the names of living men tacked to them, who, in the strongest probability, never either did, or could write a line of them, or they are published in the name of some one of the mighty dead, among cow-doctors, who most unfortunately died at last, after sixty years practice. One would expect to find something original and valuable, from this long-continued and extensive practice; but the disappointment is always complete. The chief of that which we meet with, consists of transcriptions from former writers, interlarded with learned, medical, and physical dissertations, perhaps sound and good enough in their place, to which are loosely and clumsily tacked the most nonsensical and burlesque appendages by Mr Editor. The medicinal forms in these books, are frequently the strangest jumble that imagination can conceive. Articles of a directly opposite nature and intention, are blended in one mass, which must inevitably act upon the animal system with an effect similar to that of two men pulling at opposite ends of a cord. We find balsam of Peru and Glauber's salts married together, the intent of which, no doubt must be, as a Suffolk farrier once described to the late Mr Rush, "a kind of heater, and a kind of cooler." Indeed the far greater number of the prescriptions wear rather the appearance of having been fabricated for the use of the book, than of having ever been used and approved in real practice. One truly laughable custom was introduced by the book published under the name of Topham's old one. It was to subjoin to every prescription of note, a set character, conceived in the most high sounding terms of panegyric, at the same time, with a choice of words, at once so droll, and so gravely professional, with so formal an arrangement, that he must be a man far surpassing me in gravity, grave as I naturally am, who can peruse them without bursting into laughter. It must not be denied, however, that these books contain a number of useful hints, relative to the management and dieting of cattle, whether or not such may have originated with the doctor, or have been introduced by the editor. They may also, to a certain degree, be consulted as to the symptoms of diseases, although by no means to be implicitly relied on even in that respect. So far they have their use. With regard to doctoring, as it is termed, or prescribing medicines to cattle, they are most truly blind guides; and when, unfortunately, they are set to lead the blind, the fate of both parties may be very readily anticipated. I am speaking of books, which have been published within the last half century. As to the ancient veterinary writers, none of them, not even the celebrated Vegetius, were medical men, and their medical practice is utterly beneath modern notice. The same kind of books of our old English writers, consist of a strange medley of ancient practice with various sage additions of their own. A rational man cannot read over some of their prescriptions without amazement, nor a humane one without extreme pity for the harassed victim of such monstrous practice. By the way, they who, for interested purposes, fabricate pretended cattle medicines, of the effects of which they are careless or ignorant, commit an act of gross inhumanity and crime, in too probably adding to the load of sufferings of a helpless animal already tortured by disease. One of the greatest curiosities we meet with in the old books, is their grand universal specific. It seems as though they judged by a kind of compound arithmetico-medical logic, that all medicines being conjoined and multiplied one into the other, the product must necessarily be the prevention or cure of all diseases *."

89
Culley.

Mr Lawrence has excepted from the above general condemnation, a work lately published by Mr Culley, of Northumberland; which, he says, ought to be in the hands of every farmer in Great Britain. He considers it as the only original work in our language, and, as containing in a small compass, a most valuable fund of information,

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* *Lawrence on Cattle.*

information, chiefly from the author's own experience.

90 orecroft. In the year 1800, Mr Morecroft, the rival candidate with Mr Coleman for the professorship of the veterinary college, published a small pamphlet containing a cursory account of the various methods of shoeing horses, with incidental observations. This work displays considerable ingenuity. We shall notice Mr Morecroft's method of shoeing by and by.

91 aine. In 1802, appeared Mr Blaine's Outlines of the Veterinary Art, or the Principles of Medicine as applied to a knowledge of the structure, functions, and enconomy of the horse, the ox, the sheep, and the dog; and to a more scientific and successful manner of treating their various diseases; in two volumes. Mr Blaine is well known as a practitioner of veterinary medicine, and as the advertiser of a specific against the distemper in dogs. In his Outlines, Mr Blaine, after giving a sketch of the history of medicine in general, enters on the history of veterinary medicine in particular, which he details at considerable length; not, however, without several errors, some of which we have already pointed out. He next proceeds to lay down very briefly what he conceives to be the proper means for the attainment of the veterinary art. Then follows a long section on a subject which we should scarcely expect to find in a work of this kind, the history of chemistry. The first part concludes with a sketch of comparative anatomy, in which the structure and economy of the ox, sheep, and dog are passed over much too lightly. The second part, which occupies the rest of the first volume, and one-half of the second, is taken up with a very minute account of the anatomy of the horse, with some observations on the economy and uses of the several parts. We consider this as the best part of Mr Blaine's book; but we think that he has made it unnecessarily prolix, as by carrying it to such an extent, he has not left room for a satisfactory account of diseases, which occupy the rest of the second volume. Here we cannot but consider the author as very defective. Neither the symptoms nor the treatment are given with that accuracy or precision, which the public had a right to expect from a practitioner of Mr Blaine's long experience. Many of the diseases of cattle, sheep, and especially of dogs, are passed over in a manner that is by no means satisfactory. The work is written in a very slovenly manner, and is everywhere filled with an ostentatious parade of medical phraseology that must render it nearly unintelligible to the generality of readers. In his receipts, Mr Blaine has for the most part adopted the new nomenclature, which, however we may approve in medical formulæ, we cannot think calculated for the meridian of farriers. We, however, by no means intend to insinuate that Mr Blaine's work is without merit: it certainly contains much valuable matter; but we must repeat that it is not what we should have expected from the advantages of information and experience which Mr Blaine appears to have possessed.

In the following year, Mr Blaine published a smaller work, which he calls a Domestic Treatise on the diseases of horses and dogs, which appears to be chiefly an abridgement of the Outlines, with a sort of advertisement for the sale of Mr Blaine's patent medicine.

92 Findlater. In 1802 appeared a General View of the Agriculture of the county of Peebles, by the Rev. Charles Findlater, minister of the parish of Newlands, in that county. This work, though intended merely as a local survey of the state of agriculture and improvements in a small district, abounds with much excellent matter that must prove of general utility. Besides the observations which the ingenious author has made, on the general management of live stock, in the body of his work, he has added in one of his appendices some valuable information respecting some of the most important diseases of sheep, which are partly furnished from the communications of Dr Gillespie, late physician in Edinburgh, and Dr Coventry professor of agriculture in that university, and partly derived from his own experience.

93 Dickson. In 1805 was published an elegant work on practical agriculture by Dr R. W. Dickson; the second volume of which contains much useful instruction respecting the choice, breeding, feeding, &c. of all the species of live stock employed on a farm; with a few very concise remarks on the diseases of each species. But as these are merely practical hints, they cannot be of much use, except to those who are already tolerably acquainted with the subject.

94 Daniel. In the same year, the Rev. William Daniel performed a task, which, however ill suited to the character and avocation of a clergyman, must be highly grateful to every lover of the sports of the field, in the publication of his Rural Sports, which contains perhaps the most complete account of every thing relating to dogs that is to be found in the English language. Among other subjects connected with the management of this favourite companion of man, the reverend author takes occasion to treat pretty fully of his diseases. On this subject, Mr Daniel has not only collected matter from what he conceives to be the best sources, but, what is more useful, as well as more to be depended on, he has added much from his own observation and experience.

95 Harrison. One of the latest works on the diseases of domestic animals, which we have seen, is An Enquiry into the Rot in Sheep, and other animals, by Dr Edward Harrison, a respectable physician of Horn castle, in Lincolnshire. Of this pamphlet we shall speak at large, when we come to treat of the disease, whose nature and causes it is intended to illustrate.

## PART II. ON THE STRUCTURE OF THE HORSE.

IN the sketch which we are to give of the anatomy of the horse, we must very slightly pass over such parts as appear not to be of immediate importance in the practice of farriery, in order to dwell more minutely on those organs that are of greater consequence. Thus we shall content ourselves with giving a tabular view of the bones and muscles; we shall entirely omit the brain and nerves; but we shall describe some of the other viscera, as the stomach, and the bowels, somewhat more minutely. We shall be most particular on the anatomy of the extremities, especially of the feet, as on an accurate knowledge of these parts depend the principles of shoeing;

ing; which, without such knowledge, cannot be properly understood, or rationally practised.

On the subject of the anatomy of the foot, we shall be particularly indebted to the writings of Mr Coleman; and we cannot shew the importance of the subject in shoeing better than by the following remarks of that gentleman.

97 Importance of an accurate knowledge of the anatomy of the foot.

“The organization and functions of the foot of the horse will be found rather complicated; but it is of considerable importance to those who wish to investigate the principle, as well as the practice of shoeing, to be well acquainted with every part of that organ. The practical part of shoeing is often well executed, without an accurate knowledge of the contents of the hoof.

“But, in many cases, it is very necessary to be well acquainted with the structure and functions of the deeper seated parts, and is most particularly useful for the removal of many diseases incident to the foot. The immense weight supported by the feet of the horse, and the rapidity with which this great animal is conveyed from place to place, without violence to the external or internal parts of the foot, naturally excite a desire to ascertain the cause of so wonderful an effect. If the human foot supported the same weight as the foot of the horse, the sensible parts would be destroyed. Without springs, no external covering could effectually support the weight, and prevent the foot from being smashed. The physiologist will receive infinite satisfaction in the investigation of the functions of this complicated organ; he will find as much order and beauty, as much wisdom and utility, in the formation and economy of the foot, as ever was displayed in the structure and uses of any animal. It will be seen in many instances, that the same part performs various functions, and all these functions well *.”

98 In our description of the structure of the horse, we shall, as far as possible, employ English names to denote the parts described or enumerated, as we think the writers on the subject have done wrong in giving to the parts of the horse the Latin names that are employed in the human anatomy; and we have no doubt that the generality of veterinary students must, from this circumstance alone, be in a great measure deterred from paying the necessary attention to so important a subject. But, that we may avoid affectation, we shall, wherever it appears necessary, add the corresponding Latin name, and some synonyms of the more respectable writers on the anatomy of the horse.

## CHAP. I. *A Sketch of the Bones of the Horse.*

99 Skeleton.

WHEN we take a general view of the skeleton of the horse, supposed to stand before us, we shall observe that, excepting the head and fore part of the neck, the skeleton forms nearly a square, and approaches more nearly to this form, as the body of the animal is more exactly proportional. We remark this for the sake of painters and sculptors, who commonly err considerably with respect to their proportion of length and breadth in their figures of the horse.

We shall divide the skeleton into the head, the spine, the trunk, and extremities. See Plate CCXI. fig. 1.

### 1. BONES of the HEAD. A.

*a*, *c*, Half of the *frontal bone*, which in the horse is always composed of two pieces.

*e*, *f*, One of the two *parietal bones*.

*g*, *h*, *i*, *k*, The *occipital bone*, with a process at *k*, that is peculiar to the horse.

*l*, *m*, The *temple*, or *temporal bone*, of one side; *n*, the cheek-bone of one side.

*o*, One of the small bones within the socket of the eye, that answers to the *os unguis* in man.

*p*, *p*, Bones of the nose.

*q*, *r*, *s*, The upper jaw-bone.

*t*, The *intermaxillary* bone, or what is usually called by veterinary writers the *inferior* jaw-bone. This is not found in the human skeleton.

*u*, *v*, The posterior maxillary bone, which answers to the lower jaw-bone in man.

### BONES of the SPINE. B.

1, 2, 3, 4, 5, 6, 7. The seven vertebræ of the neck. *a*, The atlas; *b*, the second vertebra, called in human anatomy, *dentata; d*, *e*, *f*, its transverse process; *e*, its oblique process; *f*, its ridge, answering for a spinous process; *g*, *h*, *i*, *k*, *l*, *m*, *n*, third cervical vertebra; *g*, its body; above the letter is the hole for the transmission of the vertebral arteries and veins; *i*, *k*, anterior and posterior transverse processes; *l*, a protuberance in the fore part of the body.

8—25, The eighteen vertebræ of the back; *a*, the body of each; *b*, the transverse processes that articulate with the ribs; *c*, the oblique processes; *d*, the spinous processes.

26 to 30, The five vertebræ of the loins, which have very long transverse processes, though these are not very easily distinguished in the figure, from its having a side view.

*x*, *x*, The sacrum bone, composed of five pieces, as in man.

From 31 to 43, the 13 bones composing the tail, answering to the *os coccygis* in man.

### BONES of the TRUNK. C.

*a*, *b*, 1, 9, The true ribs; 10 to 18 the false ribs; *a*, the head articulating with the transverse process of the first dorsal vertebra; under is seen the lower branch of the head that unites with the seventh cervical and first dorsal vertebra; *c*, the end that unites with the sternum or breast-bone; *a*, *b*, *c*, *d*, *e*, *f*, *g*, the two hip-bones, answering to the *ossa innominata* in the human anatomy; *a*, *b*, *c*, the ilium, with its tuberosity *a*, forming the haunch or hip; *e*, *f*, the ischium; *g*, *g*, the pubis with its juncture or symphysis between the two letters.

### BONES of the FORE EXTREMITY. D. D.

*e*, *f*, *g*, *h*, *i*, *l*, *m*, The scapula or blade-bone; *e*, its neck, below which is seen its glenoid cavity; *f*, antespinatus fossa; *h*, its spine, which in the human ends in the processus acromion, but as there is no clavicle in the horse, it ends by a tuberosity; *i*, coracoid process; between *m* and *i*, the anterior costa; *l*, between this and *e*, posterior costa, between *m* and *l*, is its base, and the line above it marks the extent and situation of the cartilage of the scapula; *n*, *o*, *p*, *q*, humerus or arm; *n*, its neck, above which is seen its head; *o*, its anterior head, forming the point of the shoulder, as it is commonly called

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* *Coleman on the Horse's Foot*, vol. ii.

called in the horse; *p*, its tuberosity; *q*, its lower head, behind is seen the cavity for the reception of the olecranon; *r*, *r*, ulna; the upper part forms the olecranon or elbow, the lower part is united by ligamentous fibres to the radius; *s*, *s*, the radius; 1, 2, 3, 4, 5, 6, 7, the carpus or knee; 1, 1, pisiform; 2, 2, scaphoid; 3, 3, lunar; 4, unciform; 5, magnum; 6, cuneiform; 4, trapezoid; *t*, *u*, metacarpus; *t*, canon; *u*, two small metacarpals; *v*, *w*, *x*, *y*, *z*, phalanges; *v*, first phalanx or pastern; *w*, sesamoids; *x*, coronet-bone, or little pastern; *y*, coffin; *z*, navicular or nut-bone.

### BONES of the HIND EXTREMITY. E. E.

*h*, *i*, *k*, *l*, *m*, Thigh-bone; *h*, the neck, above which is the head received into the socket of the pelvis; *i*, great trochanter; *k*, the outer trochanter; *l*, *l*, the inner trochanter; *m*, *m*, the anterior condyles; *n*, *n*, the posterior ditto; *p*, *p*, semilunar cartilage; *o*, *o*, knee-pan or patella; *g*, tibia or leg-bone, commonly called the thigh; *r*, fibula; the tibia is seen terminating in its maleoli, to articulate with the tarsus; 1, 2, 3, 4, 5, 6, 7, 8, tarsus or hock; 1, 2, 1, 2, calces, forming the point of the hock, in man the heel; 3, 4, astragalus; 5, 5, great cuneiform bone; 6, cuboid bone; 7, middle cuneiform bone; 8, small cuneiform bone; *s*, *s*, *t*, *t*, metatarsus; *s*, *s*, canon or shank; *t*, *t*, two small metatarsals; *u*, pastern; *v*, sesamoids; *w*, coronet-bone or lesser pastern; *x*, *x*, coffin-bone; *y*, navicular or nut-bone.

### Of the TEETH.

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A male horse has 40 teeth, when he has completed his full number. The mare has usually but 36. They are divided into three kinds; the cutting teeth or nippers; the cuspidatæ or tushes, and the molares or grinders. A knowledge of the horse's teeth and of the changes which they undergo, from their first appearance, is of the greatest consequence, as from it we derive the surest marks of the age of the horse; at least, till he is eight or nine years old.

Figs. 2, 3, 4, 5, 6, 7, and 8, shew the appearance of the teeth from their first cutting to the age of eight years.

Fig. 2. shews the appearance of the colt's teeth at the age of three weeks; fig. 3. that of the colt's teeth at three months. Fig. 4. shews the state of the teeth from three months to about four or five years, where *a*, *a*, are the pincers or nippers; *b*, *b*, what are called the separators; *c*, *c*, the corners, or the last of the front teeth at that age; *d*, *d*, the tusks. Fig. 5. shews the appearance of the teeth at the age of five years, and figs. 6, 7, and 8, their appearance at the respective ages of six, seven, and eight years.

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The age of a horse is easily known by his mouth, till he comes eight, after which the usual marks wear out. A horse, like many other brute animals, has his teeth divided into three ranks; viz. his fore-teeth which are flat and smooth, his tushes, and his back-teeth. His back-teeth or jaw-teeth are called his grinders, being those by which a horse chews and grinds his provender, and are 24 in number, 12 above and 12 below: they are strong double teeth, with sharp edges; but when a horse grows old they wear much smoother.

The first that grows are his foal-teeth, which begin to appear a few months after he is foaled: they are 12 in number, six above and six below; and are easily distinguished from the teeth that come afterwards by their smallness and whiteness, not unlike the fore-teeth of a man.

When the colt is about two years and a half old he casts the four middlemost of his foal-teeth, viz. two above and two below: but some do not cast any of their foal-teeth till they are near three years old. The new teeth are easily distinguished from the foal-teeth, being much stronger, and always twice their size, and are called the incisors or gatherers, being those by which a horse nips off the grass when he is feeding abroad in the fields, or in the house gathers his hay from the rack. When a horse has got these four teeth complete, he is reckoned three years old.

When he is about three and a half, or in the spring before he is four years old, he casts out four more of his foal-teeth, viz. two above and two below, one on each side the nippers or middle teeth: so that when you look into a horse's mouth, and see the two middle teeth full grown, and none of the foal-teeth except the common teeth remaining, you may conclude he is four that year about April or May. Some indeed are later colts, but that makes little alteration in the mouth.

The tushes appear near the same time with the four last mentioned teeth, sometimes sooner than those, and sometimes not till after a horse is full four years old: they are curved like the tushes of other beasts; only in a young horse, they have a sharp edge all round the top and on both sides, the inside being somewhat grooved and flattish, inclined to a hollowness.

When a horse's tushes do not appear for some time after the foal teeth are cast and the new ones come in their room, it is generally owing to the foal-teeth having been pulled out before their time by the breeders or other dealers in horses, to make a colt of three years old appear like one of four, that he may be the more saleable; for when any of the foal-teeth have been pulled out, the others soon come in their places; but the tushes having none that go before them, can never make their appearance till their proper time, viz. when a horse is about four or coming four; and, therefore, one of the surest marks to know a four years old horse is by his tushes, which are then very small and sharp on the top and edges.

When a horse comes five, or rather in the spring before he is five, the corner teeth begin to appear, and at first but just equal with the gums, being filled with flesh in the middle. The tushes are also by this time grown to a more distinct size, though not very large; they likewise continue rough and sharp on the top and edges. But the corner teeth are now most to be remarked; they differ from the middle teeth in being more fleshy on the inside, and the gums generally look rawish upon their first shooting out; whereas the others do not appear in this way. The middle teeth arrive at their full growth in less than three weeks; but the corner teeth grow leisurely, and are seldom much above the gums till a horse is full five: they differ also from the other fore-teeth, in this, that they somewhat resemble a shell; and thence are called the shell-teeth, because they environ the flesh in the middle half-way round: and as they grow, the flesh within disappears, leaving a distinct hollowness and openness on the inside. When a horse is full five, these teeth are generally about the thickness of a crown-piece about the gums. From five to five and a half they will grow about a quarter of an inch high, or more; and when a horse is full six, they will be near half an inch, and in some large horses a full half inch, about the gums.

The corner teeth in the upper jaw fall out before those in the under, so that the upper corner teeth are seen before those below; on the contrary, the tushes in the under gums come on before those in the upper.

When a horse is full six years old, the hollowness on the inside begins visibly to fill up, and that which was at first fleshy, grows into a brownish spot, not unlike the eye of a dried garden bean, and continues so till he is seven; with this difference only, that the tooth is more filled up, and the mark or spot becomes faint, and of a lighter colour. At eight, the mark in most horses is quite worn out, though some retain the vestiges of it a long time; and those who have not had a good deal of experience, may sometimes be deceived by taking a horse of nine or ten years old for one of eight. It is at this time only, when a horse is past mark, that one can easily err in knowing the age of a horse; for what practices are used to make a very young horse or colt appear older than he is, by pulling out the foal-teeth before their time, may be discovered by feeling along the edges where the tushes grow, for they may be felt in the gums before the corner teeth are put forth; whereas, if the corner teeth come in some months before the tushes rise in the gums, we may reasonably suspect that the foal-teeth have been pulled out at three years old.

It will, perhaps, be needless to mention the tricks that are used to make a false mark in a horse's mouth, by hollowing the tooth with a graver, and burning a mark with a small hot iron; because those who are acquainted with the true marks, will easily discover the cheat by the size and colour of the teeth, by the roundness and bluntness of the tushes, by the colour of the false marks, which is generally blacker, and more impressed than the true mark, and by many other visible tokens, which denote the advanced age of a horse.

After the horse has passed his sixth year, and sometimes at seven, nothing certain can be known by the mouth. It must, however, be remembered, that some horses have but indifferent mouths when they are young, and soon lose their mark; others have their mouths good for a long time, their teeth being white, even, and regular, till they are 16 years old and upwards, together with many other marks of freshness and vigour; but when a horse comes to be very old, it may be discovered by several indications, the constant attendants of age, viz. his gums wear away insensibly, leaving his teeth long and naked at their roots. The bars of the mouth, which, in a young horse are always fleshy, and form so many distinct ridges, are, in an old horse, lean, dry, and smooth, with little or no rising. The eye-pits in a young horse (except those come of old stallions) are generally filled up with flesh, look plump and smooth; whereas in an old horse, they are sunk and hollow, and make them look ghastly, and with a melancholy aspect. There are also other marks which discover a horse to be very old, viz. gray horses turn very white, and many of them all over flea-bitten, except their joints. This, however, happens sometimes later and sometimes sooner, according to the variety of colour and constitution. Black horses are apt to grow gray over their eye-brows, and very often over a good part of their face, especially those who have a star or blane fringed round with gray when they are young. All horses, when very old, sink more or less in their backs; and some horses, that are naturally long-backed, grow so hollow with age, that it is scarce possible to fit them with a saddle. Of this kind are several Spanish and Barbary horses, and many Danish and Flanders breed. The joints also grow stiff with old age, and their knees and hocks bend so, that they are apt to trip and stumble upon the least descent, though the way be smooth and noways rugged. After which they can be of little use to the owner *.

## Chap. II. *Principal Muscles of the Horse.*

102 Muscles.

We shall here only enumerate the muscles of the head, neck, and trunk, as being of less importance than those of the extremities. Of these latter we shall give a table, expressing, besides their usual names, their origin, insertion, and uses.

### *Muscles of the Eyelids and Eye.*

Orbicular of the eyelids.
Elevator of the upper eyelid, *a*, *b*, fig. 10.
Elevator of the eye.
Depressor of the eye.
Adductor of the eye.
Abductor of the eye.
Trochlear muscle of the eye.
*Obliquus major.*
Lesser oblique.
Retractor of the eye.

### *Muscles of the Mouth and Jaws.*

Orbicular, *g*, *i*, fig. 9. *o*, fig. 10.
Buccinator, *r*, fig. 9. *s*, fig. 10.
Elevator of the corner of the mouth, *m*, *n*, fig. 10.
Long nasal of the upper lip, *l*, *m*, *n*, *o*, fig. 9.
Masseter, *p*, *q*, fig. 9.
Ciliares, *u*, *w*, fig. 9.
Temporal, 2, 3, fig. 9.
Canine, 6, 7, fig. 9. *m*, *n*, fig. 10.
Depressor of the lower lip, 9, 10, fig. 9. *p*, *q*, *r*, fig. 10.
Elevator of the chin, 12, fig. 9.
Dilatators of the nostrils, *a*, *b*, *c*, *d*, *g*, *f*, fig. 9.

### *Muscles of the Neck.*

Sterno-mastoid; *a*, *b*, *c*, fig. 9.
Coraco-hyoideus; *f*, *f*, fig. 9. and *a*, *b*, *c*, *d*, *e*, fig. 10.
Sterno-hyoideus; *g*, fig. 9. *f*, *g*, fig. 10.
Sterno-thyroideus; *h*, *i*, *k*, fig. 10.
Transversals; *h*, *i*, fig. 9. A, B, C, D, E, F, G, H; fig. 10.
Trachelo-mastoid; M, O, P, Q, S, fig. 10.
Rectus internus major capitis; *m*, *n*, fig. 9. and *w*, *x*, *y*, fig. 10.
Intertransversales minores colli; *o*, fig. 9.

Long

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* Boardman's Dictionary.

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Long muscle of the neck ; *p*, *q*, fig. 9. X, Y, fig. 10.
Splenius ; *r*, *s*, *t*, fig. 9.
Hyothyroidæus ; *y*, fig. 9.
Cricothyroidæus ; *z*, fig. 9.
Lower constrictor of the pharynx.
Rectus capitis posticus major ; *t*, *u*, fig. 11.
minor ; *x*, *w*, fig. 11.
Superior oblique of the head : *u*, U, fig. 10.
Inferior ditto ; W, W, fig. 10.
Intertransversales posteriores colli ; L, &c. M, &c. fig. 11.
Intervertebral muscles.
Multifidæ spinæ ; *c*, *d*, fig. 12.
Spinales cervicis : R, T, U, fig. 11.

*Muscles of the Trunk.*

External oblique ; I, K, L, M, fig. 9.
Obliquus internus ; *s*, *t*, *u*, *w*, *x*, *y*, fig. 10.
Rectus abdominis ; *z*, fig. 10.
Transversalis abdominis ; *p*, *q*, *r*, fig. 11.
External intercostals ; 1, 2, &c. fig. 11.
Internal ditto ; 3, 4, &c. fig. 11.
Semispinalis and spinalis dorsi ; *a*, *b*, *c*, *d*, *e*, *f*, fig. 11.
Longissimus dorsi ; *g*, *h*, *i*, *k*, fig. 11.
Sacrolumbal ; *l*, *m*, *n*, &c. fig. 11.
Elevators of the ribs ; *a*, *b*, fig. 12.
Lateral of the tail ; *e*, *f*, fig. 12.
Intertransversals of the tail ; *g*, &c. fig. 12.
Elevator of the tail ; *i*, fig. 12.
Depressor of the tail ; *k*, fig. 12.

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Table of the muscles of the extremities.

## TABLE of the Muscles of the Extremities.

### 1. *Muscles of the Fore-leg and Foot.*

| *Name.* | *Origin and Insertion.* | *Use.* |
|---|---|---|
| Trapezius. | From the 4th, 5th, and 6th cervical vertebræ; from the first 12 or 13 dorsal vertebræ; and from the cervical ligament, into the spine of the blade-bone. | To raise and draw backwards the blade-bone. |
| Lager rhomboid.<br>*Rhomboideus major.*<br>*a*, *b*, fig. 9.<br>Triangulaire Vitet. | From the 3d, 4th, 5th, and 6th dorsal vertebræ, below the cartilage of the blade-bone, into the whole length of that cartilage. | To raise the blade-bone, and draw it a little forwards. |
| Lesser rhomboid.<br>*Levator scapulæ.* | From the ligament of the neck, at about the 2d vertebra, into the cartilage of the blade-bone. | To draw the blade-bone forward when the neck is fixed, or *vice versa.* |
| Lesser pectoral.<br>*Depressor scapulæ.*<br>*c*, *d*, *e*, *f*, fig. 9. | From the lateral part of the breast-bone, into the upper and fore-part of the blade-bone. | To draw the blade-bone downwards. |
| Triangular. | From the 4th and 5th vertebræ of the neck, into the upper and fore part of the blade-bone, above the pectoral. | To draw the blade-bone forwards. |
| Anterior serrated.<br>*Serratus anticus.*<br>*g*, *h*, *i*, *k*, *l*, *o*, *p*, fig. 9. | From the true ribs, and from the 6th and 7th cervical vertebræ, into the last cervical vertebra. | To connect the blade-bone with the chest, and to draw it downwards, and sometimes to assist other muscles. |
| Ante-spinatus.<br>*a*, *b*, *c*, *d*, *e*, *f*, fig. 9. | From the ante-spinatus fossa, by two tendons, into the two tuberosities of the head of the shoulder-bone. | To extend the fore-leg and move it forwards. |
| Post-spinatus.<br>*h*, *k*, *l*, *n*, fig. 9. | From a fossa, so called, into the outer-side of the shoulder-bone. | To move the fore-leg outward, and away from its fellow. |
| Extensor of the ligament. | From the coracoid process of the blade-bone, into the whole of the capsular ligament. | To prevent the ligament from being pinched between the bones. |
| Latissimus dorsi.<br>*r*, *s*, *t*, *u*, *w*, fig. 9. | From all the dorsal vertebræ connected with the muscles of the back, and with the fleshy pannicle, into the inner tuberosity of the shoulder-bone, below the blade-bone. | To draw the fore-leg backward, and towards the chest. |
| Comon muscle.<br>*Levator humeri.* | From the tuberosity of the temporal bone, and from the four first cervical vertebræ, into the upper and outward part of the arm. | To raise the arm, and when that is fixed, to draw the head and neck downwards. |
| Subscapular.<br>*a*, *b*, fig. 11. | From the hollow of the blade-bone, into the inner side of the shoulder-bone. | To move the arm towards its fellow. |

| *Name.* | *Origin and Insertion.* | *Use.* |
|---|---|---|
| Larger pectoral.<br>1 2 3 4 5 6, fig. 9. | From the side of the breast-bone, and the cartilages of the six last true ribs, into the inner side of the shoulder-bone. | To draw the fore-leg downwards and backwards. |
| Sterno-brachial. | From the fore part of the breast-bone, into the inner and lower part of the shoulder-bone, and connected by expansion with the radius. | To draw the fore-legs together, and to assist the last in respiration, when the fore-leg is fixed. |
| Coraco-brachial. | From the coracoid process of the blade-bone into the lower and back part of the shoulder-bone. | To draw the arm forwards and outwards. |
| Adductor of the shoulder.<br>*Teres major.*<br>*d*, *e*, *f*, fig. 11. | From the upper part of the posterior edge of the blade-bone, into the inside of the shoulder-bone. | When the blade-bone is fixed, to draw the fore-leg upwards and inwards, and *vice versa.* |
| Long abductor of the shoulder.<br>*Teres minor.*<br>*o*, *p*, *q*, fig. 9. | From the posterior edge of the blade-bone into the outer tuberosity of the shoulder-bone. | To draw the shoulder-bone upwards and outwards. |
| Short abductor of the shoulder. | Below the last muscle, between the last and the subscapula. | To turn the arm. |
| Anterior radial flexor.<br>*Flexor longus.*<br>*Biceps in human anatomy.*<br>*i*, *k*, *l*, *m*, *n*, fig. 10. | From the tuberosity of the blade-bone, above the glenoid cavity, into the inner tuberosity of the radius. | To bend the arm. |
| Oblique brachial flexor. | From the neck of the shoulder-bone into the inner tuberosity of the radius. | To turn the fore-arm, and assist the former in bending it. |
| Fascialis cubiti.<br>*Extensor longus.* | From the posterior edge of the blade-bone into the olecranon, or elbow. | To bind down the muscles, and assist in extending the arm. |
| Biceps extensor cubiti.<br>N, O, P, fig. 9. | From the whole length of the posterior edge of the blade-bone into the olecranon. | To extend the arm. |
| Internal brachial.<br>*a*, *b*, *c*, fig. 11. | Below the inner side of the head of the shoulder-bone, into the inner and upper part of the olecranon. | To oppose the oblique flexor. |
| Intermediate extensor. | From the neck and some part of the shoulder-bone, into the olecranon. | To assist in extending the arm. |
| Large extensor of the canon. | From the outer condyle, and tuberosity of the shoulder-bone, into the anterior tuberosity of the canon-bone. | To extend the canon. |
| Radial extensor of the canon.<br>*a*, *b*, *c*, *d*, fig. 10. | From the side of the radius downwards from the middle into the small inner metacarpal bone. | To assist the former, and turn the foot outwards. |
| External flexor of the canon.<br>*l*, *m*, fig. 11. | From the outer condyle of the shoulder-bone, at its back part, into the pisiform, and small outer metacarpal bones. | To bend the canon. |
| Inner flexor of the canon.<br>*n*, *o*, *p*, fig. 11. | From the inner condyle of the shoulder-bone, into the back part of the canon. | To assist the former. |
| Flexor of the carpus. | From the inner condyle of the shoulder-bone, at its back part, into the pisiform bone. | To bend the carpus, and extricate the ligament. |
| Anterior long extensor of the foot. | From the lower and outer head of the shoulder-bone, and upper part of the radius, into the anterior protuberance of the coffin-bone. | To extend the foot. |
| The lateral extensor of the foot. | From the outer head of the radius, passing over the knee through an annular ligament, into the upper and back part of the bone down to the foot. | To assist the former. |
| Perforated flexor of the foot. | From the inner condyle of the shoulder-bone passing behind the knee, into the arch of the coffin-bone. | To bend the foot. |
| Perforating flexor of the foot. | From the olecranon and the shoulder-bone at the back part, into the arch of the coffin-bone. | To assist the former. |

### 2. *Muscles of the Hind Leg or Foot.*

| *Name, &c.* | *Origin and Insertion.* | *Use.* |
|---|---|---|
| Posterior gluteus. *m, n, o, p,* fig. 9. | From the interior and posterior angles of the ilium, into the little trochanter of the thigh-bone. | To extend the thigh, and draw it outwards. |
| Tensor vaginæ femoris.<br>*Fascia lata.*<br>*a, b, c, c,* D, *e, f, g, h,* fig. 9. | From the anterior angle of the ilium, into a tendinous expansion over the thigh. | To stretch the fascia of the thigh, and draw it inwards. |
| Semimembranosus. 17, 18, 19, fig. 9. | From the tuberosity and lower angle of the ischium, into the fore part of the thigh-bone, and into the tibia. | To draw the thigh outwards. |
| Biceps flexor cruris. 3, 4, 5 —11, fig. 9. | From the tuberosity of the ischium, and beginning of the tail, into the inner side of the spine of the tibia. | To bend the leg, and draw it inwards. |
| Posterior flexor of the leg. | Like the former, into the inner condyle of the thigh-bone and upper end of the tibia. | To bend the leg. |
| The large gluteus. *q,* Q, *r, s, t,* fig. 9. | From the vertebræ of the loins, and from the sacrum, into the great trochanter of the thigh-bone. | To extend the thigh, and draw it backwards and outwards. |
| Capsular. *a, b, c,* fig. 12. | Rises from the brim of the acetabulum, into the outer side of the thigh-bone. | To extricate the capsular ligament. |
| Gracilis. *e, f,* fig. 9. *u, w,* fig. 11. | From the pubis and ischium, into the fascia of the thigh and the inner side of the head of the tibia. | To make one thigh approach its fellow. |
| Sartorius.<br>*Adductor longus.*<br>*p, q, r, s, t,* fig. 21. *t, u,* fig. 12. | From the inner edge of the brim of the pelvis, into the inner head of the tibia. | To assist the former. |
| Large psoas. | From the three last dorsal, and four first lumbar vertebræ, and from the two last false ribs, into the inner trochanter of the thigh-bone. | To bend the thigh. |
| Larger internal iliac. *e,* fig. 10. | From the inner surface of the ilium, into the lesser trochanter of the thigh-bone. | To assist the former. |
| Lesser internal iliac. | From the inner surface of the ilium, into the lesser trochanter of the thigh-bone. | To assist the former. |
| Pectineus. *s,* fig. 12. | From the symphysis pubis, inserted below the last. | To bend the thigh. |
| Triceps adductor femoris. | From the inner edge of the pubis, from the anterior branch of the ischium, and from its tuberosity, into the back of the thigh-bone, the upper and inner part of the tibia, and the tuberosity of the thigh-bone. | To draw one thigh towards its fellow. |
| Vastus externus. *n, o, p, r, s, t,* fig. 10. | From the great trochanter, and the outer side of the thigh-bone, into the side of the knee-pan. | To extend the leg. |
| Straight muscle of the leg.<br>*Rutus cruris.*<br>*g, h, i, k,* fig. 10. | From the ilium above the socket, and from the upper part of the thigh-bone, into the upper part of the knee-pan. | To extend the leg strongly. |
| Vastus internus. *b, c,* fig. 10. | From the neck, inner tuberosity, and whole inner part of the thigh-bone, into the inner side of the knee-pan. | To assist the vastus externus, and last muscle. |
| Crural. 1, 2, 3, 4, 5, 6. fig. 11. | From the fore part of the thigh-bone, into the inner side of the knee-pan. | Ditto. |
| External obturator. | From the inner part of the ischium, into the hollow of the great trochanter. | To roll the thigh-bone. |
| Square muscle of the thigh.<br>*Quadratus femoris.* | From the lower part of the tuberosity of the ischium, into the thigh-bone below the great trochanter. | Assists the former. |
| Gemini. *f, g,* fig. 10. | From the ischium and pubis, one above the other, inserted into the thigh with the last. | Oppose the last. |

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| *Name, &c.* | *Origin and Insertion.* | *Use.* |
|---|---|---|
| Inner obturator. 1, 2, 3, fig. 12. | From the edge of the thyroid hole, into the thigh with the preceding. | To assist the gemini. |
| *Pyriform.* | From the sacrum within the pelvis, inserted as the last. | Ditto. |
| Popliteus. 28, 29, fig. 11. | From the external condyle of the thigh bone, into the tibia. | To draw the leg inwards. |
| Tibialis anticus. 14. | From the fore part of the external condyle of the thigh-bone, into both canons by two portions. | To bend the leg strongly. |
| Gastrocnemius. | From each condyle of the thigh-bone, into the hock. | To extend the canon. |
| Plantar. 40, fig. 9. | From the upper part of the spine of the tibia, inserted as the former. | |
| Perforated flexor of the foot. | From the hollow between the condyles of the thigh-bone, into each side of the pastern-bone. | To bend the pastern and foot. |
| Larger perforating flexor of the foot. | From the back and outer part of the head of the tibia, into the arch of the coffin-bone. | To bend the foot. |
| Lesser perforating flexor of the foot. | From the back part of the head of the tibia, inserted with the preceding. | To assist the former. |
| The long extensor of the foot. | From the tendon of the extensor of the canon, in the anterior protuberance of the coffin-bone. | To extend the foot. |
| Lateral extensor of the foot. | From the outer head of the thigh-bone, and from the head of the fibula, inserted with the last. | Ditto. |
| Lesser extensor. | From the tendon of the long extensor to the lateral extensor. | To draw the tendons of the long and lateral extensors together. |

The four figures to which we have referred also represent the following parts.

The broad ligaments of the eyelids; *s*, *t*, fig. 9.
Alæ narium; *x*, fig. 9.
Angular vein; 14, fig. 9.
Angular artery; 15, fig. 9.
Parotid gland; 26, fig. 9.

### *In the Neck.*

Common jugular vein; 1, fig. 9.
External anterior jugular; 2, fig. 9.
Posterior external jugular; 3, fig. 9.
Part of the carotid artery; 4, fig. 9.
Branches of the cervical arteries and veins; 1, 2, fig. 10.
Thyroid gland; *a*, fig. 11.
Gullet; *i*, fig. 11.
Windpipe; *k*, fig. 11.
Cervical nerves; 2, fig. 11.
Ligament of the neck; 5, fig. 11.; 7, 8, fig. 12.
External carotid artery; 1, fig. 12.

### *In the Trunk.*

Epigastric artery; *w*, fig. 11.
External iliac; *y*, fig. 11.
The diaphragm; *m m*, fig. 12.
Intercostal artery; *p*, fig. 12.

### *In the Fore Extremity.*

Internal plantar vein; *s*, fig. 9.
Coronary ligament of the foot; 13, fig. 9.
Cartilages of the coffin-bone; *r*, *t*, 11.

### *In the Hind Extremity.*

Vena saphæna; 21, fig. 9.
Capsular ligament of the knee; 3, 4, fig. 10.
Sciatic artery; 34, fig. 11.
Gluteal artery; 35, 35, fig. 11.
Crural vein; 38, fig. 11.
Popliteal artery; 39, 52, fig. 11.
——— vein; 53, fig. 11.
Crural nerve; 35, fig. 12.

## CHAP. III. *Of the Stomach and Bowels.*

104 Structure of the stomach.

In the horse there is but one stomach, which is very small in proportion to his general bulk; and is partly membranous, partly cuticular, and partly muscular. It is situated immediately behind the diaphragm, in the left hypochondrium, and in part of the epigastrium, with its expellent orifice extending across the spine to the right, which is the reason that lying on that side is judged more wholesome than sleeping on the left. It has two surfaces, which may be called its sides, though one is posterior, and the other anterior; and two extremities, a large and a small; the superior surface of which receives the gullet, and is called its *cardiac orifice;* while the former ends in the duodenum, and is termed the *pyloric orifice;* this extremity, when the stomach is distended, is the most posterior of the two. The hollow part situated superiorly, only forms its *lesser curvature*, as the lower portion forms its *great curvature.*

Thus when the stomach is moderately distended, it lies in an obliquely transverse direction, with its great extremity a little forwards, and its two orifices superi-or, or, but the *cardiac* the most so, with the lesser extremity rather posterior to the other, and the great curvature inferior. It is evident that the situation of the stomach must vary much with its distension: the foregoing description answers to it when moderately distended only; but where it is very much filled, the left extremity will press upon the diaphragm, and the right will be carried more posteriorly. In oxen and sheep, where the first stomach is large, it is found, when distended, to have its left extremity carried quite into the left iliac region; in which part it is usually punctured, when they are hoved: but such an idea of the stomach of the horse would prove very erroneous; for this animal has a very small one, and therefore its situation can never be such *.

laine's lines, ii.

From a distended stomach pressing upon the diaphragm, we are at no loss to understand, why breathing is impeded after a full meal, when a horse appears to labour for breath; for he is forced to use the intercostal muscles, and the muscles of the shoulder and fore extremities, to open the chest, the posterior enlargement being prevented from the diaphragm being fixed by the pressure of the stomach; hence we see the great impropriety of galloping horses after watering, to warm it in their bellies, as it is foolishly termed. Horses, when grazing, if they drink, are never observed to do this; if it was necessary, nature would dictate it to them. How hurtful it is likewise to ride hard, after a horse has been fully fed, is equally evinced. The stomach has externally a covering from the peritoneum, which adheres closely to it, by means of its cellular portion; and which portion is dipping in between the muscular fibres. Its middle portion is made up of muscular fibres, which are more numerous in this animal, than in the ruminant; making this kind of stomach a medium between the membranous one of some animals, and the true muscular stomach of others. The direction of these fibres is various; but they may principally be referred to a longitudinal and a transverse order, though neither of them are regularly so, and are intermixed with others, whose direction is very oblique, and interlaced with each other. The longitudinal plane is the most external of the two, and appears a continuation of the external plane of the œsophagus, with some original fibres, which spread over the lesser curvature, being carried obliquely round, and likewise over the great extremity, forming themselves into a kind of vortex, whose centre is in the middle of that extremity. The inner plane is by much the larger, and is not quite circular, but slightly oblique, crossing the obliquity of the longitudinal plane. This circular plane is very thick and strong round the cardia, or that extremity into which the œsophagus terminates. They are here so very thick as to form a true sphincter; and to this it is in some measure owing, that a horse cannot vomit; for when the circular and longitudinal fibres are acting from the pylorus to the cardia, by any irritation that reverses the usual motion, producing an effort to vomit, the circular and longitudinal fibres of the cardia being infinitely stronger and more numerous, are contracting this orifice (especially the circular), as the others are contracting the other parts; for as the muscular fibres exist equally throughout the stomach, by which the motions are effected, it cannot be simply from the existence of the circular covering to the first portion of his stomach, that he cannot vomit; for it is reasonable to suppose the fibres act throughout the stomach by the common consent of parts; nor do they of actual necessity want an immediate stimulus to their surfaces; for were this the case, the fibres of the œsophagus would not by the presence of the masticated bolus be stimulated to contract through the cuticular coat, which equally here lies over the fibres; nevertheless, the cuticular coat of the stomach is probably assisting in this difficulty to regurgitate: it does it by lessening the liability to nausea, which seldom takes place in the horse; and as vomiting is only an effort to remove nausea or its cause, so nature not having given the disease, has not provided the means for its removal. As likewise vomiting appears to be a reversing of the peristaltic motion of the stomach; which motion, in its natural state, begins from the cardia, and ends at the pylorus; so in this reversed state, it commences at the pylorus, and ends at the cardia, thus regurgitating its contents; so it is very probable that the cuticular covering may lessen this inverted peristaltic motion in the upper portion, though it cannot wholly destroy it; and hence cannot be the only, or the principal reason of the impossibility, or rather of the difficulty with which this animal vomits; for instances have occurred where it has taken place. A horse in Sussex was seen to regurgitate a large quantity of grains, and we have heard of one or two other instances; but these must be regarded as very rare occurrences.

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It is not, therefore, that the stomach of the horse cannot be irritated to make an attempt to vomit, that no such effect generally takes place; for though it is but very seldom that nausea occurs, and perhaps never in a state of nature, yet it may be excited by means of aconite, hellebore, and some other substances, which have caused fruitless efforts to vomit. But the true and principal reason that a horse may be said, naturally not to be able to vomit, arises, in that nature has wisely so constructed the parts, that the very effort to it increases the resistance by the very strong sphincter placed at the mouth of the cardia. Had this resistance not been placed, and every means taken to increase the almost impossibility of vomiting in a horse, it is evident that from the curtain of the palate stopping the opening of the mouth, this action, had it taken place, would have occasioned suffocation. The inner coat of the stomach is composed of two portions, the one cuticular and the other villous. This species of cuticular covering to nearly one half of the stomach, is peculiar to such animals as appear destined to live on grain, as horses, asses, rats, and mice; and this forms a third species of stomach between the true membranous one of graminivorous animals, and the muscular of the carnivorous tribes, and it may be considered in a slight degree, as a species of gizzard, resembling the structure of those animals, as fowls, who have organs to make up for the want of teeth. For a horse has not the means of re-mastication, as in oxen or sheep, nor does he usually masticate his food at first sufficiently to comminute it; for the wants of the constitution stimulate him to a hasty deglutition of his food, which, if there was not some other structure than that common to stomachs in general, would not be sufficiently digested: for the food is solid, and the stomach small; therefore this cuticular coat may be useful, as its insensibility allows it to press in

106

in a small degree upon the food, and perform a slight trituration upon it. This cuticular coat is spread over the first portion of the stomach, taking in all the great extremity, and forming between a third and half of its extent. It is formed into folds at the cardia in the same manner as at the internal part of the œsophagus; but as soon as it has passed this orifice, these folds take an irregular direction, but are less than those formed on the villous surface.

The villous or sensible portion of the stomach, though it occupies more of the length of the stomach, yet perhaps in real extent is little more than half of its surface. It unites with or is connected to the cuticular. Its external surface is firm, and appears as it were a distinct portion, but is only dense cellular substance, which has given rise to the description of four tunics to the stomach. The *tunica villosa* is so called from its resemblance to the pile of velvet; its fine villi are probably the extreme fine ends of vessels secreting the gastric juice. The villous coat being much larger in extent than the muscular, is thrown into folds which are more considerable than those of the cuticular coat. These are largest at the portion toward the great extremity, and are irregularly waving: towards the duodenum they become less, and when at the pylorus they form a fold that makes a kind of valve to this part of the stomach, preventing the return of the food, and its too speedy passage out. The folds not only hinder the too speedy passage of the food, but by this means apply the gastric juice more certainly to all the parts; but the principal end is to increase the secreting surface, which is here more extensive than those of the human *.

107 **Bowels.**

The remainder of the alimentary canal is continued from the lower orifice of the stomach, to the anus, or end of the passage, forming a long canal of different dimensions, called *intestines*. They are usually divided into small and large. In some animals they hardly merit this distinction, there being but little difference in point of size: but in the horse, the proportion is very different; the small intestines being not much larger than the human, but the large of an immense bulk. This canal is connected through its whole extent to membranous productions of the peritoneum, especially to those called *mesentery* and *mesocolon*. The whole canal varies in point of length in different subjects; but is seldom less than 24 yards, and often more. The intestines are contained within a prolongation of the peritoneum, which arises in most instances from the mesentery: the two folds of this membrane separate and surround the intestines, forming their external coat. The next coat is muscular, and formed of two layers of fibres, a longitudinal and a circular; the latter are in greater proportion, and by the contraction of these the vermicular motion, called *peristaltic*, is performed, from the longitudinal fibres slightly shortening them, and the circular diminishing their size. Within this muscular coat there is a quantity of cellular membrane rather more dense than in some other parts; and this used to be regarded as a coat, and was called the nervous, but is only a layer of cellular membrane. The third and inner coat of the intestines is the villous, which is very vascular and sensible. There are no considerable folds of the inner tunic of the intestines, as in the human. In this animal these are rendered unnecessary by the great length of his intestines, and the slow passage of the aliments through them by this length and his position.

The first portion of the bowels, which answers to the *duodenum* in man, though in the horse it is nearer 20 inches than 12, is attached to the stomach, having its pyloric orifice ending in it; its course in the horse is rather different from that in the human, and by this it acquires a more complete covering from the peritoneum. It hangs loose and pendulous, being attached to the concave surface of the liver, where making a turn, it is fixed to the vertebræ: it then takes the name of *jejunum*. It appears rather larger in circumference than the other small intestines, and is remarkable for having the pancreatic and biliary ducts penetrating it, sometimes entering it obliquely close together, and sometimes at a distance from each other.

The *jejunum* and *ilium* differ very little from the same bowels in the human species.

The great intestines are very properly so called in the horse; and as they have very little resemblance to the human large intestines, they require a particular description.

The *cæcum* is situated in the back part of the belly, and is a very large canal, which is entered abruptly by the ilium. The fore part of this canal projects forward two or three feet, into a sort of bag of the same size of the colon; but the back part terminates in what is called a blind end. The cæcum usually occupies the right side of the belly, and appears immediately on opening the peritoneum, with its commencement from the colon and ilium in the right iliac region, extending forwards to the right side, with its blind end close to the diaphragm and liver. This termination is not furnished, as in some animals, with an appendix vermiformis, but terminates by a simple blind end. Through the peritoneal covering are seen four muscular longitudinal bands, extending from the extremity along the muscular coat, and dividing the gut into four longitudinal portions. One or two of these are usually covered with fat, and are not so regularly longitudinal as the others. The internal membrane is folded up between the longitudinal bands, and by intersecting them forms numerous cavities called the cells.

On the slightest inspection we see a great peculiarity in the form of the cæcum of the horse; and in a more accurate view, are struck with the importance of the structure to this animal, and are led to consider the cæcum as little less than a second stomach. This is in fact the case; for the food coming in a macerated mass from the small intestines, is mixed in the cæcum, with the bile and pancreatic juice, and here undergoes a farther change, to which the structure of the cæcum is evidently favourable, as it is fitted to retain the mass for a considerable time within it, and to circulate it through all its parts. It has two blind ends, one forming its basis, and near this enters the ilium; the other forming its point, and extending up towards the diaphragm. From one part of the base the colon commences by a very contracted portion, for the purpose of preventing the entrance of the contents of the ilium, till they have passed through the cæcum. In many animals the cæcum is a very inconsiderable part; in some it has one or more appendicles; in others it is almost entirely wanting; and

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* *Blaine's Outlines.*

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and in all but the horse its use is obscure, and apparently not very important; but in the horse it is certainly little less than a second stomach, for its whole structure proves, that it is purposely designed that all the food taken in shall be poured into the base of this gut, by the contraction of which it shall be forced towards the apex, and either in its passage or return shall be detained in the cells to be in some way farther acted upon, and to undergo some change necessary to the system. Having undergone this change, whatever it is, it is forced into the colon.

112 n.

The colon commences small from the side of the base of the cæcum; and as the ilium cannot be said to enter it together with the cæcum, as in some animals, there is in the horse no such part as the valve of the colon properly so called. The ilium has, however, a sort of protrusion with its inner membrane, by which in some measure it prevents the return of the contents of the cæcum. As the colon passes, it is farther contracted, and then enlarges into a very long and large canal, which, after having made nearly the whole circumference of the belly, is again slightly contracted. It then again enlarges, passes again round the belly, and is a third time contracted, just where it ends in the rectum or straight gut. The small intestines rest on the turns of the colon and on the cæcum. The colon is furnished with four ligamentous bands in its large portion, but there are only two in the small portions; these form longitudinal fræna, which are intersected again by internal folds, so as to form the cells of the colon. It is connected and supported in its situation by that portion of the mesentery termed *mesocolon.* This intestine is very different in the horse to what it is in most other animals in consequence of its variations in size, being in most other instances of one general size; it is likewise this gut and the cæcum that are the principal seat of the inflammation arising from violent purging medicines.

113 tum.

The *rectum* is the continuation of the colon, and passes backwards from the lumbar vertebræ to the anus. Its muscular coat is thicker than that of the other intestines, and it is thrown internally into cavities by the inner membrane, in some manner similar to the cells of the colon, though less; were it not for this, the intestines might be too constantly stimulated to expel its contents, but by this means the fæces are received and retained till they are collected in a considerable quantity, when they are expelled. The rectum is attached to the spine and sacrum by the peritoneum, is here called mesorectum; but the true fold of peritoneum does not invest its whole portion, but leaves it as it approaches the rectum, which is at this place only covered with the cellular part of it. The mesentery bands of the rectum are very strong, and terminate at the anus in a kind of ligamentary expansion attached to the *os cocygis.*

The *anus* is the termination of the rectum, and is opened by the force of the peristaltic motion and the consent of the parts, and shut by the muscular band round the extremity of the gut, called the *sphincter.* It is likewise elevated and retracted by two pair of muscles.

## CHAP. IV. *Of the Foot.*

In our account of the anatomy of the horse's foot, it will be necessary to describe only one foot, as those belonging to both extremities are similar in structure.

Anatomy of the Horse.

114 Bones.

The bones which compose the foot of the horse are six in number, considering the foot as commencing at the fetlock joint. Of these six bones two are included within the hoof, viz. the coffin-bone, and the navicular-bone; and four are situated above the hoof, viz. the large pastern-bone, the small pastern-bone, and the two sesamoid bones.

We shall begin from above, with the large pastern-bone, as this contributes to form what is called the large pastern joint.

115 Large pastern-bones.

The large pastern-bone, (1, fig. 13, 14, and 15.) is of an oblong cylindrical form, and, as is the case with all such bones, is smaller in the middle than at either extremity. It articulates above with the lower head of the canon-bone, and below with the upper head of the small pastern-bone. At its upper extremity there are three depressions, one on each side, large and superficial (*a*, *c*, fig. 13.) to receive the outer and inner convexity of the lower head of the canon-bone, and one in the middle, *b*, for receiving the middle narrow convexity of the same bone. The fore part of this bone is slightly rounded, and rough towards its upper extremity, as at *d*, *d*, for the firmer attachment of ligaments. Behind, at its back part, it is flatter; and here there is a rough depression (C, fig. 14.) also for the attachment of a ligament that is deep seated, and is fixed to the two sesamoid bones. At the lower extremity the large pastern-bone is convex on each side (D, E, fig. 14.) for entering into two concavities of the small pastern-bone; and there is a depression (*f*, fig. 13.) for the attachment of a tendon. At the lower extremity there is also a roughness on each side at *e e*, for the insertion of ligaments. Both extremities are covered with very smooth elastic gristle, which is kept constantly moist by the synovia or joint oil.

116 Sesamoid bones.

At the upper end of the large pastern-bone, towards the back part, are placed the two sesamoid bones, AA (fig. 14.). These are of an irregular wedge-like form, and are covered with cartilage, articulating both with the canon-bone, and on the back part they are very smooth to admit of a tendon readily sliding over them. The upper edges of these bones on each side have a rough irregular surface, into which is inserted a strong ligament that comes from the upper and back parts of the canon-bone, is fastened separately to each of the sesamoid bones, from which it proceeds downwards and obliquely forward to be inserted into the tendon of the large extensor muscles, (see *a a a*, fig. 16.) a little below the large pastern-joint. These sesamoid bones are of considerable use in the mechanism of the large pastern-joint. "In consequence of their forming the back part of the large pastern-joint, and articulating with the lower and posterior part of the canon, they contribute very essentially, by always receding whenever the foot comes in contact with the ground, to act as a spring to the animal, and to prevent concussion. All the weight received by the upper head of the large pastern-bone is conveyed to bones below; but a considerable portion of the burden is received by the sesamoid bones. While the animal is at rest, and also during motion, these bones sustain part of the weight; and where the pastern-bones are long and oblique, the sesamoids often receive so much of the weight as to put the ligaments violently on the stretch, and occasion lameness *."

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* *Coleman on the Horse's Foot*, vol. ii.

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117 **Small pastern-bone.** The small pastern-bone (2, fig. 13, 14, 15.) is about half the length of the large one, and is as broad as it is long. Besides the two concave depressions, (*h*, *h*, fig. 13.) mentioned before, there is a ridge between them, *i*, that enters a correspondent depression, *g*, in the lower head of the large pastern-bone. The small pastern-bone has at the back and upper part (F, fig. 14.) a small projection, for the insertion of a long ligament, that comes from the sesamoid bones. The lower articulating surface is more extensive than the upper, as it is connected with the upper surface of two considerable bones, viz. the navicular and coffin-bone. It is of great consequence to understand the mechanism of the joints that are formed by this connection, as it is on this part that the principal stress of the animal falls. The union of the small pastern-bone with the navicular and coffin-bones, forming what is called the *coffin-joint*, is one of the principal methods provided by nature to prevent concussion.

118 **Navicular-bone.** The navicular-bone (3, fig. 13, 14, 15.) is connected above with the back part of the small pastern-bone, and the lower edge of this bone is attached by a large ligament to the back part of the coffin-bone. The navicular-bone is slightly concave, to receive the back part of the lower head of the small pastern-bone. The upper edge of the navicular-bone behind is rough (*g*, fig. 14.) and thick, for the attachment of the upper ligament; and the lower edge of the navicular-bone receives at the back part a strong flat ligament from the coffin-bone, immediately above the insertion of the flexor tendon. The lower surface of the navicular-bone is covered by cartilage, and has a small ridge in its centre, (*l*, fig. 13.) to be received into a corresponding depression in the long flexor-tendon. This bone may be considered as forming two distinct joints, one of which is composed by the connection of one part of the bone with the tendon of the flexor-muscle, and the other is formed by the connection of another surface of the navicular-bone.

The whole weight of the animal, supported by the small pastern-bone, is thrown upon the coffin and navicular bones. Of this weight the coffin-bone receives the greater share; but the navicular-bone receives a considerable portion of it, though this bone does not contribute to prevent concussion so much as Mr Freeman has endeavoured to prove. The navicular-bone, when the hoof touches the ground, descends a little, and thus prevents that concussion which the horse's body would have received if this bone had been immoveably fixed; and when the hoof is again raised from the ground, the elasticity of the parts below the navicular-bone lifts up this bone into its former position, thus acting as a spring in facilitating the motion of the animal. As the weight supported by the navicular-bone of the hind feet is less than that supported by the same bone of the fore feet, their descent in the former is less than in the latter. The organs connected with the navicular-bone of the hind feet are also less subject to disease.

119 **Coffin-bone.** The coffin-bone (4, fig. 13, 14, 15.) is so named from its being concealed, or as it were buried within the hoof. It is also sometimes called the foot-bone. On its fore part it is rounded, having very nearly the shape of the external hoof. Its upper surface is slightly hollowed (*m*, *m*, fig. 13.) to receive the lower end of the small pastern-bone, with the fore part of which it articulates, as it does behind with the fore edge of the navicular-bone. At the back part the coffin-bone ends in two processes on each side, the upper of which are tipped with cartilage. At the upper part of the front of the coffin-bone there is a small protuberance, (*w*, fig. 13.) extending upwards above the joint, and serving for the insertion of the tendon of the muscles that extend the foot. Below this the coffin-bone is extremely porous, for the passage of nerves and blood-vessels; and towards the lower part in particular there are about 13 holes, for the transmission of considerable arteries, which go to supply the sensible sole. At the heels and quarters the coffin-bone is still more porous, and is supplied with a greater number of arteries, but these are proportionally smaller. The lower surface of the heels of this bone is also very porous, where it unites with the sensible sole, but the rest of the lower surface is generally smooth. There are here two hollow surfaces, which receive two corresponding rounded parts of the sensible sole. They are unequal, the foremost being the larger. Into the hollow on the back part, the tendon of the flexor-muscle is inserted. (A, fig. 16.).

120 **Ligaments.** There are seven ligaments belonging to the coffin-joint, of which there are three pairs, and one single. The first pair of ligaments take their origin from the heels of the coffin-bone on each side, and pass obliquely upwards as high as the middle, to which they are attached, and at which part of the small pastern-bone (B, fig. 16.) they are blended with the fibres of the lateral ligaments of the small pastern-joint. The second pair of ligaments on each side arise from the edge of the coffin-bone, near the heels, and pass obliquely forward to be inserted into the middle of the small pastern-bone (C, fig. 16.) near the attachment of the extensor-tendon. The third pair take their origin from the lateral edges of the anterior process of the coffin-bone, and are inserted into the edges of the cartilages. The use of these ligaments is to unite the cartilages more firmly to the coffin-bone. The extensor-tendon being inserted into the upper edge of the anterior process of the coffin-bone, prevents the necessity of a ligament at this part. The single ligament of the coffin-bone is connected with the posterior and inferior concave surface of the coffin-bone, immediately above the insertion of the flexor-tendon, and also with the lower edge of the navicular-bone. Besides this ligament there is another attached to the whole of the upper and back part of the navicular-bone, by which means that bone is enabled to support a greater share of the weight that rests upon it. By means of these ligaments this important joint is rendered very strong, while by the elasticity of the cartilages, and the constant supply of lubricating fluid within the joint, all the motions of the animal are rendered safe and easy.

The small pastern-joint is also well secured by means of ligaments, and by the sheath of the flexor-tendon. There are also ligaments proceeding from the sesamoid bones, which enter the sheath of the flexor-tendon, and are attached to the small pastern-joint (*o*, *a*, *u*, fig. 16.).

"The weight which the sesamoid bones, by means of ligaments sustain, is very different in different horses; and bears no proportion to the bulk and weight of the animal. The pastern-joints of large horses destined for slow motion, are constructed very differently from those

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Horse.

of blood horses. Their pastern bones are short, and the joints nearly straight; but thorough-bred horses of light weight have long and very oblique pastern joints; and, as in proportion to the obliquity of the large pastern, or fetlock joint, the canon conveys more of the weight to the sesamoid bones, the ligaments that support the sesamoids are necessarily put into motion, and more on the stretch, as the weight presses down the lower and back part of the canon on the sesamoid bones. Short pastern joints are as much adapted to the frame of heavy horses as longer joints are to that of lighter horses. The ligaments that support the sesamoids above also contribute to assist the flexor muscles and tendons in preserving when at rest, and in motion, the large pastern joint in its proper place*."

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Before we proceed in describing the structure of the foot, it will be proper to shew how the hoof is formed, and how it is connected with the parts within.

121
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ie hoof.

The hoof of the horse forms a sort of organized shoe, which is adapted to the foot with the greatest nicety; so that every part of the cavity is completely filled, without the foot's being subjected to any unequal pressure.

A correct knowledge of the natural form and structure of this part of the horse's foot, and of the deformities produced in it by improper treatment, is of the utmost importance; as on this must depend the most advantageous method of shoeing, and the only rational means of correcting the unnatural deviations. It will be obvious, that in order to form a just idea of the original shape of the hoof, we must examine it before any shoe has been applied to it; for, unless this shoe has been so constructed and fitted to the foot, as to preserve unaltered the original form of the hoof, this will be so changed, that we cannot recognise from it what was the original shape. That the methods of shoeing usually employed are calculated rather to deform the hoof, than to preserve its original figure, will appear presently.

A vertical section of the hoof shows it to be nearly conical; the broadest part of the cone being next the ground. This inferior surface, in a hoof that has not been shod, especially in the fore foot, appears nearly circular; or the diameter, from side to side, is nearly equal to the diameter from toe to heel, (see fig. 17.).

The hoof is composed of a horny substance that is entirely without sensation. It is divided into crust, sole, frog, and bars.

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The crust surrounds the foot on the fore part, and on the sides, like a wall (A, A, fig. 17). It grows obliquely downwards from the coronet, and becomes broader as it approaches the ground. It is thicker at the toe than at the quarter; and the outer quarter is thicker than the inner. On the outside it is smooth and rounded, but within hollow and laminated (B, B, fig. 15.) to unite with the coffin-bone. The crust is the only part into which nails can with safety be driven in shoeing.

3
sole.

The horny sole (B B, fig. 17.) unites with the lower part of the crust, and is situated below the coffin-bone; but between it and the coffin-bone, there is a vascular substance, to be presently described, called the *sensible sole*, from the blood-vessels of which the horny sole is formed. On the outside next the ground, the horny sole is hollow, but rounded within next the coffin-bone. The horny sole protects the sensible sole from injury, and in the horse's motions it embraces the ground, acting as a stop. When the laminated substances of the hoof lengthen, the horny sole descends, and thus assists in preventing concussion.

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of the
Horse.

124
Bars.

The bars, or binders (CC, fig. 17.) are two horny substances placed between the sole and the frog, and forming at the heels a close solid union with the crust. The small part of the bars called the *toe*, sometimes reaches almost as far as the toe of the frog. Within the frog, the bars are laminated like the inner part of the crust, and are closely united to the horny sole. The bars on the outside keep the horse's foot extended, and within, they tend to prevent the separation of the sensible sole from the horny sole. In the natural state of the hoof, there is a considerable cavity between the bars and the frog on each side.

125
Frog.

The frog (DD, fig. 17.) is that hard rounded protuberance, which we observe in the middle of the lower part of the hoof, pointed towards the toes, and expanded towards the heel like a wedge. In the middle of this broad part, there is a fissure (E, fig. 17). The external frog is united within the hoof to a narrow substance of a similar shape, but of a more elastic structure, and possessing sensation, and therefore called the sensible frog. This substance is connected above with the navicular bone, towards the back part; and at the extremity of the heels, it is united with cartilages on each side. The toe of the sensible frog is united to the coffin-bone, but by far the greater part is behind this bone. The back part of the frogs being united with elastic and moveable substances, admit of considerable motion, the frog rising when the hoof touches the ground, and descending when the foot is raised. By the ascent of the frog, the heels are prevented from contracting, and the cartilages are expanded, so as to afford the horse a considerable spring, whilst the form of this part fits it for embracing the ground, and thus prevents the horse from slipping. The convex form of the frog clearly shows that it was always intended to touch the ground, and experience has fully proved, that, unless this contact takes place, the healthy state of this organ cannot be preserved. It has been supposed that the frog is intended to defend the principal tendon or back sinew; but Mr Coleman has shown that this is a mistake.

126
Weight of
the horse
not supported by
the sole and
frog.

The weight of the horse is chiefly supported by the crust, and not by the sole or frog; for when these parts have been removed, or by being diseased, become soft and fungous, and thus incapable of resistance, it is found that the crust is still competent to bear the whole of the weight. If the sole and frog really supported the weight, it is evident that when these parts are removed or diseased, the foot would slip through the crust.

127
Importance
of the frog's
receiving
pressure.

The union of the sensible frog with the horny frog, and the connection thus formed between the sides of the sensible frog and the lower cartilages, effectually prevents dislocation. When the horny frog touches the ground, both that and the sensible frog ascend; but when by any means the horny frog is prevented from pressing on the ground, its proper functions are suspended. The cartilages partake of the motion of the frog; and, in proportion as this receives pressure, they recede from each other, and allow the sensible frog to ascend between them. But when the cartilages are rendered immoveable by becoming bony, or by contraction of the

the foot, the sensible frog is much confined in its motion. By this immobility of the cartilages, the horse is deprived of a powerful spring. When the frog does not press on the ground, and consequently the cartilages are deprived of motion, the moisture of the crust evaporates; and hence the quarters and heels of the hoof become contracted much more than the fore part of the crust, and this contraction is increased by the frog not being allowed to rise between the cartilages. Thus, the natural circular shape of the hoof is destroyed by the frog not receiving pressure.

Fig. 18. represents the lower part of a horse's hoof, as it is usually lengthened or contracted by improper shoeing.

128 Sensible sole.

We have not yet described the sensible sole. This is situated between the horny sole and the coffin-bone, and is united to the lower cartilages immediately behind the latter (CC, fig. 15.). Its lower edge is firmly connected with the sensible laminæ, at the lower edge of the coffin-bone; but at the extremity of the heels, the laminæ are continued for about an inch, forming what are called the *sensible bars*. The sensible sole is well supplied with blood-vessels, but when these are emptied, it appears of a ligamentous texture. From the vessels of this part, the horny matter of the horny sole and bars is formed and renewed.

129 Coronary ligament.

The only other part of the foot that we shall describe, is an important ligament, which surrounds the junction of the coffin-bone with the hoof, and is called the *coronary ligament*, (DD, fig. 16.). This ligament is attached at its upper part, to the anterior protuberance of the coffin-bone, and to the lateral cartilages; and extends a little above the coffin-joint, being united on its outside to the skin. Below it is united to the sensible laminæ, at their origin. On its outside it is convex, and is received into a correspondent hollow in the crust, called the *coronary ring*. It is ultimately inserted into the heels of the sensible frog. The uses of this ligament are very important. By its union with the sensible laminæ, lateral cartilages, sensible frog, and coffin-bone, it assists the action of all these parts, increasing their strength and connection; and in particular, preserves the proper situation of the cartilages, and prevents their being dislocated, to which they would otherwise be liable, by being separated by the rising of the sensible frog between them, when the horny frog touches the ground.

We have thus described the structure and functions of the foot and hoof, as far as appeared to us to be absolutely necessary for understanding the principles and practice of shoeing. The names, insertions, and uses of the muscles of the foot, have been already concisely given in the table of the muscles of the extremities (see page 437.). The blood-vessels, nerves, and absorbents are well described, and most beautifully figured in Mr Coleman's elegant work on the structure, economy, and diseases of the foot of the horse; to which, and to Mr Freeman's work on the same subject, we refer such of our readers as wish for a complete and accurate account of that curious and important piece of mechanism, the foot of the horse.

We shall conclude this chapter with a summary recapitulation of the more important circumstances that have been mentioned, as we shall immediately apply them in describing the most approved method of shoeing; and they will be the better understood, and the more easily remembered, by being brought together in a comprehensive point of view. It appears then,

130 Recapitulation.

"That the natural form of the hoof of the fore feet of horses, before any art has been employed, approaches to a circle; and,

"That the internal cavity of the hoof, when circular, is completely filled by the sensible parts of the foot.

"That the hoof is composed of horny insensible fibres, that take the names of crust, sole, bars, and frog.

"That the crust is united with the last bone of the foot, by a number of laminated elastic substances.

"That the uses of the laminæ are to support the weight of the animal, and from their elasticity to prevent concussion.

"That the horny sole is internally concave, internally convex, and united by its edge with the inferior part of the crust.

"That the uses of the horny sole are to act as a spring, by descending at the heels; to preserve the sensible sole from pressure, and (with its concavity) to form a convexity of the earth.

"That the external bars are nothing more than a continuation of the crust, forming angles at the heels.

"That the internal bars are a continuation of the laminæ of the crust, attached to the horny sole at the heels within the hoof; and that these insensible laminæ are intimately united with sensible laminated bars, connected with the sensible sole.

"That the use of the external bars, is to preserve the heels expanded; and the use of the internal horny bars, to prevent separation and dislocation of the horny sole from the sensible sole.

"That the external frog is convex, and of an insensible horny elastic nature.

"That the internal sensible frog is of the same form, very highly elastic, and united with two elastic cartilages.

"That the frogs are not made to protect the tendon, as Mr St. Bel and other writers have supposed.

"That the use of the frog is to prevent the horse from slipping, by its convexity embracing the ground; and from the elasticity of the sensible and horny frogs they act as a spring to the animal, and keep expanded the heels *."

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* *Coleman on the Horse's Foot*, vol. i.

PART

# PART III. OF THE OPERATIONS USUALLY PERFORMED ON DOMESTIC ANIMALS.

## Chap. I. *Of Shoeing.*

131 THE principles and practice of shoeing are usually explained at the end of treatises on the veterinary art, immediately after describing the usual surgical operations. We think it better, however, to treat on the subject of shoeing in this part of our article, immediately after having described the anatomy of the horse's foot; the necessity of understanding which has been fully explained in the last chapter.

132 It is very uncertain at what period mankind first began to shoe their horses with iron; but it is probable that this practice commenced as soon as they were sufficiently civilized, to have such roads as were composed of solid, hard materials, fitted for the purposes of constant traffic. In many countries where such kind of roads are not required, as in the deserts of Arabia, and in many eastern countries, we know that to this day the horses are not shod; and we have been assured, that some years ago, when the roads in most of the United Provinces of America were not so hard as they are at present, horses were shod only on the fore-feet (D).

We shall first briefly describe the mode of shoeing commonly practised by the smiths of this country, and shall then give a short account of the most important improvements that have been made in the art, from the time of Lafosse to the present method employed at the veterinary college.

133 Common method of shoeing.

In the common mode of shoeing, the bars are totally cut away, and the frog is considerably pared down, by means of a cutting instrument called a *butteris*. The reason assigned for cutting away the bars, or opening the heels, as it is called, is, that the heels may not contract, and that the shoe may not press upon the sole, and occasion corns. The hoof being thus prepared, the shoe is to be applied. The common form of this shoe is nearly elliptical, being broader at the fore part, and growing narrower towards the heels, where it is thicker than at the toe. It is convex on its outer surface where it is to touch the ground, and concave on its inner part, which is applied next the hoof. It is fastened to the hoof by means of eight nails, four in each quarter; and the heads of these nails are nearly cubical, standing out a little beyond the shoe. This shoe is commonly applied nearly red hot, in order, as we suppose,

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(D) Attempts have been made to prove that the ancients understood the use of iron shoes, and passages have been quoted both from Greek and Roman writers to support this assertion. But we think that the learned Beckmann has fully demonstrated the fallacy of this opinion, and has shown, that although leathern shoes were sometimes employed on the feet of horses and other beasts of burden, the use of iron horse-shoes was entirely unknown both to the Greeks and Romans. Indeed, if such shoes were in use among them, the ancient authors who have treated on horsemanship, husbandry, and the veterinary art, as Xenophon, Julius Pollux, Columella, and Vegetius, could not possibly have omitted to notice them. It cannot be supposed that these writers would have been silent with respect to the shoeing of horses, when they treat so particularly of the breeding and rearing of these animals, and prescribe remedies for the accidents and diseases to which they are subject.

Beckmann is of opinion that iron horse-shoes were used in Europe as early as the ninth century, for in the works of the emperor Leo, who lived about that period, they are expressly mentioned by the name of σεληναια σιδηρα. The emperor also speaks of horse-shoe nails by the appellation of καρφια, and mentions that a certain number of pounds of iron should be given out from the imperial stores to make σεληναια, and other horse furniture. The antiquity of horse-shoes is also confirmed by their being spoken of in the writings of Italian, French, and English authors of the same century. "When Boniface marquis of Tuscany, one of the richest princes of his time, went to meet Beatrix, his bride, mother of the well-known Matilda, about the year 1038, his whole train were so magnificently decorated, that his horses were not shod with iron, but with silver. The nails were even of the same metal; and when any of them dropped out, they belonged to those who found them. The marquis seems to have imitated Nero; but this anecdote may be only a fiction. It is related by a cotemporary writer, but unfortunately, his account is in verse; and the author, perhaps, sensible of his inability to make his subject sufficiently interesting by poetical ornaments, availed himself of the licence claimed by poets to relate something singular and uncommon. However this may be, it is certain that the shoes of the horses must have been fastened on with nails, otherwise the author could not have mentioned them.

"Daniel the historian, seems to give us to understand, that in the ninth century, horses were not shod always, but only in the time of frost, and on other particular occasions. The practice of shoeing appears to have been introduced into England by William the Conqueror. We are informed that this sovereign gave the city of Northampton as a fief, to a certain person, in consideration of his paying a stated sum yearly for the shoeing of horses; and it is believed that Henry de Ferrers, or de Ferriers, who came over with William, and whose descendants still bear in their arms six horse-shoes, received that surname, because he was entrusted with the inspection of the farriers. We may here observe, that horse-shoes have been found with other riding furniture, in the graves of some of the old Germans and Vandals in the northern countries; but the antiquity of them cannot be ascertained." *Beckmann on Inventions*, vol. ii.

suppose, to adapt it better, and make it fit closer to the hoof.

134
**Defects of the common mode.**

The consequences of this method of shoeing must be, 1. That the function of the bars, whatever it may be, (and we have shewn that they are intended to prevent contraction of the feet), must be destroyed. 2. That cutting away the frog, exposes this part to injury, and is productive of many diseases. 3. That the heels of the shoe being higher than the toe, will prevent the frogs from embracing the ground, for which we have shewn they were naturally intended. 4. That by making the shoe concave at the quarters, and placing the nails near the heels, the growth of the crust in these parts is impeded, and thus the foot is contracted, and its proper shape destroyed. 5. That by fastening the shoe near the insensible frog at the heels, the proper action of the frogs and sole, as a spring to assist the motions of the animal, is destroyed. 6. That by putting on the shoe hot, the moisture of the crusts is dried up, and thus the contraction of the foot is still further increased; and, 7. That by making the shoes rounded next the ground, the sure footing of the horse is greatly lessened, much to the danger of his rider.

135
**Lafosse's method.**

The first modern writer who attempted to reform the common mode of shoeing, appears to have been Lafosse. It is true that an excellent mode of shoeing was recommended about 300 years ago by Cæsar Fiaschi, an Italian writer on horsemanship; but his plan never came into general use, and Lafosse appears to have all the merit of the improvement, as it is more than probable that he had never seen Fiaschi's work. The shoe recommended by Lafosse was what he called the *half-moon-shoe*, being nearly semicircular, and reaching little further than to the middle of the foot; the nails being placed round the toe. Lafosse's shoe was never very generally employed in this country, even though the improvement was rendered familiar by Bracken and Bartlet, who, as we have said, translated Lafosse's treatise into English. It has been considered as useful in some cases of diseased feet, and for strong feet which have begun to contract, or appear likely to do so, provided such horses are not employed on very hard, rough roads; but it is by no means applicable to the majority of our horses. Its principal disadvantages appear to be, that the heels wear too fast, and that in running, horses are apt to slip with it.

136
**Osmer's method.**

Mr William Osmer, whose work on shoeing we have mentioned in N° 65. improved considerably on the shoe of Lafosse. He forbade the frogs and bars to be cut away, except when they were ragged. He, however, remarks, that the feet of all horses should be pared according to their length; the crust being made perfectly smooth by paring or rasping. His shoe was everywhere of an equal thickness, rather narrower behind than before, of a flat surface next the ground, and bevilled away from about the middle of its breadth inwards, leaving a flat surface for the crust to rest on.

137
**Lord Pembroke's method.**

The next improver of shoes was Lord Pembroke, though Mr Blaine most unaccountably places him after Mr Clark. Lord Pembroke's remarks on shoeing are exceedingly ingenious. He observed that the weight of shoes must, in a great measure, depend on the quality and hardness of the iron. If the iron be very good it will not bend, and in this case the shoes cannot possibly be too light; care, however, must be taken, that they be made of a thickness so as not to bend, for bending would tear out the nails, and ruin the hoof. That part of the shoe which is next the horse's heel, must be narrower than anywhere else, that stones may be thereby prevented from getting under it, and sticking there, which otherwise would be the case, because the iron when it advances inwardly beyond the bearing of the foot, makes a cavity, wherein stones being lodged, would remain, and by pressing against the foot, lame the horse. The part of the shoe which the horse walks upon, should be quite flat, and the inside of it likewise; and only just room enough should be left next the foot, to put in a picker, (which ought to be used every time the horse comes into the stable, and often on marches), and also to prevent the shoe's pressing upon the sole. Three, or at most four nails of a side, hold better than a greater number, and keep the hoof in a far better state. He advises that the toe of the horse be cut square and short, and that no nails be placed in that part. By these means narrow heels are prevented, and many good effects produced. His lordship advised the hinder feet to be shod in the same manner as the fore feet, except in hilly and slippery countries, where the shoes on the hinder feet may be a little turned up behind.

The utmost severity, (says Lord Pembroke), ought to be inflicted on all those who clap shoes on hot. This unpardonable laziness of farriers in making feet fit shoes, instead of making shoes fitting feet, dries up the hoofs and utterly destroys them. Frequent removals of shoes are detrimental, and tear the foot, but sometimes they are very necessary. This is an inconvenience which half shoes are liable to (though excellent in several other respects), for the end of the shoe being very short, is apt to get soon into the foot, and consequently then must be moved.

138
**Mr Clark's method.**

The shoe recommended by Mr Clark did not differ very much from that of Osmer. He does not, however recommend the hollowing of the surface of the shoe next the foot. Mr Clark recommended that the hoof and frog should not be pared or cut away without necessity, and was much against raising the heels with calkins; to the use of which he preferred that of an ice nail. He, however, admits, that sharp calkins may be necessary in hilly countries.

139
**Method of the veterinary college.**

The shoe originally used at the veterinary college by the first professor, was very similar to that of Osmer; but when Mr Coleman succeeded to the professorship, he adopted the half-moon shoe introduced by Lafosse. This was, however, soon given up, as experience shewed that it was not adapted to the generality of horses in this country. Within these few years, a method of shoeing has been introduced by Mr Coleman, which appears in most instances preferable to any former method. We shall therefore consider it pretty much at large.

140

Mr Coleman has laid down two general principles, by which the practice of shoeing for all horses, in every country, must be invariably followed. "So long as nails and iron are employed to protect the hoof, the crust is the part that should receive the nails, and the pressure of the shoe; and the sole of every horse employed for every purpose, is a part that should *not* be in contact with the shoe." These are Mr Coleman's general rules, and to these it must be added, that the frog

frog should, in almost every case, be allowed to come in contact with the ground, where this is practicable, whenever the horse sets down his foot.

Two general circumstances are to be observed in shoeing; the cutting of the hoof, and the application of the shoe. Some parts of the hoof require to be removed, before the shoe can be applied; while others must be carefully preserved. These circumstances are at least of as much consequence as the form of the shoe, but are not in general so fully attended to.

In Mr Coleman's method of shoeing, he first recommends that a part of the horny sole between the whole length of the bars and crust, be pared away with a drawing knife, as the heels of the sole cannot receive the pressure of the shoe, without corns being produced. The sole must therefore be laid hollow, that it may not come in contact with the shoe. This he considers of the greatest consequence. The heels of the shoe must be made to rest on that part of the hoof where the bars unite with the crust. See fig. 19. If the heels have been previously lowered by means of the butteris, there may perhaps not be left sufficient sole to admit of the application of the drawing knife, without penetrating to the sensible sole; so that it is better, first to cut the sole, as it may then be easily determined how far the heels may be lowered, and the toe shortened, with propriety. When the hoof is cut in this way, the sole readily descends when the hoof touches the ground, without being obstructed by the shoe; and stones, or other foreign bodies that have gotten between the shoe and the hoof, are thus readily pushed out. It is found by experience, that the sole never suffers from stones and gravel, when there is sufficient space left between the bars and the crust. The cavity between the sole and shoe should also be left sufficiently wide after the shoe is applied, to admit of the introduction of a large horse-picker, especially between the bars and the crust. If the sole should be naturally concave, a shoe that has a flat surface next the hoof will not touch any part of the sole when applied to the crust; and even should the sole be flat, or rounded in the middle or towards the toe, yet the quarters and heels may generally be made sufficiently hollow by the drawing knife, to avoid pressure on a flat shoe.

141 If it is found that a shoe with its upper surface flat, does not leave a space large enough to admit the picker between it and the sole, it is necessary to make either the sole or the shoe a little hollow. Sometimes the sole appears ragged and in flakes, and of considerable thickness. It is then proper to make the whole of the sole hollow with the drawing knife, before attempting to lower the heels or shorten the toe. When the sole is made hollow, the shoe will rest only on the crust; but if we cannot hollow the sole, we must, to prevent pressure, make the upper surface of the shoe hollow. As the hoof is always growing, and is preserved from friction by the shoe, it is necessary to pare the toe of the crust about once in every month. The more we can remove from the toe of the crust, in hoofs that are not well shaped, the sooner we shall be able to apply a shoe of the proper form and thickness.

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" The bars and frog should never be removed. Where there are ragged and detached parts of the frog, it is better that they should be cut with any small knife, by the groom, than by the farrier; for if the latter is once allowed to touch the frog, the sound parts are generally destroyed. Where the frogs are not large and projecting, and the heels are higher than the frogs, then it is adviseable to lower the heels, which may be done by a rasp, or the butteris; for in every case we are to endeavour to bring the frog in contact with the ground. We should never lose sight of this principle, that the frog must have pressure, or be diseased. If the frog does not touch the ground, it cannot perform its use; and no organ can be preserved in health, that does not perform the functions for which it was made. Nevertheless, where the frog has been disqualified for its functions for a considerable period, and becomes soft, it must be accustomed to pressure by degrees *."

143 When it is necessary for the horse to work, though his frog is soft and diseased, it must be gradually accustomed to pressure, by cutting down the hoof about one-tenth of an inch at every fresh shoeing, that the frog may become hard, and equally protuberant with the heels. If the horse be not required to labour, much advantage will be derived from allowing him to stand in the stable without shoes.

144
Shoe to be adapted to the hoof.

The feet of most horses have been deformed by bad management. It will therefore be necessary to use a particular shoe to each particular form of hoof. Any one form employed indiscriminately for all feet, cannot be alike successful for all. It is from not having sufficiently attended to this simple fact, that the shoe recommended by the veterinary college has not been more generally adopted. It is therefore necessary to vary the length, breadth, and thickness of the shoe, according to the form of the hoof to which it is to be applied. If the heels or fore-feet are two inches and a half or more in depth; if the frog be sound and prominent, and the roads dry, the toe of the hoof only requires to be shortened, and afterwards covered by a short shoe, which may be made of the usual thickness at the toe, but must be thinner gradually towards the heel. The proportional thickness of a shoe of this kind for a common saddle horse, as recommended by Mr Coleman, is three-eighths of an inch at the toe, and one-eighth at the heel. By means of such a shoe the frog is completely brought in contact with the ground; the heels are expanded; and corns, thrushes, and canker are prevented. The horse may continue to wear such a shoe as long as the weather is warm, and the ground dry.

145 Race-horses, who generally have the heels high, and the crust thicker and stronger than heavy horses, may generally wear short shoes, at least on the fore-feet. But such as have weak legs, bent knees, long pasterns, or low heels, must not wear such a shoe.

146
Changes to be made gradually.

A long shoe is necessary in wet weather, and even in summer, when the heels of the hoofs are low. In winter, when the heels are too high, they should be lowered by means of a rasp, rather than suffered to wear down, by being exposed to the ground with a short shoe; for moisture is very destructive to the hoof; and thus as great a part of it may be removed as is necessary. Besides, when a horse has been accustomed to high-heeled shoes, if he was suddenly made to wear those with thin heels, the frog might be bruised or inflamed, and the muscles and tendons of the leg considerably strained. It is therefore necessary to bring the heels of the shoe to the proper degree of thinness gra-

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* Coleman on the Horse's Foot, vol. i.

dually, observing that the heels of each succeeding shoe be made somewhat thinner than those of the last. In general, as much as possible of the horny part of the hoof next the toe is to be removed, and as little iron employed next the heels every time of shoeing, till the feet be brought as nearly as may be to their natural shape.

147 In horses that have been accustomed to wear shoes of an equal thickness all round, and where the frog is healthy, we may in general apply a shoe, much thicker at the toe than the heel, by paring down the toe, and taking nothing from the heel; and if a horse appear to suffer no inconvenience from a thin-heeled shoe, during the first month after it is applied, it may be continued with safety, and will greatly improve the hoof. In young horses, however, that have never been shod, and in horses just taken up from grass, the toe seldom admits of being pared down, and a thin-heeled shoe cannot be applied at once.

148 In all cases where the frog does not embrace the ground with a thin shoe, the heels must be lowered; and if the horse has been accustomed to wear high-heeled shoes, both the shoe and the hoof must be gradually lowered, till the frog can safely and easily perform its proper function.

A few horses require to be shod in a manner different from that which we have described, but still dependant on the same principles.

149 **Weight of shoes.** Different weights of shoes are required for different horses. Mr Coleman lays down the following proportions, for horses of various descriptions.

150 **For a coach-horse.** A moderate-sized coach-horse will require a weight of shoes and nails, from eighteen to twenty ounces; an inch wide, and half an inch thick at the toe, and three-fourths of an inch wide, and one-sixth of an inch thick at the heels.

151 **A saddle-horse.** An ordinary saddle-horse will require only from 12 to 14 ounces; and the shoe may be three-fourths of an inch wide at the toe, and half an inch at the heel, and three eighths of an inch thick on the outside of the toe, but only one-eighth at the inside of the toe, and at the heel.

152 **Coleman's ordinary shoe.** The shoe most recommended by Mr Coleman, is concave on its upper surface, where the sole is flat or convex, but it is flat on the rest of the upper surface; but if the sole admits of being hollowed, the whole upper surface may be flat. It is regularly concave on its lower surface next the ground; and it is fastened to the crust by means of eight nails placed round from the toe backwards, so as to leave a part of the shoe about an inch and a half from the heel. Hunting-horses usually require an additional nail on each side, next the quarter. The nail-holes are made with a punch of a wedge-like form, and to correspond to this the heads of the nails are made conical, so that as long as any part of the head of the nail remains in the hole, the shoe cannot easily come off.

153 For hunters, and such horses as run in shafts, it is recommended by Mr Coleman to turn up the outer heel; but, as in this way there is often some inequality of position, the outer heel of the foot is to be lowered, while the inner heel of the shoe is somewhat thickened. By these means cutting is avoided.

In such horses as have weak low heels, Mr Coleman recommends the use of the bar-shoe, as the bar affords a support to the frog, without wearing out the heels. When the bar-shoe has been employed long enough to admit of the heels growing to the proper size, the ordinary thin-heeled shoe may be adopted.

154 The method recommended by Mr Coleman, as described above, has been for some time followed with considerable success by the board of ordnance, whose horses, as well as those of the British cavalry in general, are now shod after this manner. The method has, however, met with considerable opposition, partly from such as do not understand the principles on which it is founded, and partly from its having been too hastily adopted, in cases to which, as Mr Coleman himself allows, it is not generally applicable.

Fig. 19. and 20. illustrate Mr Coleman's method of shoeing.

Fig. 19. represents the hoof turned upwards, to shew the manner in which the shoe is applied. It may be seen from this figure that the web of the shoe is hollow; that the heels at *a a* are narrower than the other parts of the shoe, and that the nails are placed all round from the toe backwards. Fig. 20. shows that the heels of the shoe are much thinner than the point, and also shews the manner in which the nails are rivetted or clinched on the outside of the hoof round the toe and crust.

155 **Mr Morecroft's method.** The only remaining method of shoeing that we shall here mention, is that of the ingenious Mr Morecroft. This gentleman has acquired much celebrity by his invention of *casting* shoes, by sinking them in dies, by which means horses may be fitted with any shoes best adapted to their hoofs. Mr Morecroft's shoe differs from Osmer's, in being concave within for more than half its width. He condemns the use of calkins, on the principle that the public roads are now much more solid than when calkins were in general use; and, consequently, that instead of sinking them into the ground, they rather tend to raise the heels above it, and thus the frog is prevented from receiving the necessary pressure. Mr Morecroft, however, allows calkins to heavy draught-horses, for whom he recommends two on each shoe; but in lighter horses of the same description, one on the outside of each shoe. The latter is also recommended for hunters, but for other riding horses he forbids the use of calkins. The number of nails in Mr Morecroft's shoe is usually eight, but in heavy draught horses they are not to be placed on the sides of the shoe, but all round at equal distance, leaving a space at the heels of about two inches or two inches and a half. In frosty weather, Mr Morecroft recommends nails with a lozenge head, or a double countersink, terminating in an edge instead of coming to a point, which greater breadth of surface prevents its being rubbed away so fast as a point. The thickness in the middle gives it strength, and the regular taper to the shank causes it to apply exactly to the side of the hole in the shoe, by which it is equally supported, and prevented from bending or breaking.

156 **Coleman's artificial frog.** Mr Coleman considering pressure as necessary to the healthy action of the frog, has contrived a method of affording this pressure in those cases in which, from diseased feet, or bad management in shoeing, it cannot naturally receive it; and where, if the heels were lowered, in order to bring the frog in contact with the ground, there would be danger of straining the tendons. Mr Coleman's patent artificial frogs are intended to produce

duce pressure on the natural frogs, while the horses are standing in the stable, and thus to give time for the growth of the heels, and to avoid the evils that would arise from lowering these too suddenly, or from allowing the frog to remain elevated above the ground. For the particulars of this ingenious invention, we must refer to Mr Coleman's pamphlet.

157 **Shoes for oxen.** Where oxen are worked in farming business like horses, it is generally thought necessary to defend their hoofs in a similar manner by means of iron shoes. The form and manner of fitting these do not appear to be universally the same in all places; nor are we acquainted with the methods usually practised. We know that M. St Bel recommended the following methods; either to shoe the ox with a flat plate of iron, having six or seven nail holes on the outer edge, accompanied with a projection of four or five inches of iron at the toe, which passing the cleft of the foot, is bent over the hoof: or with eight shoes, one under each nail; otherwise with four, one under each internal nail; or only two, one under the external nail of each fore-foot.

## CHAP. II. *Of Casting.*

158 **Casting.** THERE are several tedious and painful operations that we are sometimes obliged to perform, and which it would be difficult or impossible to execute, were the animal left at full liberty to resist us. It is, therefore, necessary to render ourselves completely masters of him, by throwing him down on the ground, and in a convenient situation, so as not to expose him or ourselves to injury. This operation is called *casting*, and is usually thus performed.

The first object is to prepare a thick bed of straw or litter, not less than eight feet square, to prevent the animal from being hurt in the fall. If the stable be sufficiently large to admit of the bed being made there, it is to be preferred, as during the operation, to prepare for which casting is necessary, the parts operated on will suffer less from exposure to the air in the stable, than without doors.

But, if there is not room in the stable, the bed must be made in the stable-yard, or rather, if possible, in some field or park adjoining.

The animal is now to be brought to one side of the bed; a strong leather strap, with a buckle at one end, and having an iron ring fixed to it, at a convenient distance from the buckle, is to be fixed round the pastern of each of the four legs, in such a way, that the rings of the straps that are round the fore-feet shall be directed backwards, and those of the straps on the hind-feet shall be opposite to these; while the buckles point outwards, to prevent hurting the animal. A pretty strong cord, ten or twelve feet long, is to be fastened to the ring of that strap that has been placed on the fore-foot on that side of the animal which is farthest from the bed: from this ring it is to pass through the ring on the hind feet, on the same side, from which it passes through the ring on the other hind-foot, then through the ring on the other fore-foot, and lastly, through that to which it was first fastened. The animal being thus fettered, a number of men are to place themselves beside him, so that he may be between them and the bed, while others are to stand on the opposite side of the litter. Now, the men that are beside the animal, laying hold of the end of the rope, are to pull gradually with considerable force, so as to bring the four feet of the animal as near as possible together. When this is done, the men on the other side, standing in a row, one at the head of the animal, another at his chest, a third at his haunches, a fourth at his tail, &c. pull the animal toward them and complete his fall.

It is necessary to observe that the men who pull the rope, and those who receive the animal on the bed, must not act at the same time; as in this case the shock would be so great and sudden, as probably to occasion some accident, either to the men or to the animal. It is also proper to remark, that the animal must be cast in such a manner, that the part to be operated on may be fully in the view and reach of the operator.

When the animal is once on the bed, his head must be held down by a man, and it will be proper to cover his eyes. Another assistant must stand by the cord, which, for greater security, should be fastened with a knot at the first ring.

There are some little niceties to be observed in casting an animal, according to the operation that is intended to be performed on him; but of these we shall speak, when we describe the operations themselves.

## CHAP. III. *Of Bleeding.*

159 **Bleeding.** BLEEDING is distinguished into *general* and *local*. General bleeding is performed for the purpose of taking away a quantity of blood from the general mass, and consists in opening some large vein, or some considerable branch of an artery. The vein usually opened, in horses and cattle, is the vein that runs along the neck, and which is called the *jugular vein*. This vein may be easily felt, as it is generally considerably raised above the muscles.

The vein is usually opened by means of a fleam, which is forced into the vein, by striking it with a small wooden mallet, called by farriers a *blood-stick*. There are many objections to this mode of bleeding. In the first place, it is extremely clumsy; and, if the vein happens to roll, which is very commonly the case, a large wound may be made in the skin, without drawing blood. Again, these animals, especially horses, are easily frightened by any sudden motion of the hand; and some persons have a way of shaking the blood-stick before they give the stroke; and, in doing this, they often use more exertion than is necessary. The animal, alarmed at these strange motions, tosses up his head, and thus renders the stroke uncertain.

Many prefer the ordinary lancet used by surgeons; and, in several cases, particularly of local bleeding, this is the most convenient instrument. But in opening the jugular vein, we do not consider it as much superior to the common fleam. When this latter is employed, the back of it should be made of considerable thickness, as, when it is too narrow, as is commonly the case, when the instrument is struck with the stick, it sinks into the channel of the vein, which is often not opened, as the prominent muscles of the neck receive the stroke.

For most purposes of bleeding, we would recommend the spring-fleam, as being easily applied, and much more certain in its effect.

160 **Danger of using a ligature about the neck.** It is a common practice with grooms and farriers, to tie a rope or other ligature about the neck of the

animal, previous to the bleeding in the jugular vein. They do this from a supposition that the vein will thus swell the more readily, and that it will be opened with greater certainty. But this ligature is in most cases unnecessary, and will at some times be highly dangerous.

Where exercise is not improper before bleeding, it will be sufficient that the animal be gently trotted previous to the operation, as thus the circulation will be promoted, and the superficial veins will be sufficiently filled with blood. Where general exercise is improper or inadmissible, the filling of the vein may easily be promoted by briskly rubbing the neck for some time with a wisp of straw or hay; and just before applying the fleam, it will be proper to press with one finger upon that part of the vein that is between the shoulder and the place where the fleam is applied.

The danger of a ligature will appear both from reason and experience. When the ligature is fastened round the neck, it produces a swelling of the vein on each side; and thus the circulation being in a great measure impeded, and the return of much of the blood from the head prevented, an accumulation of blood takes place in the vessels of the brain. If the ligature be continued round the neck, which must happen when, by want of dexterity of the operator, or by the horse being frightened, the vein has not been opened at the first attempt, the stagnation of the blood in the head goes on to an alarming degree, and the horse not unfrequently falls down in an apoplectic fit. "In such cases, (says Mr Clark), I have observed the operator greatly disconcerted, and desist from any further attempts to draw blood at that time, being prepossessed with the idea that the horse was vicious and unruly, although the very treatment the horse had just undergone rendered bleeding at this time the more necessary, in order to make a speedy revulsion from the vessels of the head; therefore a ligature or bandage ought never to be used till such time as the opening is made into the vein, and even then it will not be necessary at all times, if the horse can stand on his feet, as a moderate pressure with the finger on the vein will make the blood flow freely; but if the horse is lying on the ground, a ligature will be necessary."

But further, the concussion or shock the horse receives from his falling down, in the above situation, which will always happen if the ligature is too long continued, may cause a blood-vessel in the head to burst, and death may be the consequence.

161
Place where the vein is to be opened.

The place where the vein is to be opened is of some consequence, as, when the opening is made too far from the head, where the vein lies deep among the muscles, both the vein is not so easily opened, and the wound is not so readily healed. The most proper place for opening the jugular vein is about an inch below the joining of the small branches that come from the lower jaw. This is generally about a hand-breadth from the head, but it may be easily seen by the swelling of the vein when pressure is made on its trunk.

Before opening the vein, it is usual to wet the hairs that lie above it, and to stroke them in the direction of the intended orifice. This is a good practice, as the instrument thus passes through the skin more readily, not having to overcome the resistance of the hair. In mentioning the direction of the orifice, it is worth while to remark, that this should neither be longitudinal nor directly across the vein, but rather oblique; as the flow of blood from an oblique orifice is most easily stopped.

162
The blood to be saved.

When the vein is opened, it is highly proper in all cases to catch the blood in some convenient vessel. It is a very absurd practice, although it is commonly adopted, to allow the blood to flow at random on the ground or on a dunghill, by which means no precise estimate can be made of the quantity of blood taken away. This may either be so small, as to be of no advantage; or it may be so considerable as to produce fainting, before the operator thinks of stopping the orifice.

For the purpose of measuring the quantity of blood taken away, Mr White recommends a graduated tin vessel, capable of containing five quarts; every pint being marked on the inside of the vessel, so that the quantity of blood that is taken off may be exactly known. The blood should always be preserved, that we may judge from its appearance of the nature of the disease, and whether it is proper, or not, to repeat the operation. If the blood continues fluid for a considerable time, it shows that there is an inflammatory state of the body; and if a jelly-like substance, of a whitish or light buff colour, and rather firm consistence, appears on the surface after the blood has cooled, and especially if the surface is hollowed, we may be certain that the animal's complaint is of an inflammatory nature, that the bleeding has been proper, and must be repeated, if the symptoms continue or increase; but if the blood coagulates quickly, is uniformly of a dark liver colour, loose, and easily broken, with a considerable quantity of water upon its surface, it denotes debility, and shews that the disease arises from a weakness of the system; that instead of *bleeding*, *tonic* and cordial medicines are to be employed, with every thing that may tend to restore the animal's strength *.

163
Securing the orifice.

When a sufficient quantity of blood has been taken away, it is for the most part necessary to secure the orifice, in order to prevent future accidental bleeding. This is usually done by thrusting a common pin through the lips of the wound, and twining about it a little horse hair. As in this way the wound often rankles, and becomes a sore difficult to heal, which we are disposed to attribute to the brass pin employed, as often as to any other cause; we would recommend a pin of silver, or at least of polished steel. The pin need not pass through more than the skin, and in some cases when the horse can conveniently be fastened to the rack after bleeding, the pin may be entirely dispensed with.

As it is often required to bleed on either side of the neck, or on both sides, it is proper that the operator should be able to bleed with either hand. This is indeed not quite so necessary in bleeding horses and cattle, as in the human subject; but it will be often found very convenient in both.

164
Opening the temporal artery.

In some cases, especially in inflammation of the brain, where a sudden and copious loss of blood is required, it becomes necessary to open the temporal artery. This is easily effected, as the artery is situated very superficially, about an inch and a half backwards from the upper and outer corner of the eye. It is most conveniently opened with a lancet, and when a sufficient quantity of blood has been drawn, the flood is in general very easily stopped by making continued pressure upon the artery; or, if this should not succeed, and a dangerous effusion of

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* *White's Materia Medica.*

of blood should be apprehended, this may be effectually prevented by completely dividing the artery.

165 General bleeding is one of the most efficacious remedies in most of the acute diseases to which horses and cattle are subject. "When a horse appears dull and heavy, (says Mr White), and indifferent about his food, by bleeding we often prevent a fever. If a horse is bled at the commencement of a cold, the complaint generally proves moderate, and of short continuance. In all cases of internal inflammation, or symptomatic fever, bleeding is the most essential remedy, provided the operation be performed at an early period, and the blood drawn in sufficient quantity. In such cases I have often taken away five quarts, and repeated the operation the following day, when it appeared necessary. By bleeding copiously at first, these formidable diseases are crushed at once; while by suffering them to proceed, or become at all violent, which they will do, unless this practice is adopted (or if only a small quantity of blood is drawn) they generally prove fatal; nor will bleeding then be of any service [*]."

66 Mr Clark very justly remarks, "that although the cases which may require bleeding are numerous, yet there is one general caution to be observed, viz. never to take away blood but when it it is absolutely necessary; as it is a fluid that may be easily taken away, but cannot be so easily replaced; besides that the practice of bleeding frequently, or at stated times, is exceedingly improper, as it disposes the body to become lax, weak, and plethoric.

"In bleeding, therefore, a due regard must always be had to the constitution, age, strength, &c. of horses, and the state or habit of body they are in at the time.

"It is commonly said that the taking away a little blood from horses, even when they are in health, or when they are in the least indisposed, will do no harm: this in one sense may be allowed to be literally true; but why draw blood from them on every trifling occasion, unless there may be such symptoms attending as may require it? I have observed in many horses who have been very frequently blooded, and which may be easily known, from the cicatrices or marks on the neck veins, that their blood had lost much of its tenacity, together with a considerable portion of its florid and red colour. Butchers who slaughter calves, may find their account in bleeding them frequently, as it renders their flesh white, by taking away the red particles of the blood. But in horses it is quite otherwise; as they are destined for hard labour and active exercises, it impairs their constitutions, subjects them to disease, and hastens a premature old age.

"As the blood of horses, more especially those who are constantly employed in hard labour, or in active exercises, when drawn from a vein, appears of a darkish or deep red colour, even in the highest state of health, it is commonly said to be bad blood, and more so, when a thick yellow or buff-coloured crust forms on the surface after it is cold; hence these appearances are said to require repetition of bleeding; for it very unluckily happens, that most of the diseases to which horses are subject, are thought to proceed from some impurities or humours, as they are called, in the blood, which require to be drained off by bleeding, and other evacuations [†]."

Operations.

167 Topical bleeding.

Topical bleeding is useful in several cases, as in inflammatory affections of the feet, which are often relieved by opening the coronary veins, or the vein that encircles the coffin-bone; in inflammations of the eyes, in which blood may be often drawn, from the angular veins, with considerable success; and in affections of the mouth, where it is sometimes useful to draw blood, by scarifying the bars of the mouth, or even, in some urgent cases, by opening the veins of the palate. Topical bleeding is best performed with a lancet.

Almost the only method that is practised for bleeding sheep, or dogs, is to cut off a joint or two of the tail; and this is certainly often productive of good consequences, as the flow of blood is sometimes pretty considerable. Unfortunately, however, we can seldom have recourse to this mode of bleeding more than once or twice, whereas cases often recur in which it is necessary to repeat the bleeding. It is also a cruel method, and we see no reason why the veins in these animals may not be opened like those of horses and cattle. In the sheep, indeed the thickness of the wool will commonly prevent bleeding in the neck, but the temporal artery and the veins of the foot may be opened without difficulty; and in most dogs we may bleed in the jugular-vein with nearly as much ease as in the horse or cow.

## CHAP. IV. *Of making Rowels and Setons.*

168 Rowelling described.

ROWELS in horses and cattle are much the same as issues in the human body. The operation consists in opening the skin, so as to insert between it and the cellular membrane some foreign body, which is kept there, in order to produce and keep up a suppuration or running of purulent matter. The operation is usually performed in the following manner. An incision is made through the skin by means of a very sharp pair of scissars, or, what appears better, a sharp knife. The finger is then introduced below the skin, so as to separate it from the flesh all around, as far as the finger will reach. A piece of leather about the size of a crown-piece, and of a circular form, with a hole cut in the middle, is then inserted between the skin and the muscles, having been first anointed with some stimulating ointment. A small piece of tow or caddice spread with the same ointment, is put over the hole in the centre of the leather; the skin is laid down over all, and the part is covered with a pledget, also covered with ointment, to keep out the external air.

The leather is left in this situation for two or three days, during which the parts adjoining the rowel swell, and at the end of the time there appears a discharge of a yellowish matter, which gradually becomes thicker and whiter. In three days at farthest the part must be examined, and the plug removed from the centre hole, to allow the matter to flow out. The rowel is now complete, and may be continued as long as shall be found necessary. The action of the rowel is easily explained; the leather introduced excites a degree of inflammation between the skin and the flesh, and no means being taken to check this, it goes on, like most other inflammations of fleshy parts, to suppuration. Thus a discharge is produced from the part, which is found to have considerable effect in checking inflammation of some more important organ near which the rowel.

rowel has been inserted. Thus, in inflammation of the lungs, after copious bleeding, a rowel in the chest, like a blister in the human body, is found to have considerable effect in checking the progress of the disease.

169 **Situations proper for rowels.** Rowels may be placed in most of the fleshy parts of the body; but they are most commonly inserted in the belly, the breast, the inside of the thighs, the outside of the shoulders, and the hips. They are sometimes placed between the jaw-bones, below the tongue; but this is very improper, as a good suppuration can seldom be brought on in this place.

It is sometimes found necessary to make several rowels at the same time; but they should always be placed, as nearly as possible, to the seat of the affection which they are intended to relieve.

Besides dangerous inflammations, rowels are found serviceable in large swellings of the hind legs, in obstinate cases of grease, and in strains of the shoulder.

170 **When improper.** Though rowels are thus found extremely useful in many cases, they are, like many other operations performed on brute animals, sometimes made where they are unnecessary or improper. Where there is considerable debility, the insertion of a rowel would be very injudicious, as it would not suppurate kindly, and as the discharge produced would tend still farther to increase the debility. The discharge in these cases is usually thin and ichorous; sometimes they are perfectly dry, and not unfrequently a mortification is produced. When a rowel is found to be attended with any of these effects, it must be immediately removed, and the parts must be fomented with a warm decoction of the chamomile-flowers, and some stimulating herbs; or must be bathed with spirit of wine or oil of turpentine. If gangrene should have come on, it will besides be necessary to administer cordial and strengthening remedies.

171 **Setons.** Setons are inserted through an opening made in two opposite parts of the skin, and the extraneous body introduced is a cord.

The opening is made by means of a sharp-pointed instrument, with an eye at the other end for receiving the cord. The sides of the instrument must be proportioned to the opening to be made, and the size of the cord to be inserted.

172 **Their use.** Setons are particularly useful for the purpose of gradually draining off matter from abscesses or suppurating tumours, that are either so deeply seated as not to be easily opened in any other way, or so large that the sudden discharge of matter from them while opened by the knife, would be attended with bad consequences. They are best employed in large abscesses of the back withers, and the upper part of the neck behind the ears. Setons are also attended with the advantage of draining off the matter without exposing the inside of the abscess to the air.

173 **Mode of introducing them.** The method of inserting the seton for the purpose of opening an abscess is this. When it is found that there is a considerable accumulation of matter, the needle, furnished with a cord of the proper size, is to be introduced at the highest part of the tumour, and brought out towards its lowest part, so that the matter may more easily drain off. The cord, which must previously be rubbed with stimulating ointment, is now to be cut from the eye of the needle, and then fastened together at both ends, to prevent its being pulled out; but if the cord should not admit of being thus tied, a small button of wood may be fastened on each end. It is better, however, if possible, to tie the ends together, as every time the sore is dressed, the seton requires to be drawn a little round. When the discharge appears to be nearly stopped, except what evidently arises from the presence of the cord, this may be gradually removed, by drawing out a single thread of it at every dressing.

In introducing the needle, great care must be taken to avoid large blood-vessels and nerves; and where there is a danger in encountering these, it is better to pass the needle through a sheath. This may easily be done, by first making a small opening with a lancet at the upper part of the tumour; and through this introducing the sheath, which is to be pushed down till it reaches the part at which the needle is intended to come out. The needle in this way will pass through the sheath without danger of wounding any important nerve or vessel.

## Chap. V. *Of Firing.*

This operation consists in applying to the skin, or other parts of the body, a metallic instrument heated to a greater or lesser degree of redness. The instrument is called a cautery, and the operation was well known among the ancient surgeons, by the name of the actual cautery. 174 **Firing.**

The instruments employed for firing are usually made of iron, sometimes of copper; but iron is to be prefered. They are of various forms, according to the part to which they are to be applied, and the purpose for which the operation is to be performed. These will be considered in describing the cases to which firing is applicable.

The operation is found of use on several occasions: 175 **Its uses.**

1st, In order to oppose the progress of mortification. With this view a cautery shaped like a knife, with a blunt edge and a thick back, is to be employed. This form will also answer for many other cases. There should be several instruments of the same kind, that when one becomes too cool, another may be ready of the proper degree of heat. The heat of the iron intended for the present case should be that of a cherry-red. In applying the iron, the parts adjoining to the mortified place are to be passed over with the edge of the instrument in successive parallel lines, so as the heat may penetrate to the living parts, and thus produce such a degree of healthy action as may enable them to throw off the mortified slough. When the iron has been applied for a sufficient time, which must be regulated by the nature of the part, and the extent of mortification, the wound is to be covered with a pledget spread with some stimulating ointment.

2d, Firing is employed to brace the skin, and to strengthen the sinews. The instrument above described is used on this occasion, but its heat must be somewhat greater. The mode of applying it is to pass the edge lightly and quickly over the skin, describing parallel lines from one end of the part of the other. When one iron has been used in this way, a fresh one is to be taken, and made to retrace the lines first formed, beginning where the last iron left off; and this is to be repeated as often as appears necessary, taking care not to destroy the texture of the skin. It is recommended by by some to apply the hot iron, so as to burn away the hair, for some time previously to firing the skin; as much time is otherwise lost before the proper impression can be made by the iron. After firing, a blister is sometimes applied, as this is thought to increase the good effect produced by the iron. When firing is employed on the hind legs, or on any part where the operater would be exposed to danger from the horse's kicking, it is necessary to confine the legs by means of fetters.

3d, This operation has been found useful in spaving, ring-bones, old callous swellings of the back sinews, and in wind-galls. For this purpose the irons are used as already directed. It is the custom with some farriers to apply a blister in these cases before firing, in order to reduce the swelling; as they suppose that firing employed without this precaution would tend to fix the swelling, and render it incurable. There is probably little foundation for such an idea.

4th, Firing is very frequently had recourse to by way of a styptic in stopping or checking profuse bleedings, from accidental wounds, or surgical operations. The iron employed with this view has generally a rounded extremity, except in the operation of docking, where an iron in the form of a ring is generally employed.

5th, Another use of firing is in wounds of the joints, or other circumscribed cavities, where it is employed to promote a kindly circulation, and consequent granulation of healthy flesh. It has been employed in these cases by Mr Coleman, with considerable success.

6th, Firing has been found one of the most effectual remedies in those superficial ulcers that accompany farcy or glanders in the horse; and,

Lastly, the use of the hot iron has been found the only certain means of preventing the dreadful effects arising from the bite of a mad animal, when properly applied after cutting out the bitten part.

## Chap. VI. *Of Docking.*

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The honour of having introduced this most useful and humane practice, belongs, we believe, solely to this country. It appears that it was in use in England, so long ago as the end of the eighth century; for at a council held there about that time (*concilium Calchutense*, or council of Calchute), there was a canon enacted, expressly forbidding this practice as indecent and abominable.

It does not appear that this operation is performed among the Arabians, or other eastern nations; or at least, if it be, it is not intended as an ornament to the animal, but either from necessity when the tail is diseased, or by way of mark, to distinguish some particular horse.

Docking has been practised in Germany for about 300 years; and probably much longer in France. It was certainly unknown to the Italians at the latter end of the fifteenth century; for we are told, that when the army of the emperor Maximilian was in Italy in 1497, the Italians were much surprised to see his cavalry mounted on docked horses.

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It is strange that prejudice and false taste should lead mankind to deprive their horses of a part, which, to the eye of reason and unsophisticated nature, must appear not only an ornament to the animal, but as designed by the Creator as a protection against flies, gnats, and innumerable other winged enemies, which harass them in the summer months. It is true, indeed, that in Britain, where the summer heats are in general not so lasting, or so violent, as in the more southern countries of Europe, these insects are not always so troublesome as they are found in those climates. But even here they are sufficiently so, to render the protection of the tail necessary; and when our cavalry are unhappily sent to the continent, the loss of the horses tails proves a very serious obstacle to the success of the troops. More than one instance of this has occurred. At the battle of Dettingen in 1743, great part of the British cavalry were absolutely dismounted, from the death of the horses, occasioned in a great measure by the torment which they experienced from the bite of gad-flies, and other insects; and at the battle of Minden, in the seven years war, the cavalry of the allies were thrown into so much disorder by these petty enemies, that they had nearly lost the battle. Lord Pembroke declares, that he has seen the cavalry horses belonging to our army, sweating, rubbing against each other, refusing their food, and absolutely devoured by flies for want of their tails to brush them off; while those of the horses of the foreign cavalry that had not been deprived of this necessary defence, were cool, tranquil, fed well, and were in good condition. From the inconveniences which our cavalry have suffered from the want of the horses tails, it has been for some years the custom to employ long-tailed horses.

The principal reasons that have been assigned for this absurd practice, are, that a long tail is extremely inconvenient to both horse and rider, when travelling through dirty roads and bushy forests; and that when the tail is of its ordinary length, the animal cannot carry it in that fine, arched, cocked-tail direction, which seems to form one of the chief beauties of the modern racer.

We apprehend that few horses enjoy such an ample length of tail as that of the redoubted Hudibras; of whose horse we read, that

> "His draggling tail hung in the dirt,
> "Which on his rider he would flirt,
> "Still as his tender side he prickt
> "With arm'd heel, or with unarm'd kickt."

As to the beauty of a cocked-tailed horse, we profess ourselves not competent to judge; but with due deference to the gentlemen of the turf, and the respectable fraternity of jockies, we should humbly conceive (we speak with submission) that a horse with a long tail is a much finer object than one that is perpetually perking and wriggling his tail in the air, and exposing his bare breech to the broad stare of open day.

178
Mode of performing the operation.

Docking is usually performed on horses, by laying the tail upon a block, and chopping off the part by means of a cleaver or hatchet struck with a mallet. Perhaps it would be rather less bungling to perform the operation by means of a knife, and it would not take up much more time. When this is done, the hair must be previously clipped away, that the knife may cut more easily; and previous to making the incision, the skin should be drawn up forcibly towards the rump. The incision may be made by beginning on one side, and cutting round from below upwards, so as to perform the whole

whole as nearly as possible at one stroke. When the skin and muscles have been completely divided, the part of the tail is to be cut off at the joining of two of the bones as nearly as possible to the edges of the wound, still keeping the skin drawn up. When the part has been removed, the flesh is to be seared all round with a hot iron, to stop the effusion of blood. The iron employed in France for this purpose is formed like a ring, so that it is easily applied to the flesh without injuring the bone. The wound must be covered from the air, and the animal must live rather low to prevent inflammation.

The practice of nicking, or cutting across the muscles that draw down the tail, so that those which pull it upwards may exert their full power, is still more inhuman and absurd than that of docking; and as we will contribute nothing towards extending this abominable practice, we shall omit the operation altogether.

## CHAP. VII. *Of Cropping.*

179 Cropping.

TASTE and fashion have introduced another operation, by which the ears of horses and dogs are changed from their natural shape and size, to those which are considered by their owners as more handsome or agreeable. The ears of the horse and dog are seldom of such a shape or size, as to render them inconvenient to the animals, or to unfit them for the purposes for which nature has designed them. This may, however, sometimes happen; and there are some cases of wounds or diseases that may render cropping necessary: but in performing this operation, it should always be kept in mind that as no part of the animal is made in vain, no more of the ears should be taken away than what is absolutely necessary. We not unfrequently see horses and dogs cropped close to their head, a practice which is cruel and absurd, and which is always followed by more or less deafness, and exposes the animals to much inconvenience from the weather. In those dogs that are employed in rabbit warrens, or for similar purposes, where they are required to enter burrows, cropping is attended with the worst effects, as the ears of the dog are unavoidably exposed to the particles of sand and earth that he brushes away in his passage through the burrow.

The operation of cropping scarcely requires description. In the dog it is usually performed by means of a pair of scissars, but these should be very sharp. In the horse, more nicety is required; and a particular instrument, called the *cropping iron*, is required, and a shape of the size of which it is intended the ear shall be, is applied to the ear, to mark the line of section. After the ear is cut, the skin and muscles recede considerably from the gristly part; but this seems of little consequence, and the wound heals in a few days without any other attention, than confining the animal within doors, and keeping him on a moderate, cooling diet. Horses ears are sometimes trimmed, as the grooms call it; that is, they are deprived of the fine soft hair that lines the inside of the cavity. This practice is equally absurd with cropping, as will appear from the following observations of Mr Clark.

180 Absurdity of trimming horses ears.

"The ears of horses, as of other animals, (says Mr Clark), are covered on the inside with a short down, intermixed with long hairs, which line the external cavity of the ear, which seems designed by nature to prevent harsh sounds from making too great an impression upon the brain, and likewise to prevent the cold air, rain, dust, flies, &c. from annoying the internal ear. The means commonly used to remove this down, &c. is by the scissars, the flame of a candle, or that of a burning torch. Both the latter are cruel and barbarous, and cause a deal of pain to the animal, not only from the blisters that sometimes rise on the ears after this manner of singing them, but likewise from the means that are used to make horses stand with patience to undergo the operation, that is a twitch on the nose; and perhaps, if he is troublesome to the operator, one put on the ear. It is to be observed, that horses are very much guided or directed by the sense of hearing. This is obvious in those that hear distinctly, from the motion of their ears, and the direction they give them to whatever quarter any sound comes from, the attention they pay to what passes around them, or to what is spoke to them. Many of them, particularly the finest kind, as they only are liable to this kind of treatment, have the sense of hearing considerably blunted, if not rendered quite deaf from the above operation.

As this operation is generally first performed on young horses at the time they are breaking, it is the more hurtful; as the uncommon sounds, as the rattling of carriages, drums, &c. which are entirely new to them, and to which they are then more exposed on the roads or in streets, must make the greater impression on the sense of hearing; and perhaps it may be owing to the above cause only that many horses are timorous to pass carriages, and remain so ever afterwards.

Another disadvantage which attends this operation upon the ears of horses, is, that they will not go on cheerfully when travelling in opposition to the wind, more especially if it rains; for as the wind and rain get free access into the ears, they are continually shaking their heads and endeavouring to turn from it; and those who are of a more impatient temper, will wheel suddenly round, in order to avoid what gives them so much uneasiness. They are then said to be restive; the whip and spurs are applied by way of chastisement for a supposed fault only.

From what has been said, it will be obvious, from the practice of taking away the natural covering from the inside of the ears, that the internal ear must be exposed to be considerably injured, particularly from cold, dust, &c. which blunts the sense of hearing, and perhaps causes deafness; for it is observed in those horses who have been much used to this treatment, that they lose that lively, active motion of the ears, and appear dull and inattentive to what passes around them, and even to the voice of their keeper*.

## CHAP. VIII. *Of Castration.*

181 Castration.

IT is found of use to deprive the males of several of the domestic animals, especially of horses and cattle, of the means of propagation, either to render them more mild and tractable, or, in the case of cattle, to promote their fattening, and render their flesh less rank. It has been disputed whether the castration of the stallion is productive of such advantages as are not counterbalanced by the loss of strength and spirit, which the animals sustain

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* *Clark on Prevention.*

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sustain by the operation. It is not our intention to discuss this point; and we shall here only describe the usual modes of performing the operation.

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The most prudent mode of castrating an adult or grown horse, appears to be the following. Let him be thrown on some convenient spot, on the one side, and when down, let the off hind leg be drawn towards the neck, by which the scrotum will be fairly exposed. Holding the scrotum firmly, make a cut at once though it, not of too great length, but sufficient to admit the testicle being pressed out; this being done, apply the clams or a pair of nippers on the cord within an inch of the testicle, and hold the clams sufficiently tight to stop the flow of blood, but not to bruise the cord; the stone may then be cut off with a scalpel, or it may be seared off with a burning knife. If it is cut off with a scalpel, immediately before the clams let go their hold, sear the end of the cord. Some apply a little powdered resin on it before searing, after which the clams may be loosened. When this is finished, proceed to remove the other in the same manner.

After both are removed, a pledgit of lint, wetted in warmed spirits, may be introduced just within the edges of each wound; but no salt should by any means be introduced, as is the practice of some farriers; nor will any kind of bandage be easily retained, and if any thing of this kind is used, it should be very loosely applied, so as not to irritate.

When this operation is performed on a full grown horse, if he is at all fat, he should be previously bled, and kept rather low; and it will be prudent to choose mild weather for the operation; and the place likewise he is put into after the operation, should be of a moderate temperature.

Sometimes there is a considerable degree of inflammation, and when this happens, it is by no means proper to trot the horse about as is commonly done, but to bleed and purge, and apply a solution of sugar of lead to the parts. It will also be of advantage to insert a seton smeared with blistering ointment in the inside of the thigh.

Some operators separate the epididymis from the testicle and suffer it to remain, by which means they think that a portion of the animal's spirit is retained. A similar custom is said to prevail in France; but the French operators object to it, on the idea that it produces fistulous sores in the part. The fact is, that when any portion of the testicle is suffered to remain, though it cannot secrete semen, yet it has some action going on within, by which it produces some influence both on the mind and form; and as such, the future growth of the animal may perhaps be slightly affected by it, and perhaps his temper to, but the addition to the latter may probably not be a very favourable one [*].

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Where the operation is to be performed, the best time is probably when the foal is about three months old, though some prefer a much more advanced age, as six, or even 12 months, and more in some cases. In all animals there is, however, the least danger of inflammation while they are young, in performing such operations. Besides, it is better to cut colts before they have any propensity to hanker after mares, and get bad habits. When the foals are early, and the weather is not too hot, the latter end of May or beginning of June may be a good and proper season.

Operations.

Some of the Yorkshire breeders, however, think that they find advantage in deferring the operation till the horses are two years old, as they suppose they become the stronger and handsomer for it. And where the operation is performed at one year old, they find that the foals have not recovered the check they sustained by weaning before they experience another in this operation. They experience no greater difference in their recovery at two years old than one. The foals should be kept up some time before the gelding is to be performed [*].

The castrating of male lambs is performed at different periods in different districts; but it seems the most proper to be done in the first fortnight in the stronger sort of lambs, and in those of the weaker kind from a fortnight to three weeks, or a month old, according to circumstances. Some, however, advise its being done at a much later period. When done early, there is, however, the least danger of too much inflammation coming on, if the lambs be in a healthy condition. When performed while very young, on tender, delicate lambs, mortification may sometimes be apt to come on and destroy them [†].

## CHAP. IX. *Of Spaying*.

184
Spaying.

SPAYING is an operation performed on the females, chiefly on cattle and dogs, to prevent their producing young. It consists in taking away the *ovaries*, or those appendages to the womb in which are formed the rudiments of the young. It is supposed that it is attended with considerable advantage, in cows or heifers, as it greatly promotes their fattening. In bitches, it is generally employed to prevent the unpleasant circumstances that often occur in the time they are in heat.

Spaying is usually performed after the animal has been newly impregnated, as at that time the ovaries are larger than before impregnation, and are of course more easily discovered. In performing the operation, a cut is made through the integuments of the belly, between the haunch-bone and the last ribs, and through this opening the fingers are to be introduced. If the animal has not been impregnated, a roundish hard substance will be felt attached to the loins. This is to be drawn out and cut off, and that on the other side is now to be felt for, drawn out, and cut away. The ovaries, as has been said, will be much more readily found, especially the inmost one, when the animal is impregnated, as the young within the horns of the womb afford a good direction to the finger. It is sometimes necessary, when the animal is not in a state of impregnation, to make an opening on each side of the belly, one for the extraction of each ovary; but when this is found requisite, it will be better to delay the second operation till the animal is in some measure recovered from the first.

When the ovaries have been cut away, the openings must be closed by means of a stitch through the integuments of the belly, and must be carefully covered with sticking plaster, to prevent the admission of the external air.

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Mr Daniel remarks, that this operation does not always succeed in bitches, unless done by a skilful person, who can be relied upon. If it be ill done, although the bitches can have no puppies, they will notwithstanding go to heat, which defeats the purpose. There is a difference of opinion, whether a bitch should be

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[*] Dickson's Agricult. vol. ii.

[†] *Ibid.*

Operations.

spayed *before* or *after* she has had a litter of whelps; Mr Daniel, however, has tried, and found both periods to answer. The best time is 14 or 15 days after she has taken the dog, and when the puppies just begin to be knotted within her. All the roots of the veins should not be taken away; her strength and swiftness will be injured by so doing. They should be kept low for several days before the operation is performed, and fed on thin meat for some time after*.

## CHAP. X. *Of Delivery in Difficult Labours.*

186 Delivery.

In general, Nature is all-sufficient for bringing forth the young of domestic animals, and man has little to do, except to take care that the females be not in such a situation as may expose themselves or their young to injury. It is proper always to watch a mare, or a cow, that is near the time of bringing forth; and to be at hand, to afford assistance where necessary. Mares do not often require assistance, as with them, difficult labour is uncommon. Where this does occur, the directions we are about to gve for the cow, will in general answer for the mare.

Cows, particularly the short-horned species, often need the assistance of the accoucheur. The natural presentation of the calf, is with its head and fore-feet, the nose between the feet, and the back upwards. Downing enumerates seven preternatural positions: namely, 1st, Reverse presentation, or tail first. 2d, Fore-feet, no head appearing. 3d, Side-belly upwards, head reversed over one shoulder, legs appearing. 4th, Fore-feet, with head under the brisket. 5th, Head alone, or one fore-leg only with it. 6th, Head and one leg, or head alone. 7th, Calf lying on its back, its four legs folded nearly together, and close up to the cow's back; the head appearing, or doubled back, even with the ribs, on one side or other; one hind-leg, perhaps, appearing.

187 Directions for delivering cows in cross positions.

The following general rules are given by Mr Lawrence.—Timely assistance before the cow is exhausted. Extraction never to be attempted in an improper position. Supple the hand and arm with warm water and fresh lard. Examination best made, the cow standing, and in the interval of pains. In pulling at the feet, inclose the claws in the hand, that the horn may not bruise the cow. Navel string bursting, and the usual flux of blood, of no consequence. Instruments to be used only in the last resort, and by experienced and steady persons only. The proper hook is of hard iron, four inches long, with a loop for the cord at the straight end.

In a natural position, if the cow should want help, the position of the calf may be ascertained after the waters have been seen. A cord ought to be in readiness, to attach to the fore-legs of the calf, in order to assist each natural exertion. The head to be kept clear of obstruction.

Preternatural position. N° 1. as above. No attempt to turn the calf (this position being favourable for extraction), but use expedition, for fear it be suffocated. Press the haunches back with the palm of the hand, take hold of the bend of the hough of one leg, pull at it, and reach the foot; both feet may thus be brought forth. N° 2. Reduce the head to its proper situation, between the fore-legs, either by hold of the nose, or the face-bone. A long arm is needful, which must be kept to the full extent in the body, that instant advantage may be taken of every throe, the fingers being properly fixed. N° 3. Gently move the calf back, and bring the head forth to the legs. N° 4. Push the calf back to find the head; pull at the nose: this requires address, but it is useless to employ force, until the head be in its proper place. N° 5. and 6. Push the calf back against the shoulders and brisket; the feet will be found folded under the belly; bring the feet forward, one at a time, the hand being gently placed on the bend of the knee. Should the head be too much swelled and bruised, to be returned, it must be skinned and amputated. Dissect in a straight line from the poll to the nose, force the skin back over the first joint of the neck, divide the head from the body, pushing the latter back to obtain hold of the knees. The loose skin must be previously wrapped over the ragged bone, and an assistant should have fast hold, in order to guide it clear of the haunch-bones of the cow; should it hitch there, put back instantly. N° 7. If one hind-leg appear, put it back; the calf cannot be brought forth with a hinder and fore-leg together, and the difference between the knee and hough will be immediately discovered. The head being doubled back, must of course be reduced to its proper place. The cow being strong and quiet, the business may be effected with care and patience; but should the hook be positively necessary, hold must be taken either in the sockets of the eyes, cavity of the ears, or in the jaw. The case of *dropsy* in the calf will be sufficiently apparent by its preternatural size; use the knife carefully, should that be necessary, to pierce the belly of the calf*.

There is a very material obstruction which frequently happens to the calving of cows. It is called a horning of the lye or calf-bed, when the passage of it is contracted into a very small circumference, insomuch, that at the full time of gestation, it will not admit so much as the smallest hand, and grows so sinewy or horned, as renders it utterly impossible for the cow to calve without assistance, and many cattle have died under this dreadful inconvenience, when it might have been easily prevented; but so little has been known hitherto of the diseases peculiar to black cattle, that many thousands have fallen victims to untimely death, that a simple remedy or operation might have saved.

In the case before observed, it must take a considerable length of time, before it is contracted, as it is often found; but no suspicion or dread can reasonably take place, until near the time when the beast has arrived at the end of nine months, her full time of bearing young; when they generally make a regular preparation, or falling of the parts of generation, for a few days or weeks before calving; but in cases of this hornedness of the calf-bed, it is observed that they are backward in making these necessary alterations, preparatory to the approaching change; and when this is noticed, more than usual observation ought to be taken, for when they do not prepare in a regular manner, they seldom have the efforts of nature in due course, for the delivery of their burthen.—But when the beast is observed sick for calving, and has reached the end of her time, and any dread of this is apprehended, there is no danger or impropriety in searching with the hand, in order to be satisfied, whether that part is open, or

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* Daniel's Rural Sports.

grown up, as previously described; yet the greatest care is necessary, that the inquiry be made with judgement, and the hand that is introduced must be well lathered with soap and water, or greased with tallow, fresh butter or some such thing, that will not cause irritation in the neck of the womb.

Now, if it be found in the state described in any degree, and a certainty of the beast being at its full time, with the common sickness and symptoms for calving, no time should be lost until the animal be relieved. The difficulty greatly depends on knowing to what degree it is grown up; it is sometimes so strait as not to admit the end of a finger, but with some exertion, it may give so much way as that a small knife may be introduced, whose blade should not be above an inch and a half in length, and very sharp, with a hollow on the back part of the point, for the end of the fore-finger to guide the knife when cutting, and to cover the point and edge, when introduced, which must be covered as much as possible with the hand. Its handle ought to be short, and the fore-finger of the operator should always be kept forward on the knife, to prevent any danger that might arise from the edge of it. The horny circle is sometimes so hard and gristly, that it takes more exertion than may have been expected from the nature of the place; but as soon as it is cut through, the beast will find a very material difference, and strive to void her burden, if possible, when every exertion of art ought to be used for her relief. Many people have suffered the beast, so disordered, to die a miserable death before their eyes, without offering to render her any assistance, and some have attempted to take the calf out at the side of the animal, a practice commonly known by the name of the Cæsarean operation; but the other method is to be preferred, when the obstruction is the result of hornedness. But operations of this kind in general fail, from neglecting the attempt until every natural hope is gone, and the patient so much weakened, as to die under the hands of the person who has undertaken the task. It is therefore recommended, that no time be lost in ascertaining the cause of any delay in calving, and that every exertion be used, while the animal has strength to undergo the operation, and to second the attempt. When the business is happily over, the wounded parts within must be taken care of, by providing one pint of rectified spirit of wine camphorated, to anoint the wound, and any other parts which may have been exposed to the air, bruised, or over distended. This may be conveyed up the neck of the womb by a syringe, sponge, or linen rag filled with it, and carried thither by a small hand, well fomented with some of the foregoing articles for that purpose. Let the beast be kept moderately warm, and in a comfortable situation, allowing her at all times a plentiful supply of good, dry, and sweet litter. We have taken the above from Rowlin's Complete Cow-doctor.

# PART IV. HYGEIOLOGY; OR, THE MEANS OF PRESERVING THE HEALTH OF DOMESTIC ANIMALS.

189 BEFORE we enter on the consideration of the diseases, that affect domestic animals, whose medical treatment is to form the subject of the remaining part of this article; it will be proper to lay down some instructions for the management of these animals in a state of health, with a view to that most important object, the avoiding of the causes of disease. The preservation of health must ever be considered as one of the principal objects of the medical practitioner, and has exercised the pens of some of the most eminent physicians in all ages. But the consideration of this subject is still more necessary in the treatment of the inferior animals, than in that of man. In the former the cure of disease is rendered much more difficult and precarious, on account of the obscurity in which the symptoms are often hid, and the difficulty which we frequently experience in investigating the causes of morbid affections.

190 Habitations. The management of domestic animals in a state of health, chiefly respects the habitations in which they are placed, when taken from their native fields; their food and drink; cleanliness, and exercise.

## CHAP. I. *Of Stables, Cow-houses and Kennels.*

IN a state of nature, all the animals at present under our consideration, are constantly exposed to the open air, and only seek for shelter from the inclemencies of the weather under woods and thickets. The young of all these animals when domesticated, except the dog, are for a long time left in a similar state, till, for the convenience of their masters, it is found necessary to place them in habitations. The structure of these, that is of stables, cow-houses, and kennels, and the method of treating the animals confined in them, is of the utmost consequence; as on these the animals health and comfort must in a great measure depend.

### 1. *Of Stables.*

191 Should be built on a dry and elevated place. Stables should be built on a dry soil, that is somewhat elevated; or, at least, they must not be built in a hollow, or in the neighbourhood of boggy or marshy land. The damp cold air, arising from moist, low situations, is extremely prejudicial to the health of all animals, particularly horses, and, as we shall see hereafter, to sheep. It renders them subject to colds, rheumatism, and not unfrequently to fever. Stables built in these situations are therefore always dangerous; and more particularly so, when the animals return to them after having been heated by violent exercise or labour.

192 Should be roomy. Stables should be roomy in proportion to the number of horses that it is proposed they should contain. Perhaps no stable should be made to hold more than five or six horses, as many inconveniences arise from keeping too many of these animals in the same apartment. Not only is the air thereby much more vitiated, but the rest and sleep, so necessary to repair the fatigues of the day, are thus prevented or disturbed. Some horses will not sleep, or even lie down, if not perfectly at their ease; and hence, in large stables, that are made to contain a dozen or more horses, as is often the case in livery sta-

bles, and such as are attached to large inns, the frequent entrance of grooms, ostlers, and other persons with lights, into the stable, and even the restless noise of some of the horses, who are more watchful, or have been less fatigued than others, must be a great disturbance to these latter. Where necessity requires a long range of stables, it is better to have them divided, by thick partition walls, into separate apartments, each made to contain not more than six horses. The additional expence of this would be trifling, compared to the greater ease and comfort of the animals.

193 Double stables improper.

It is usual in large stables, for the sake of keeping more horses conveniently under the same roof, to make them double headed, as it is termed; that is, to have a range of stalls along each wall, with a space between, for persons to pass to and fro. Stables of this kind are very improper; the space between the two ranges is often so narrow, that when the opposite stalls are occupied at the same time, the horses can reach each other with their hind feet, especially when standing, as they often do, at the full length of their halter. Hence, in the contests that often arise between quarrelsome or mettlesome horses, very severe bruises, and even lameness, are not unusually the consequences of the animals being within each other's reach. The danger that threatens passengers in these narrow spaces is also not small; we have often trembled when obliged to pass between two rows of horses, kicking and wincing under the curry-combs, where the intermediate space did not exceed three or four feet. If double-headed stables must be used, the space between the ranges of stalls should be at least eight feet.

194 Roof should not be low. The roof of stables should not be low; for, as the foul and vitiated air, generated by respiration and the exhalations of animal bodies, naturally ascends to the highest parts, the horses, who usually carry their heads very high, are, when the ceiling of the stable is low, fully exposed to the noxious influence of this vitiated atmosphere. This is not the place to enlarge on the vitiation that the air undergoes from the action of the animals that are confined in it; this subject has been already fully considered in the article CHEMISTRY when speaking of *respiration*; and, from what has been there delivered, the reader will see the necessity of pure air to horses and other animals as well as man, and will be able to judge of the propriety of the above maxim, and some others which we shall presently lay down.

The walls of the stable should be of stone or brick, and by no means of wood; they should also be left bare, or at least only covered with plaister. The temperature of the air, in buildings of stone or brick, is much more equable than in those built of wood, they are not so easily penetrated by the heat of summer or the cold of winter, and they are also attended with another important advantage, that they resist the spreading of fire.

195 Stalls. The stalls in which the horses are to stand should be divided from each other by strong wooden partitions, that should rise sufficiently high to prevent the horse from stepping over, but not so high as to impede the free circulation of air, and admission of light from one stall to another. The breadth of each stall should be such as will freely admit of the horse turning himself, and stretching at his full length when he lies down; but they should not be so wide as to allow of his kicking against the partition. The floor of the stall should have a gentle declivity, from the manger backwards. This allows the urine and water to run easily off; it also relieves the fore quarters of the horse, and adds much to the grace of his appearance behind. Too great a slope, however, must be avoided, as when the declivity is too rapid, all the weight of the horse is thrown on his hind legs; and, as it is extremely uneasy for the animal to remain long in this position, he is obliged to press his body forward, which he cannot accomplish, without keeping the hind legs always on the stretch; the pastern-joint, from its situation, receives the whole additional weight, and the ligament which connects it is invariably strained in all horses which are kept in this sort of stable for any length of time.

A slope of one inch in six feet will be sufficient to answer every purpose.

This declivity should terminate in a hollow space a few inches from the end of the stall, forming a sort of gutter, extending the whole length of the stable, and passing out through the wall at each end, where iron bars should be placed, to admit of the water, &c. passing out of the stable, which is the intention of this gutter, but preventing the intrusion of rats, and other noxious animals.

196 Floor. The floor of stables is commonly paved with stone, or hard bricks made for that purpose. This kind of flooring has the advantage of being more durable than any other; but it is not without its inconveniences. The stones or bricks become smooth by wearing, and, when the stable is wet, the horse, especially if he be very frisky, is apt to slip, and endanger straining or otherwise injuring his limbs. Again, by the pawing, or stamping, to which these animals are often subject, the pavement may be loosened or broken. For these reasons, it would perhaps be better that at least the stalls should be floored with strong oaken planks well seasoned, and laid across the stall, with their extremities below the partitions, and having their joining edges accurately adapted to each other. A flooring of this kind has the advantage of being more elastic, and of preserving a more equable temperature than pavement; and it is not liable to the inconveniences which we have mentioned, as attending this latter. A wooden flooring is indeed expensive, but this is more than counterbalanced by the advantages to the horse. It is of little consequence how the rest of the stable is covered; some gentlemen floor their stables with a sort of cement, which in course of time becomes as hard as stone, and has the advantage of being perfectly smooth and even. The gutter should of course be well paved.

197 Manger. The manger for receiving the horses corn should be about a foot broad, and five or six inches deep. The manger is usually made of wood, and when this is the case, the boards composing it should be so closely joined, that the corn cannot get through between them. The front of the manger should rise about three feet, or a little more from the ground; should slope a little, and should terminate above by a strong rounded border. This, if the manger be made of wood, should be covered with tin plate, or white iron, as horses are very apt, when without food, or when allowed to remain long in the stall, to bite the front of the manger, and thus acquire a very bad habit, which farriers call *cribbiting*. Some choose to make the manger of stone, which

which has the advantage of wood in being more durable and cleanly, wood acquiring by use an unpleasant smell, and being soon rotted by the moisture of the food, which it often receives. The bottom of the manger should slope a little forwards.

The manger is sometimes made to extend the whole length of the stable, when it is in general divided into several cavities, one for each horse. It is of little consequence whether it be one continued cavity, or whether there be a separate manger for each stall; but the manger should by no means be supported on legs, so as to make it moveable, as is sometimes done; as this prevents the litter from being conveniently stowed below the manger, and exposes the horse or the manger to accidents. It should therefore be firmly fixed at the back to the wall of the stable, and to each partition of the stall. Sometimes a hollow is made at one end of the manger, or at one end of each division of it, for the purpose of holding water. When this is done, there should be a hole in the bottom of this cavity fitted with a plug, to draw off the water when the horse has done drinking, or when the manger has been washed.

In the middle of the front of the manger, in its thick edge, there is usually fixed an iron ring, turning easily in an eye bolt, for the purpose of passing through the halter, by which the horse is fastened. Sometimes, instead of this ring, a hole is made through the border of the manger for the halter to pass through; but as the halter does not slip backwards and forwards easily through such a hole, and wears very fast by rubbing against the wood, the iron ring is to be preferred. The horse should always be fastened in such a way, as that the halter shall slide backwards and forwards with every motion of the horse's head; and he should on no account be tied by the halter, as this exposes him to accidents, by twisting the halter about his neck or legs.

198 **Rack.** The rack should be placed at such a height above the manger, as that the horse can easily reach it, to pull out the hay; it should be very strong and firmly fixed, and should incline a little outwards from the wall of the stable. The bars of which it is composed, should not be above four or five inches asunder, that the hay may not fall out and be wasted.

One circumstance particularly to be attended to in the construction of stables is, to preserve a free circulation of air.

199 **Stables should not be too close.** The generality of stables are by much too close and warm; not a chink is left for the free admission of air; the door and windows (if there are any), are made so close, as perfectly to exclude the air; or, if this is not the case, the crevices are frequently stopped with hay, under the idea that the horses cannot be kept too warm. This is a most absurd and mistaken notion; and is contradicted both by reason and daily experience. When we consider that horses in a state of nature, or even in their usual pastures, are perpetually exposed to the open air, and that, under these circumstances, they are more vigorous and active than under the most attentive care of their masters, we must be convinced of the impropriety of keeping them for hours together in the foul and heated atmosphere of the ordinary close stables. Whoever enters one of these stables when the door is first opened in the morning, after it has been closely shut up all night, will be able to judge from his own sensations, whether such an atmosphere can be wholesome to the animals that breathe it. Besides the great heat of the stable, which, if many horses have been shut up in it all night, is nearly intolerable, the air will be found highly impure from the continued respiration of so many animals, and the steams arising from the exhalations of their bodies, which have probably sweated profusely from having been so long confined in an atmosphere so foul and heated. Add to this the impregnation of the air by the effluvia arising from the litter, &c.; and it is not easy to conceive a more unhealthy situation for an animal, who, to perform the offices required of him with activity and vigour, should be in the full possession of all his strength. Now it may easily be supposed, that such an air as we have described, cannot be calculated to strengthen the body of the horses. On the contrary, it must be in a high degree weakening and relaxing. In this relaxed state, the horse is probably taken out immediately into the open air, whatever may be the season or weather, and made to enter on his daily task. The effect which such a sudden change must have on the constitution of the strongest horse, need not be described. The sudden action of the cold and probably moist air on a body that has been exposed for so many hours to the heated air of the stable, must be productive of the worst consequences to the health and vigour of the animal. Accordingly, fevers, colds, rheumatism, asthma, and a number of other formidable diseases, may be traced to this debilitating source.

We should think, that the analogy of nature would have taught men to avoid such absurdities. We learn from those authors who have written on the natural history of the horse, that the Arabians, who live in tents, and are extremely careful in the management of their horses, allow them to stand all day, when not employed, at the door of the tent; and at night bring them within the tent, where they lie down in the same apartment with their master and family, sheltered indeed from the dews of the night, but freely exposed to the circulation of air that must constantly prevail in these temporary dwellings.

200 **Mode of ventilation.** To avoid the inconveniencies arising from confined air, the stable should be made high and roomy; the door and windows should not be made too close; and the stable should be provided with proper ventilators. Perhaps a good method of preserving a free circulation of air in the stable at all times, would be to carry up a flue diagonally through the wall at each extremity, terminating above in a sort of chimney; and below, within the stable, in an opening sufficiently wide in any part of the wall that is not immediately within the stall.

201 **Windows.** The free admission of light into stables is nearly of as much consequence as that of air. It is a very erroneous opinion which is maintained by some grooms and stable-keepers, that horses feed best in the dark. These animals naturally love the light, and are much more cheerful and spirited in stables where this is freely admitted, than in the dark and dismal hovels that we sometimes find attached to inns and farm houses. There is one bad consequence that follows keeping horses in a dark stable, which does not appear to be sufficiently attended to. By being kept so long excluded from the light, the horses eyes become weak, and unable to support the full glare of open day. The pupils being so long

long habituated to an unusual degree of dilatation, do not readily contract when the animal is brought out into the open air; hence his eyes being offended with the strong light, to which he is so little accustomed, are perpetually winking and watering; the horse appears as if half blind, and starts and stumbles at almost every step.

The stable should, therefore, be furnished with glazed windows, in number proportioned to the size of the building. In general, no stables should have fewer than two windows; and they should be placed in such a situation, as that the horses may not receive the rays of light too directly on their eyes. Where the stable has only one range of stalls, this point can be easily effected, and in such stables, the windows should always be placed at the back of the horses. But in double stables it is not easy to place the windows so as not to incommode some of the horses, since, on whichever side of the stable they are made, the horses on that side are exposed to the full glare of the light; another argument against double stables. The windows should by all means be sashed; and should be made to draw down from the top, as well as to be thrown up from below. They should not be made too small, and should be carried up as near the ceiling of the stable, as is compatible with the strength and symmetry of the building. Windows constructed in this way not only add much to the appearance of the stables and to the comfort of the horses; but they afford one of the best means of promoting a free circulation of fresh air through the stable. For by throwing one of them up, and drawing another down, the ventilation becomes nearly as complete as possible.

Nothing has astonished us more, when viewing the handsome offices attached to some of the gentlemen's houses in this country, than to see the deficiency of the stables in the article of windows. When viewing them from without, we have congratulated the animals confined in them on the comfort of light and air, which they must enjoy from the fine sash-windows, which we saw on each side of the stable door. How great has been our astonishment on entering the building, to find all gloomy and dark within; and that the fine sash-windows which we thought to have seen at a distance, were nothing but efforts of the painter to deceive our senses, and to present an appearance of what certainly ought to have been a reality!

We must be permitted here to draw what we hope will not be considered as an invidious comparison between the Scotch and English method of lodging their horses. In England we have rarely seen such miserable hovels as, in many parts of Scotland, are used to supply the place of stables. We have indeed in the former country seen the stables sometimes very small, or even consisting of a thatched building not very well defended from the weather; but they are for the most part tolerably well ventilated, and we believe scarcely ever without windows.

[201]
Lofts above the stable improper.

It is a common practice to build stables of two stories, the upper story forming a loft for the purpose of keeping the horse's hay and corn; and in gentlemen's stables, where the building is sufficiently large, it is usual to have apartments on the upper story for the grooms and other servants employed about the stables to sleep in.

The apartment employed as a hay loft has usually a vacancy in that part of the flooring which is immediately over the rack, for the purpose of more conveniently supplying the horses with hay. This mode of building stables has its convenience in an economical point of view, and these apartments in the upper story add much to the showy appearance of the building; but there are several material objections to this construction.

1. The hay and corn being kept immediately over the stable, are constantly exposed to the foul and heated air and putrid steams rising up from the stalls through the rack, and are thus rendered liable to be heated and mildewed; whilst the dust rising from the shaking of the hay into the rack is very prejudicial to the lungs of the horses. On this account, it is much better, where this can be conveniently done, to keep the hay and corn in some place distinct from the stable, and bring from time to time a sufficient quantity of hay nearly to fill the rack, into which it might be put while the horse is abroad.

2. Another serious objection to having lofts and chambers above the stable, is that the building is thus much more exposed to accidents from fire, owing to the carelessness of the servants. And,

3. These apartments above the stable render the latter much too close and warm.

Where, from convenience or fancy, a gentleman chooses to build his stables in the manner which we have just described, it will be advisable to have the flooring above the stable made as close as possible, and covered with thin bricks or stones for the purpose of checking the progress of fire; and for preserving the hay and corn as much as may be from the steams of the stable, a partition wall may be raised from the extremity of the flooring immediately over the rack all the way to the roof of the loft, with a door opening over the rack in each stall. The entrance to the hay loft or chambers above the stable should be without, and by no means, as is generally the case, by a trap door and ladder within the stable. If, as we frequently see in gentlemen's offices, the stables are built on each side of the coach-house, the entrance to the rooms above may be conveniently made by a stair from the coach-house.

The building of which the stable forms a part, should be as much as possible detached from other buildings, so as to admit of a free circulation of air all around.

202
Stable should be apart from the dung-hill.

It is a vile practice, which is common on many farms and in some inns, to have the dung-hill or midden close to the stable. This nuisance should be removed as far as possible from the door and windows of the stable, as the heat and noisome vapours arising from the fermenting dung impregnate the air to a considerable extent.

203
Necessity of cleanliness.

It is of great consequence that the stable be kept swept and cleaned. It should therefore be regularly swept every morning, and every part of the litter that is wet and dirty should be removed to the dunghill, while what is clean and dry should be put up close below the manger, unless where the horse is lame, or has any affection of the feet or limbs, which renders it necessary for him to stand upon soft litter. Where the horse is perfectly healthy, no litter should be allowed in the day time, much less should the stall be crammed with litter, as is often done, and is suffered to remain in this situation for many days, for the purpose of increasing the quantity of manure. Nothing injures the feet

feet of horses more, or more frequently produces softness of the hoof, canker, and greasy heels, than allowing them to stand night and day on hot fermenting dung. It is also impossible for the horse to lie down in comfort in such a hot-bed; and if the poor animal is obliged to recline himself for a time, he is soon compelled to rise again, and repeatedly making the same attempt to rest, and finding it impracticable, he is forced at length to stand altogether, perhaps shifting his legs from one part of the stall to another, to avoid the heat of the dung.

Lord Pembroke is of opinion that after working, and at night of course, as also in lamenesses and sicknesses, it is good for horses to stand on litter; it also promotes staling, &c. At other times it is a bad custom; the constant use of it heats and makes the feet tender, and causes swelled legs. Moreover it renders the animal delicate. Swelled legs may frequently be reduced to their proper natural size by taking away the litter only, which, in some stables, where ignorant grooms and farriers govern, would be a great saving of physic and bleeding, besides straw. "I have seen, (says he), by repeated experiments, legs swell and unswell, by leaving litter, or taking it away, like mercury in a weather-glass."

204
thing.

It is a very common practice to keep horses, while in the stable, covered up with warm clothing. This is in some cases necessary, especially when they are under a course of physic, or are otherwise so delicate, as that they would be liable to injury from too much exposure to the air. But its indiscriminate use is highly improper, as it tends to render the horse too delicate, and exposes him to the danger of catching cold whenever he goes out into the air. While a horse is in complete health, and stands idle, he requires very little, if any covering, unless the stable be extremely cold, or ill sheltered. When indeed he comes into the stable, much heated by violent exercise or hard labour, it may be proper to throw over him a single cloth, that he may cool gradually. Some grooms think it necessary, besides enveloping the horse with body clothes, to gird them fast round the belly with tight rollers; and this is done with the view of taking up the horse's belly, as they term it. The practice is exceedingly absurd, for these tight rollers impede the circulation in the superficial veins, produce difficult breathing, and if they be applied, as is often the case, after eating, they greatly obstruct digestion.

To finish the subject of stable economy, we have only to make a few remarks on currying, or dressing horses.

105
ssing.

Friction employed on the horse's skin is not only necessary to keep him clean, and to promote the insensible perspiration, by freeing the skin and hair from impurities, but it is exceedingly useful when considered as a kind of exercise. It promotes the free circulation of the blood, which is much impeded by the horse standing long idle in the stable; and it much improves the appearance of the horse's coat. Horses should therefore be regularly dressed, at least twice a-day.

There are, however, some cases in which general friction ought not to be employed; such are cases of internal inflammation, especially of the bowels; or when there is a discharge of sharp ichorous matter from any part, especially the legs and heels. In these cases the affected parts should not be rubbed, as it would tend to increase the pain and distress arising from the inflammation.

## 2. *Of Cow-houses, or Byres.*

206
Cow-houses or byres.

After what we have said on the construction of stables, we need not here enlarge on that of cow-houses or cattle byres, as these buildings, so far at least as respects their outsides, are constructed on similar principles. We shall take occasion, when treating on the manner of feeding cattle, to describe a byre that appears to us to afford a good model for buildings of this kind.

It is of material importance in the wintering of young stock, to keep them more warm, and sheltered from wet, than is usually done, as by this means they thrive faster, with a less consumption of food, than in the contrary circumstances. This may be effected, either by tying them up in stalls, in houses for the purpose, or by keeping them in good sheds in well inclosed yards.

207
Propriety of tying cattle.

The question of feeding the cattle tied up, or loose in the yards, in winter, has not been yet decided. Each method has probably advantages. In the first, the cattle thrive better than when left at liberty to run about the yards. Mr Marshall found that in Yorkshire, cattle kept tied up, and regularly fed with straw in a moderate proportion, did better than in the southern parts of the island, where left loose in the midst of greater plenty. Whether this effect is to be ascribed to the greater warmth, the resting better, or the being fed more regularly, *and eating with an appetite*, he cannot determine. Some experiments of Mr Young's also lead to the conclusion that cattle stock thrive better when tied up. They likewise show that the practice of tying up is the only one that can be had recourse to, where straw is not in great plenty, and the quantity of the stock very inadequate to its consumption.

In the latter method there is the advantage of a large supply of manure, especially where the farmer has the conveniency of litter. Where however the farmer has convenience, the former method is probably in general the most beneficial. In either mode of management much attention is necessary to keeping the stock constantly supplied in an evenly proportioned manner, as in this way there will be great advantage, both in the saving of food, and the condition of the animals *.

208
Ox-houses.

The necessity of providing shelter for cattle in bad weather, is now we believe pretty well understood by every intelligent farmer; and experience has proved that proper buildings erected for winter feeding are attended with considerable advantages. The erection for this purpose at Hafod in Wales, the residence of Thomas Johnes, Esq. M. P. for the county of Cardigan, and one of the most eminent improvers of the present time, seems to be calculated upon a moderate scale. The whole length of the building is fifty feet, the roof shelving, its chief height being fourteen feet, the lower extremities, one seven and a half, the other six feet. A stone wall running up to the summit, parts the feeding-house from the other and smaller apartment, which is a receptacle for dung. Width of the feeding-house, nineteen feet within-side. Stalls each twelve feet long by four feet two inches wide. Gangway three feet and a half, at the heels and tails of the cattle, leading from the doors, the first door being for the cattle, the other for

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* *Dickson's Agricult.* vol. ii.

for the attendants. Similar doors at the opposite ends of the building. Running water in troughs, with racks, and mangers. The cattle lie on wooden platforms, perforated for the passage of the urine. The urine runs, and the dung is pushed through apertures in the wall, each of which is two feet square, and one between every two stalls. There are 12 wooden flaps or windows to give light and air, to each stall. The dung pit is about twelve feet wide, sunk some feet deep in the earth, extending the whole length of the building. The walls are built partly with stone, and in part with wood, the roof with larch wood, as an experiment of its durability in that exposure.

According to Mr Lawrence, the round or quadrangular form might perhaps, either of them, be more economical as to space and materials for a building to contain a considerable number. The oxen would most conveniently stand around with their tails toward the wall, contrary to the usual practice, for the more easy throwing out the dung from a gangway, through apertures purposely made in the wall, into a pit, under cover, sunk around the building. The area within would, of course, be for feeding, and every necessary purpose of attendance. A store-chamber above completes the building, the chief objection to the form of which, is the greater expence attendant upon the reversed position of the cattle, which perhaps is compensated by the great saving of labour, in the more easily getting rid of the dung. The gangway will in course be sufficiently wide to admit the beasts to and from their stalls; the dung aperture in the wall may be closed in cold weather *."

209 **Sheep-cots.** Of all domestic animals, sheep are the most exposed to the inclemencies of the weather. This arises chiefly from their numbers, which renders complete shelter very difficult; but even in the case of a small flock, the prejudices of many feeders have prevented their procuring proper shelter for their sheep, under the idea that it would render them too lazy to provide for themselves. These prejudices, however, are gradually wearing away, and few sheep-farms are at present unprovided with shelter, either of trees or buildings. Mr Findlater, in his able survey of Peebles, strongly recommends shelter for sheep. "It would be (says this gentleman) for the interest of every proprietor of sheep-farms, to encourage the farmer to rear shelter of trees, by allowing him the weedings of the plantation, and becoming bound to pay the farmer, at the rate of perhaps eight-pence or ten-pence a piece, for every tree left standing at specified distances, at the expiry of his lease; such interest communicated to the farmer, would give the most effectual security for the protection of the trees. Shelters are also procured by buildings, enclosing a square open area in the middle, furnished with sheds on every side. *Stells* (that is circular spaces of area, proportioned to the size of the flock, enclosed by a five or six feet wall of stone, or sod, without any roof) were the primeval shelters invented by our forefathers. The circular figure of the building causes the drifting wind in snow storms to wheel round it, without rising over it, and depositing the snow in the calm region within. The sheep are fed, in winter storms, with such provision as can be procured, under the trees, in the sheds, and within the circles. Even where no feeding is administered, much advantage results to the animals, from mere defence against the weather; and they are much the more alert in searching for natural food, so soon as the storm ceases. The mode of acting of the sheep gives a pretty certain indication of the weather to be expected: Upon the near approach of a storm, those accustomed to shelters are observed to make for their shelters. Upon the near approach of thaw, their presentiment leads them to be less industrious in digging the snow for food, as if conscious that such labour was no longer necessary *."

According to Mordaunt, who wrote about the middle of last century, sheep pens and houses were then not uncommon in Essex and Gloucestershire. He directs the pens to be made at some convenient corner of a pasture, or where several fields, commons, or pastures meet, so as to be common to them all. They should also be erected on a dry spot of ground, and stones laid at the bottom to keep the sheep dry and clean, whilst under examination. The pens to be divided into partitions to hold about forty sheep.

"The *sheep houses*, for warmth in the winter season, are made low, and a third part longer than broad, and rather large, the sides lined with furze or boards, for warmth; the bottom laid with large stone slabs, and very level, that the urine run not away, but soak into the litter. It would be proper to have the sunny side well lined with moveable hurdles, that when the sun shines it may be laid open to give the sheep a refreshment, by letting them into some close or croft, wherein the sheep-house stands: the house to be well covered."

### 3. *Of Dog-kennels.*

210 **Dog-kennels.** It is usually recommended to erect a particular building, for the sole purpose of a kennel; and certainly where the proprietor's fortune will admit of it, such an appropriate building is to be preferred. A common barn has, however, often been employed as a kennel: and Mr Daniel says, that the excellence of the hounds kept in such a building has been rivalled by few that were lodged in the most sumptuous edifices.

Whatever may be the form or original intention of the building, *cleanliness* is absolutely necessary, both to the nose of the hound and the preservation of his health. The sense of *smelling* is so exquisite in a hound, that every stench must be supposed injurious to it; upon that *faculty* all our hopes depend, and nostrils clogged with the effluvia of a dirty kennel, are ill adapted to carry the scent over greasy fallows, or guide one through the soil of deer, or over ground tainted by sheep. Dogs are by nature cleanly; where they lie, if they can avoid it, they seldom dung. Air and fresh straw are essential to preserve them healthy. They are subject to the *mange*; nastiness very much contributes to this, and although at the first appearance it may be easily checked, the remedies that are used are in themselves strong in their operation, and will do no good to the hounds constitution. Let the *cleanliness* of the kennel, therefore, be carefully attended to; a resort to these remedies will then be unnecessary, and all injury to hounds from this source will be prevented.

On the presumption that a kennel is to be erected, its site is strongly pointed out by Somerville.

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* *Lawrence on Cattle.*

* *Findlater's Survey*, p. 154.

"Upon some little eminence erect
"And fronting to the ruddy dawn, its courts
"On either hand wide opening to receive
"The sun's all-cheering beams, when mild he shines
"And gilds the mountain tops."

But this selection of a high situation is incompatible with a running brook; and as these two advantages cannot be united, water is to be preferred, with the aspect to the *morning sun* as much attended to as possible.

11 The number of its inmates must determine the size of the kennel; and the architecture should be neat, without being uselessly expensive. The most magnificent is the duke of Richmond's at Goodwood, which cost 19,000l. and is sufficiently extensive for two packs of hounds. The building comprises five kennels, two 36 by 15, three 30 by 15, and two feeding rooms 20 by 15 feet, with stoves to warm the air, when too cold. The huntsman and whipper-in have each a parlour, kitchen, and sleeping-room.

The nearer to the house the kennel is placed the better. There are reasons against its too close approach, but they yield to others which forbid a great distance. To mention one, derived indeed from a vulgar saying, "that the master's eye makes the horse fat;" recollect that the inspection of the kennel is even more needful than that of the stable; for in both, cleanliness is no less essential than food.

12 The kennel should be of sufficient dimensions at its first building; room for two kennels should be under the same roof; when there is but one it is seldom sweet; and when washed out, the hounds, particularly in winter, not only suffer during the time of cleaning, but as long afterwards as it remains wet. The second kennel affords opportunity for drafting the hounds intended to hunt the next morning. In a few days they will be drafted with little trouble, will readily answer to their names; and with equal ease as a shepherd numbers his sheep, you may count your hounds into the hunting kennel.

13 In a morning, upon the feeder's first entering the kennel, he should let the hounds into the outer court; the door of the hunting kennel, when not occupied by the drafted hounds for that day's hunting, should be opened in bad weather to shelter them; the lodging-room should then be thoroughly cleaned, the windows and doors opened, the litter well shaken, and the kennel made sweet, before the hounds are again shut into it. Every omission prejudicial to the hounds should be immediately pointed out to the feeder, who must be made to remedy it; and also observe that the *great court and the other kennels* are equally objects of his attention.

4 The lodging-room should be bricked, and sloped on both sides to the centre, where should be a gutter to carry off the water, that when washed, the floor may be equally dried: but flag-stones, or large square bricks termed *pammonds*, are far preferable; there are fewer interstices, and consequently less filth or water can there accumulate, and the surface is sooner dry. Let the floor be kept in thorough repair, that no water may remain in any cavity, until the mason can be had, when at any time wanted; let the stagnant water be carefully stopped up; for nothing is more hurtful to hounds, than *damp*, or more refreshing than *warmth* after hard work.

215 Doors. The kennel should have three doors; two in front, and one behind; that in the back to have a lattice window in it, with a wooden shutter, which is to be kept always close, except in summer, when it should be left open the whole of the day. This door has a twofold utility, it serves to carry out the dirty straw, and being opposite to the window, will admit a thorough air, when the lodging room is cleaned, which will much contribute to render it sweet and wholesome. The front doors will be useful in drying the room when the hounds are out; and as one is to be shut and the other hooked back, so as to allow a single dog to pass, they are not liable to any objection. The large centre window should have a folding shutter, which at night, according to the weather, may be wholly or partially closed; and thus the *warmth* of the kennel may be regulated as is judged most salutary. The two great lodging rooms are exactly similar, and having a court belonging to each, are distinct kennels situated at the opposite ends of the building. In the centre of the boiling-house and feeding-yard, a lesser kennel, either for hounds that are drafted off, hounds that are sick and lame, or for any other required purpose, is on each side; at the back of which, it being but half the depth of the two larger kennels, are places for coals, &c. for the use of the kennel. There is also a small building in the rear for hot bitches.

216 Inner court. The inner court floor should be bricked or flagged, and sloped towards the centre like those of the lodging-room; and water brought in by a leaden pipe, should run through the channel in the middle. In the centre of each court is a well sufficiently large to dip a bucket for the purpose of cleaning the kennel. To keep these from wanting repair, they should be faced with stone, and to that of the feeding-yard a wooden cover should be fixed. The benches, which must be open to let the urine through, should have hinges and hooks in them all, that they may fold up when the kennel is washed. They should be made as low as possible, that when a hound is tired, he may have no difficulty in jumping up, and at no time be able to creep under them. Recollect that if, owing to the smallness of the hound, as in beagles, it should be difficult to make the benches sufficiently low, it will be proper to nail a ledging projecting downwards in the edge, or the benches may be faced with boards at the bottom, to prevent hounds from creeping under.

A large bricked court in front, having a grass court adjoining, and a brook running through the middle of it, completes the kennel. This court should be planted round, and also have some lime trees and some horse chesnuts near the centre for shade. Some posts bound round with straw, rubbed with galbanum, may be placed so as to prevent the hounds from making water against the trees. The brook may be used as a cold bath for hounds lamed, in the stifle, in strains, or for other purposes for which the cold bath is required. A high paling should inclose the whole, and which, to the height of four feet, should be close, the remainder being open, with an interval of two inches between the pales. At the back of the kennel should be a thatched house, fenced at the sides, to contain at least a load of straw, a a pit for receiving the dung, and a gallows for the flesh. If a piece of ground adjoining to the kennel can conveniently be enclosed, for keeping such horses as may be brought alive for the use of the hounds, it would be of great service, as the disorders of condemned horses are not always ascertained; and an opportunity may thus be offered of investigating their nature and progress, which may prove advantageous in future similar cases. The hounds may also be brought into this field, to empty themselves after feeding; and the draught for the next day's hunt can be here made with greater accuracy than when they are confined to the kennel.

Stoves are used in some kennels; but a good feeder, and the mop properly applied, render them unnecessary. Should ticks prove troublesome at any time, the walls of the kennel should be well washed; and if that should fail to destroy the ticks, they must be white-washed with lime.

217 When the hunting season is over, one kennel will be sufficient, and the other with the grass-yard adjoining to it may be allowed to the young hounds. This separation, which should continue till the season commences, is necessary for preventing many accidents that might otherwise happen at this time of the year. Should there be conveniencies, it will be proper to keep the dogs separate from the bitches during the summer months. When hounds are very riotous, the feeder may sleep in a cot in an adjoining kennel; if the dogs are well chastised at the first quarrel, his voice will afterwards be sufficient to keep them quiet *.

## CHAP. II. *Of Diet.*

218 Diet. IN preserving the health of domestic animals, much will depend on the quantity and quality of their food, and on the manner in which they are supplied with it. This subject, therefore, requires some share of our attention. We have already, in the article AGRICULTURE, treated pretty much at large on the different kinds of food that are most proper for horses, sheep, and cattle; and have here little to add on that head. Our principal object in this chapter will be, to consider the best means of dispensing food to the different classes of domestic animals, and to describe what are considered the most beneficial methods of preparing the food in those cases where its preparation appears to be necessary.

219 Food of horses. The natural food of the horse is the simple herbage of the field, and on it alone he can be constantly kept in a high state of health and vigour, so long as he shall not be required to labour; and whilst he is employed in labour, grass in some form, either dried or green, seems absolutely necessary for his maintenance in a healthy state. Hay, straw, and corn of various kinds have been, from the earliest time, the common food of horses; but in Britain, and indeed in France and Germany, during the later periods especially, they have rejected all other species of horse corn, from a well-grounded preference in favour of oats and beans; the latter for draught horses chiefly, or as substantial auxiliaries to the oats, imparting as strong a nourishment as the constitution of the horse will properly bear, and at the same time of a cleansing nature; and are, moreover, the best and cheapest in-door fattening for almost all domestic animals.

The species of corn usually given to horses in many countries is barley, the bulky provender is straw, both of which, in warm climates, are said to be nearly equal in nutriment to our oats and hay. With us, barley is apt to scour horses, and make their urine red, especially at its first being given. Wheat is often given to horses of the great upon the continent. It is said when Philip of Spain was in this country, his jennets were fed upon wheat during the time of scarcity, and this gave great umbrage to the people.

There seems to exist no particular difference of quality between the white and the black oats, they being equal in weight and thinness of husk; these criteria, and their being short, are the best marks of their goodness. It is equally well known that they should be some months old when used, as new oats are apt to swell the belly and produce gripes.

221 Beans. New beans are improper for horses, for the same reason. The best remedy is to dry them in a kiln. Old beans should be split, and given either with bran or chaff; or the best way would be to break them in a mill. Mr Lawrence fed cart-horses with beans for nearly seven years, without experiencing any ill effect from such food; but the horses laboured very hard. Beans contain more solid nourishment than oats, but of a less salubrious nature.

Grains constantly loosen a horse, and impoverish his blood; bran scours and weakens the entrails; both of them are good occasional dietetic alteratives.

222 Carrots. Carrots are said to purify and sweeten the blood, to amend the wind, and to replenish after the wastings occasioned by disease or inordinate labour. Mr Lawrence informs us that he has been accustomed to use them for years in all forms, and to all descriptions of horses. They are either given in spring or autumn to high fed horses, as a change of diet, at the rate of one feed per day, in lieu of a feed of corn, or as full subsistence to others. They ought to be washed clean, and, if large, cut into flat and sizeable pieces. The quantity of carrots for a feed is from half a peck to a peck.

223 Time of feeding. The usual periods of feeding with corn are in this country, morning, noon, and night. The quantities each time either a quarter or half a peck, with or without about two handfuls of beans, according to the horse's state of body. Much greater care than is common ought to be taken in sifting the oats clean from dust, and the dung of mice. Water should be allowed without fail twice a day. There is an error not unfrequent among stable people, who suppose water to be at best but a kind of necessary evil to horses, and therefore think it a point gained whenever they can find an opportunity to abridge the quantity. But how well soever a horse may shift with little or no water while in the field, and while feeding on succulent meat, much mischief may ensue from its being withheld; and this may produce costiveness, gripes, inflammation of the bowels, perpetual longing, and a danger of drinking to excess on every opportunity.

224 Hay. The well known use of hay is to dilate the body of the horse, to satisfy his appetite with bulk and quantity, as corn does with compact and solid nourishment. British hay, the best in the world, contains great nourishment,

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* *Daniel's Rural Sports*, vol. i.

nourishment, and will keep a horse and even fatten him; but he is unable to labour upon hay alone, and experience has shewn that Bracken's observation of the constant use of hay injuring the sight of horses, particularly if suddenly put on such food after good keeping, is very just. Hard upland hay is the best for race and coach horses; and it should be of a fine greenish colour, fragrant scent, and full of flower. It is said that horses and cattle prefer such hay as has been sweated, or which has undergone a partial fermentation: and it is even thought that they grow much sooner fat on heated hay than on such as has been gotten up dry and cool. There can be no doubt that sweated hay contains a considerable quantity of sugar, formed during its state of fermentation; this may render the hay more palatable to the beasts, but we have some doubt whether it be so wholesome as fresh well-coloured hay. Clover-hay, and hay of artificial grasses, from its grossness, is appropriated to cart-horses. Without attempting to ascertain the precise quantity, it may be said that hay should be given as often as a horse has a keen appetite for it; but great care should be taken that so much be never allowed at once, as that he shall leave it, and blow upon it. At night a considerable quantity of hay is usually left in the rack, and this is no doubt absolutely necessary for horses who are hard worked during the day, as night is their most leisure time for feeding; but it admits of doubt whether horses who live in a state of luxury, and are but little worked, should be indulged in much hay at night *.

25 It will obviously occur to most people, that the quantity and quality of a horse's food should be proportioned to his labour: that horses who are lightly worked, will not in general require so much or so nourishing food, as those who are constantly kept to hard labour. It is evident that when horses stand idle, and are at the same time high fed, they are exposed to many dangerous diseases, as inflammation, staggers, arising from a too full habit of body; and these diseases will be more likely to come on when a horse that has been thus fed is suddenly put to hard labour, or obliged to make any unusual or violent exertion. But this must not be carried too far. Horses should not, because they have little work at the time, be entirely confined to grass, or grass and hay, unless they are at pasture, and are never worked. For while a horse stands in the stable, and is liable to be called upon on any emergency, his diet should be so regulated, as that he shall neither be so fat and full of blood, as not to perform occasional work without difficulty and danger, nor, on the other hand, so poor and weak as to be incapable of supporting exertion without injury to himself or rider. All horses that are fed on grass and hay alone, are too weak to perform a good day's journey without stumbling. A moderate quantity of corn or other hard food, should therefore be allowed to such horses as stand constantly in the stable, or who, while at pasture, are occasionally worked.

26 Mr Clark observes, that throwing great quantities of clean grain before horses at one time is very improper; as they eat it too greedily, and swallow whole mouthfuls of it almost dry. The moisture in the stomach, or water drunk immediately after eating, causes the grain to swell, and thus the stomach is greatly distended, and loses its contracting power on the food. By the pressure of the full stomach on the intestines, the passage of the food backwards is obstructed, and the confined air, arising from the indigested food, not having a ready passage backwards, and horses not possessing the power of belching, the air becomes rarefied to a great degree, the horse is seized with colic pains; as these increase he becomes convulsed, and in many cases the stomach bursts. Out of a number of cases where the above was discovered on dissecting the bodies, Mr Clark mentions the two following.

"A young draught-horse was fed in the morning with too great a quantity of barley mixed with pease, and had been allowed to drink water immediately thereafter. He was yoked to a two-wheeled chaise, in order to travel a few miles, and was observed about the middle of the day to be very uneasy, frequently attempting to lie down. As soon as he was unyoked he lay down and tumbled about, frequently lying on his back, starting up suddenly and turning his head towards his belly. He continued thus in great agony till towards next morning, when he died. Upon opening his body, the stomach was found burst, the barley and pease mostly entire, only greatly swelled, and the whole contents of the stomach spread through the abdomen.

"The other case was a horse who had been fed with too great a quantity of oats and barley, and had been allowed to drink water freely afterwards. He was seized with griping pains, so that he frequently lay down and tumbled, seemingly tortured with the most acute pains. He died next day. Upon opening his body, the stomach was found distended to a most enormous size, but was not burst. Its coats were so very thin, from the great distention it had undergone, that its cohesion was almost destroyed, and had more the appearance of a coat of mucus or slime, than the stomach. The oats and barley were for the most part entire as they were swallowed, only greatly swelled from the moisture they had imbibed.

"From the cases now related, it will appear how necessary it is not to allow horses to eat too great a quantity of clean grain at a time, but to give it in small quantities, and repeated the more frequently. At the same time, it will show the propriety of mixing with it a little chopped straw, or hay, in order to make them chew it the more thoroughly before they swallow it. This process also prepares the food for being properly digested, and not a single grain of it is lost *."

The method of feeding horses with bruised grain and oat straw is recommended by the earl of Pembroke, in his excellent treatise on horses, as exceedingly proper. "Every grain (says he) goes to nourishment: none is to be found in the dung; and three feeds of it go further than four as commonly given which have not been in the mill. But wheaten straw, and a little hay sometimes mixed with it, is excellent food. To a quantity of corn, put the same quantity of straw. It obliges them to chew their meat, and is many other ways of use †." 227 Cut straw.

Mr Lawrence disapproves of the use of straw, as containing no nourishment. In this he probably goes too far, as both horses and cattle are in straw-yards often fed with little else. He prefers chaff, or cut clover hay, to mix with the corn, especially for cart-horses. Mr Lawrence, however, allows that cutting

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* *Clark on Prevention.*

† *Military Equitation.*

up unthrashed oats for food is a good practice, particularly when hay is scarce; as thrashing and dressing of the oats are thus saved, and it is an economical expenditure of the oats, which are moreover very fresh, and agreeable to the horse.

228 Of grinding corn for horses.

It has of late been recommended to bruise the corn in a mill, before giving it to the horse, and it is certainly a good practice, as there is thus little danger of its passing through the bowels undigested. It is usual only to bruise the corn, but Mr Lawrence thinks that it is better to grind them as fine as possible. Whole corn, with whatever it may be mixed, will, much of it, be swallowed in that state; a great deal only half masticated, which will elude the digestive powers of the animal, and be ejected from his body crude and unbroken. This is particularly the case with the brood-mares and young stock, the bellies of which are full of slippery grass; such should ever have ground corn, and mashes should always be made with it. Ground buck-wheat agrees well enough with horses, but that species of corn is the least substantial.

229 Lawson's food for horses and cattle.

Mr Lawson, a merchant of London, has lately published an essay, on the use of Mixed and Compressed Cattle Fodder, intended as food and fattening for horses, oxen, sheep, and hogs. His plan is, to grind, cut, mix, and compress, all the articles in present use, as food for cattle, with some additional ones of his own recommending; and to keep the mass stowed in casks, or other close stowage. He gives a detailed account of all the instruments necessary in the process, the most commodious methods according to his practice, and various tables of expence and quantities.

With respect to the drink of horses, we have little to remark. Their water should be as pure as possible, as muddy and hard water is not only very unpleasant to the horse, but probably lays the foundation of gravelly complaints. It is a very absurd custom, which is however very prevalent, to gallop the horse after watering, with the view, according to the groom's idea, of warming the water in his belly; for if the horse has drunk heartily, as he is very often improperly allowed to do, any violent exertion immediately after cannot but occasion great uneasiness. It is, however, a good practice to ride the horse moderately before watering; but care should be taken, not to throw him into a perspiration, as drinking cold water in this state is attended with considerable danger.

230 Food of cattle.

The feeding of cattle is of considerable importance to the farmer, and has of late been much improved. Both the food and the manner of administering it must be different according to the age of the cattle, the season of the year, and the purposes for which the cattle are fed.

It has been well observed in a late useful practical work, that in the winter the yearlings should "be fed with hay and roots, either turnips, carrots, or potatoes; and they should be thoroughly well fed, and be kept perfectly clean by means of litter. At this age it is a matter of great consequence to keep such young cattle as well as possible; for the contrary practice will inevitably stop their growth, which cannot be recovered by the best summer food. If hay is not to be had, good straw must be substituted; but then the roots should be given in greater plenty, and with more attention. To steers and horses two years old, the proper food is hay, if cheap, or straw, with baits of turnips, cabbages, &c*."

Mr Donaldson thinks the advantages of green winter food for live stock, so great, that there is no way in which it can be applied with greater benefit than "by giving the young cattle a daily allowance during the first two or three winters." Whenever straw is employed as fodder for young stock, without the above sorts of food, if it be not very good, or slightly mixed with some grassy material, a little hay should always be blended with it, in order that it may be preserved in proper condition. It is also of consequence that the animals be served with this sort of fodder, in a regular manner, as where too much is given at a time, Mr Marshall has remarked, that they do not thrive so well.

The following observations of Sir John Sinclair merit every attention.

231 Sir John Sinclair's remarks.

"Some intelligent graziers recommend the following mode of feeding and fattening cattle. Suppose there are four inclosures of from six to ten acres each, one of them should be kept quite free from stock till the grass has got up; and then the prime or falling cattle, should be put into it, that they may get the best of the food: the second best should then follow; and the young store after all, making the whole feed over the four inclosures in succession, as follows.

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| 1st Inclosure. | *Free from stock, till ready for the best cattle.* |
| 2d ditto. | *For the best cattle till sent to N° 1.* |
| 3d ditto. | *For the second best till sent to N° 2.* |
| 4th ditto. | *For the young cattle till sent to N° 3.* |

N° 4. is then kept free from stock till the grass gets up, and it is ready for the prime cattle. The proper size of inclosures has never yet been ascertained by experiment; probably from 10 to 30 acres is the best; but the size should be various, as small ones are better calculated for grass, and large ones for corn. Probably the best plan to adopt is to feed cattle entirely in the house, or *soiling* them as it is technically called. In that case, small enclosures must be preferred, as the shelter they afford is extremely favourable to the growth of the herbage.

232 The larger a bullock is, he must take the more food to support him. It is desirable to change his food often, and to give him frequently, but little at a time, which makes him more eager to eat. After his kidneys are covered with fat, he will take less meat every week. It is better, therefore, to ascertain the quantity he eats, by the week, than by the day.

233 Fatting cattle, to be sold immediately from the farmer's house, and not sent to market, should be kept moderately warm. If kept too hot it makes them perspire, and their skins to itch: this vexes them, and they rub themselves against any wall or post within their reach, which is much against quick feeding. Currying and combing them are useful practices; and washing them at least once a week, is of great service. Bleeding is now exploded as an old and unnecessary practice.

234 In some parts of the kingdom, the whole attention of the farmer is dedicated to suckling, or, in other words, to feeding calves, for supplying the market with veal. In Essex, this plan is reckoned more profitable than the dairy, and next to grazing. But the profit there must depend much upon the immediate neighbourhood of

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* Dickson's Agriculture, vol. ii.

of that country, to so great and certain a market as London.

235 Essex mode of rearing calves.

The particulars connected with this branch of rural economy, will, it is probable, be fully detailed, in the improved Agricultural Survey of Essex, in so far as regards that and the neighbouring districts. But as the mode of suckling, adopted in some parts of Scotland, is extremely different, it may not be improper to give a short account of it in this place. As soon as the calf is dropped, it is put into a box made of coarse boards, four feet and a half or five feet long, and four feet, or four feet and a half high, and about two feet wide, according to the size of the calf. The boards are not put so close but that a sufficient quantity of air is admitted; light is, however, carefully excluded; and the box has a cover for that purpose. The box stands on four feet, which, at one end, are four inches high, but at the other, only two inches; and, as there are holes at the bottom, all wetness is drained off. The bottom is also covered with straw or hay, which is changed twice a-week. For seven or eight days, milk is but cautiously given, for unless a calf is fed moderately at first, it is apt to take a loathing to its food. It should be bled in about ten days; and afterwards, as much milk given it fresh from the cow, either twice or thrice a-day, as it will take. The bleeding should be repeated once a-week; and at all times when a calf loathes its milk, and does not feed well, bleeding ought to be repeated. These frequent bleedings prevent diseases from plethora, to which calves are subject, even when not fed so high, and still more so when they are. A large piece of chalk should be hung up in the box, which the calf will lick occasionally: this contributes nothing to the whiteness of the veal; but it amuses the animal, and corrects that acidity in the stomach which might otherwise be engendered, and which certainly often takes place. A cow calf is reckoned the best veal; if a bull calf is suckled, he ought to be cut when about a week old, otherwise the veal will neither be so good nor so white. By this mode of treatment calves are kept clean, quiet, warm, and dry; the veal they furnish is excellent, and they are soon ready for the market; and, on the whole, it seems to be preferable to the practice of stupifying them with spirits, or with laudanum, so common in other places where a different system is pursued.

The supposed necessity of beginning to feed oxen at an early age, is a great objection to their being generally used, as they are hardly trained properly to work, before it is thought necessary to fatten them, after which they do very little work; but, in consequence of the improved mode of fattening by oil-cake, &c. there is no difficulty to fatten oxen, even at twelve years of age, which is a material circumstance in their favour†."

236 Mr Hunter's feeding byre.

It is now very generally understood, that the more cleanly and comfortable cattle are kept, and the cleaner and better the order in which their food is presented to them, the better they will thrive, and consequently the sooner they will fatten, and the heavier they will be. With these views, and with the additional view of saving a greater proportion of the dung and urine of the cattle than is usually done, so as to increase the quantity of manure as much as possible, a byre has been constructed by Mr Hunter of Blackness in Forfarshire, which has been found, on trial, completely to answer the ends proposed. The byre consists of two apartments, an inner apartment or byre for feeding the cattle, and an outer apartment or barn for containing the turnips and fodder.

At the proper season when the turnips are completely ripened, and the turnip feeding commences, the turnips are gathered together on the field in large quantities, and two or three men with coarse turnip knives made from old scythes, cut off the whole of the roots, carefully cleaning the turnips at the same time, from any earth which may adhere to them. The turnips are then carted to the turnip barn, the door of which is wide enough to allow the carts to back in, and throw them down. Here the men with their turnip knives are again ready immediately to cut off the whole green tops or shaws of the turnips, and these green tops are immediately given to cows, young winterling cattle, sheep, &c. who readily eat them when fresh. The turnips, now quite clean, are piled up in one end of the barn like cannon balls, and will keep in excellent order for months together. Should the winter storm set in, a small quantity of clean dry straw laid over them, will effectually preserve them from being injured by the frost. The other end of the barn receives the straw and litter for the use of the byre. The advantages proposed to be derived from this method of treating the turnips are, 1. The preservation of a great many of the best turnips, which, if allowed to remain on the field during winter, are unavoidably spoiled by the effects of the weather, and the alternate operations of snow, rain, and frost. 2. The green tops being cut off fresh and good, are immediately consumed, in place of being entirely lost if allowed to remain on the field. 3. It saves much labour and trouble, both to men and horses, to lay in a stock of turnips at once, in place of going to the field every day, whether good or bad, and when, as the fields are necessarily wet and soft, the horses, carts, and harness, are severely strained, and the fields poached and cut up.

Lastly, By having a couple of months supply of turnips in the barn, you are never under the necessity of using frosted turnips, which are often little better than lumps of ice. And even if you should not incline, or find it convenient, to lay in so large a stock of turnips at once, still you can take the advantage of any good fresh day, as it occurs, to add to your stock of turnips in the barn.

At right angles to the turnip barn, stands the feeding byre, constructed as follow. At the distance of about three feet and a half from the great side wall of the byre, there are constructed on the ground, in a straight line, ten troughs for feeding ten large cattle; these are of hewn pavement on all sides, and at the bottom; and they are divided from each other by divisions or bridges, likewise of hewn pavement. These troughs are so constructed, that there is a small and gradual declivity from the first or innermost, to the last and outermost one; and the bridges separating them, being made with a small arch at the bottom, a pail or bucket of water poured in at the uppermost, runs out at the undermost one, through a stone spout passing through the wall, and a sweep with a broom, carries off the whole remains of the turnips, &c. rendering the whole troughs quite clean and sweet. The whole food of the cattle is thus kept perfectly clean at all times.

In a line with the feeding troughs, and immediately over

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† *Farm. Mag.* vol. iii. 163.

over them, runs a large strong beam of wood, from one end of the byre to the other, which is strengthened by two strong upright supporters to the roof, placed at equal distances from the ends of the byre, and the main beam is again subdivided by the cattle stakes and chains, so as to keep each of the ten oxen opposite to his own feeding trough and stall.

The three and a half feet of space betwixt the feeding troughs and outer wall of the byre, lighted at the farther end by a glazed window, is the cattle-feeder's walk, who passes along it in front of the cattle; and, with a basket, deposits before each of the cattle the turnips into the feeding trough of each.

To prevent any of the cattle from choking on small turnips, or pieces of large ones, as they are very apt to do, the chains at the stakes are contrived of such a length, that no ox can raise his head too high when eating; for in this way, it is observed, cattle are generally choked. However, in case it still should happen, that an ox chokes on a turnip, the cattle-man, or feeder, is provided with a ramrod, made of a piece of strong stiff rope, with a small round polished wooden head at the end of it; this he introduces into the mouth of the ox, and so gently knocks the turnip down his throat without either difficulty or danger to the animal. That the cattle-feeder may be always at hand to attend his cattle, a small apartment with a window in it, in which his bed is placed, is constructed immediately off the corner of the byre, so that he is ready, even in the night-time, in case of any accident happening, to give assistance.

At the distance of about six feet eight inches from the feeding troughs, and parallel to them, is the dung groop and urine gutter, neatly and substantially built with hewn stone. Here too, like the troughs, there is a gradual declivity from the inner and upper to the outer and lower end; so that the moment the urine passes from the cattle, it runs to the lowest end of the gutter, whence it is conveyed through the outer wall of the byre in a large stone spout, and deposited in the urinarium outside of the wall. At this place is a large inclosed space, occupied as a compost dung-court. Here, all sorts of stuff are collected for increasing the manure; such as, fat earth, cleanings of roads, ditches, ponds, &c. rotten vegetables, &c.; and the urine from the byre being caused to run over all these collected together, which is done very easily by a couple of wooden spouts moved backwards and forwards to the urinarium at pleasure, renders the whole mass, in a short time, a rich compost dunghill; and this is done by the urine alone, which in general is totally lost. The dung of the byre again is cleaned out several times each day, at the two front doors of the byre opposite to the groop, and deposited in the dung-court; so that in this way, too, the byre is kept in as good order as any stable, and the cattle as clean as horses. Along the edge of the dung-court, a few low sheds are constructed, in which young beasts, sheep, or swine, &c. are kept; and these consume the refuse and remains of the turnips from the great feeding byre.

In the side wall of the byre, and opposite to the heads of the cattle, there are constructed three vents, or ventilators; these are placed at the distance of about two feet four inches from the ground in the inside of the byre, and come out immediately under the easing of the slates on the outside. The inside openings of these are about 13 inches in length, seven in breadth, and nine in depth in the wall; and they serve two good purposes. 1. The breath of cattle being specifically lighter than atmospheric air; the consequence is, that in some byres, the cattle are kept in a constant heat and sweat, because their breath and heat have no way to escape; whereas, by means of the ventilators, the air of the byre is kept in proper circulation, which conduces as much to the health of the cattle as to the preservation of the walls and timber of the byre, by drying up the moisture produced from the breath and sweat of the cattle, which is found to injure those parts of the building *.

237 London mode of feeding cows.

The method of giving cows their food by the milk-farmers in the vicinity of the metropolis, where this business is carried on upon the most extensive scale, is thus stated in the valuable Agricultural Survey of that district. "During the night, the cows are confined in stalls; about three o'clock in the morning, each cow has a half-bushel basket of grains; when the milking is finished, a bushel basket of turnips is given to each cow; and very soon afterwards they have an allotment, in the proportion of one buss to ten cows, of the most grassy and soft meadow hay, which had been the most early mown, and cured of the greenest colour. These several feedings are generally made before eight o'clock in the morning, at which time the cows are turned into the cow-yard. About twelve o'clock they are again confined to their stalls, and served with the same quantity as they had in the morning. When the afternoon milking, which continues till near three, is finished, the cows are again served with the same quantity of turnips, and about an hour afterwards with the same distribution of hay, as before described. This mode of feeding generally continues during the turnip season, which is from the month of September to the month of May. During the other months of the year they are fed with grains, cabbages, tares, and the other foregoing proportion of second-cut meadow hay, and are continued to be fed with the same regularity until they are turned out to grass, when they continue in the field all night; and even during this season they are frequently fed with grains."

As the grains employed in feeding cattle cannot always be procured fresh as they are wanted, it becomes a desirable object to preserve them for a length of time. They are preserved in some places by putting them into pits dug in the earth, into which they are trodden down, and afterwards covered to a moderate depth with dry earth. In this way being defended from the action of the air, and thus prevented from fermenting, they may be kept for a considerable time during the months of summer, when brewing is not carrying on; they may also be kept by pressing them down into casks placed upon stands, so as to elevate them a little from the ground, and having their bottoms pierced with holes, to carry off the superabundant moisture.

### *Food of Dogs.*

238 Food of dogs.

A good feeder is very essential. He should be young, active, industrious, and good tempered, for the sake of the animals entrusted to his care, who, however they may be treated by him, cannot complain. He must strictly obey any orders that his master may give, both

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* See Farm. Mag. vol. iii. p. 8.

both with regard to the management and to the breeding of the hounds, and he must not consider himself as solely under the direction of the huntsman. This is a necessary hint, as it has sometimes happened that a pack of hounds apparently belonged entirely to the huntsman, when the master had little more authority over them than if he were a perfect stranger.

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On the exquisite sense of smelling, so peculiar to the hound, our sport entirely depends; care must therefore be taken to preserve it, and the surest method of doing so is, to observe the utmost cleanliness; to keep the kennel sweet, is a point that cannot be too much recommended, and which must on no account be neglected. This must therefore be inculcated on the feeder, and the proprietor should see that his orders in this respect are carefully observed.

40 ege- food. 41 meal.

Oat meal is by far the heartiest and best food; for hounds will run more stoutly with that, than on any other meal, or than even on oat meal mixed with any other. In point of expence, as well as for the greater benefit of the hounds, the most advantageous method is to grow one's own oats, and have them properly dried, and broken at the mill into meal that is not too fine. A sufficient quantity should be ground, to serve for 12 or 18 months consumption; the older the meal, so much the better; but unless it is kept by one, there is scarcely any mode of procuring it sufficiently old. It should be kept in bins, in a dry granary, and the meal should be trodden into the bins as closely as possible. Should there be no granary near, sugar hogsheads will answer the purpose, but the meal must be pressed into them very firmly, and it must be kept dry. These hogsheads should be placed upon stands, like beer stands, by which means vermin will be prevented from getting at the meal unobserved.

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Barley meal is used in many kennels, being cheaper than oat meal, but it is said to be much more heating and less nourishing; or as the huntsmen express themselves, there is less proof in it.

13 of ring ood.

It is well known that the principal animal food given to hounds, is the flesh of horses, which should be boiled. The boiler employed for this purpose should be made of cast iron, and its size should be in proportion to the number of hounds in the kennel. The flesh must be thoroughly boiled, and must then be taken out of the broth with the strainer, and a proper quantity of oat meal must be put into the broth. When this has been boiled sufficiently, which will require from three quarters of an hour to an hour, the fire may be withdrawn. As it cools, it thickens into a pretty firm jelly, and for hunting hounds it cannot be too strong. Five or six pecks of good oat meal will be sufficient to make a boiler of broth that will furnish 30 couple of hounds for two feeds sufficiently thick. Some are of opinion that oat meal and barley meal in equal quantities make the best food for hounds. The oat meal is to be first boiled for half an hour, the fire is then to be extinguished, and the barley meal put into the copper, and both mixed together. The reason for not putting both kinds of meal into the boiler at the same time is, that the boiling which thickens the oat meal, makes the barley meal thin. When barley meal alone is used, it should not be put into the boiler at all, but should be scalded with the hot liquor, and mixed up in a large tub, capable of containing at least half a hogshead. We must however remark, that barley meal should never be given by itself to hunting hounds during the hunting season, as its heating quality renders them exceedingly thirsty; and when out, they take every opportunity to lap water.

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The meat should never be given to the dogs too hot, and should be mixed up to as thick a consistence as may be. The feeding troughs should be wide at the bottom, and have wooden covers, and they should not be made too long; five or six troughs that are easily moved, are better than two or three that are unwieldy.

The boiling for the hounds, mixing of the meat, and preparing it for them at proper hours, will of course be taken care of by the huntsman. He must constantly attend the feeding of the hounds, who should be draughted according to the state they are in at the time. Some hounds are better feeders than others, and some require less meat than others; a nice eye and great attention are required to keep them all in equal flesh. This is what constitutes the merit of the huntsman, and shews him to be well qualified for his office; but few are sufficiently attentive to this. The hounds are fed in a hurry, without examining them before they begin. To ascertain properly the condition of a pack of hounds requires no small circumspection.

245 Mode of administering it.

The huntsman should call each hound by name, letting him in to his food as he is called; this uses them to their name, and teaches them obedience. A hound should always approach him who calls on him; and if he touches him with a stick, he should follow wherever he is led.

The thin and tender feeding hounds being first turned out to the feeding room, will have the opportunity of picking where they choose. Such hounds as are in low condition, had better be drafted off into a separate kennel. Thus selecting those that are poor, we proceed to the feeding of the rest with less trouble and more accuracy; but those that are drafted off, when more flesh is mixed with the meat, must be let in to feed one by one as they answer to their names; or they may be better fed than taught. Thus the hounds who want flesh, will all have a share of it; and if any of them be much poorer than the rest, they should be fed again, as such hounds cannot be fed too often. Unless peculiarly good, a soft washy constitutioned hound will scarcely ever be worth the attention that is given him; and after a hard day is frequently unserviceable for some time. It must be recollected, however, that such hounds as are tender, or lean feeders, cannot be fed too late, or with too rich meat. Should any hounds appear to get too fat, they must not be suffered to eat their fill, but the rest may eat as much of the meat as they please.

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Once a week, or fortnight at most, during the hunting season, the hounds should have a pound of sulphur given them in their meat; and when the season is over, they should have half a pound of antimony added to the sulphur, and well mixed with the meat. On these days, the hounds should all be let in to feed together, and such as require flesh, have it given to them afterwards. Greens boiled in their meat once-a-week, is likewise proper. A horse killed and given to hounds whilst warm, after a very hard day's hunting, will make an excellent meal, but they should not hunt again till three days after it. The bones broken are good food for poor hounds, as there is considerable nourishment in them.

Sheeps trotters are also very sweet food, and in a scarcity of horse flesh, bullocks paunches may be employed with advantage.

247 It is customary with some to shut up the hounds for two hours after they have returned from hunting, before they are fed, and the other hounds are shut up with them to lick them clean; but probably this practice does more harm than good, as the idle hounds will disturb the tired dogs more by their licking, than this will make amends for. Besides, hounds shut up on their return from hunting, will not afterwards readily quit their benches, as, if much fatigued, they will seek repose rather than food. It is therefore a better way when the hunt is nearly over, to send forward a servant to see the meat prepared, that the dogs may be fed immediately on their return. If they have had a severe day, they should be fed again afterwards. When hounds are fed twice, they should be kept separate from the hounds that were left at home, till after the second feeding, and it will be still better if they are not put together till the next morning. It is the best plan to feed the hounds that have been out twice. Some hounds will feed better the second time than the first, and besides, the turning them out from the lodging house refreshes them, and allows them to stretch their limbs; and if the kennel is cleaned out, and the litter well shaken up, they will afterwards settle themselves better on their benches. It is at all times proper, after feeding, to turn out the dogs into the grass court, as this contributes very much to the cleanliness of the kennel.

## Chap. III. *Of Exercise.*

248 Exercise. Nature dictates the necessity of exercise to almost every animal, and a greater or less proportion of it is necessary to enable them to perform their functions with health and activity. The proportion requisite for this purpose is, however, not the same in all animals. Sheep and cattle require but little exercise, much of which, indeed, appears to be incompatible with the manner of their eating; for, as they require a second mastication of their food by rumination, a considerable time is necessary for this process, which cannot be properly performed unless the animal be entirely at its ease. It is found, however, that such of these animals as are kept without exercise, or are wholly cooped up in houses, for the purpose of fattening them more speedily, are neither so healthy, nor afford such fine and wholesome meat, as those which are permitted to rove at large in their native pastures. It is to the horse and dog that exercise seems the most essential. These animals require the greatest proportion, and are most injured by the want of it. The observations we are about to make will chiefly apply to the horse.

Such horses as are constantly employed in active labour have, of course, sufficient exercise; but it often happens that those which are kept by gentlemen, for their pleasure or convenience, are, when their labour is not required, permitted to stand whole days in the stable, without any other exercise than being ridden perhaps twice a-day to a neighbouring pond. In cities and large towns, even this exercise is often not permitted them. They are in the mean time plentifully fed with rich hard food, and thus pampered, they are rendered liable to the attacks of many acute diseases; and when their exertions are required, they cannot perform their usual labour with their usual ease. It is therefore necessary that such horses as are not regularly worked should receive daily a moderate proportion of exercise, and should be accustomed to such a degree of labour as may counterbalance the effect of high feeding, and enable them to undergo occasional exertion. A horse who is kept in the state of regular labour, is said to be in *wind*. The exercise of a horse that is not constantly worked should not, however, be excessive, or be carried beyond the commencement of fatigue, as this would wear out the horse without necessity. It is an absurd practice which some people pursue, to send out their horses every day to be galloped and rattled along the roads, or perhaps over the streets, for the purpose of keeping them in wind. This is wrong, even where the horse is in good health and sound condition; but when it is practised with sinew-strained, or foundered horses, as is not uncommon, it must be productive of considerable mischief.

In general, two hours a-day will be sufficient for the purpose of preserving the health of the horse, and this may be taken at once or twice in the day, as may be most convenient. If possible, the owner should ride his own horse on these exercising jaunts, for the groom will probably do the horse more injury than benefit.

Some horses require more exercise than others. Gentlemen's horses that are merely kept for light riding, will do with but little; but hunters and racers require a greater proportion, and should seldom have less than three hours a-day. This, however, must depend in a great measure on the quantity and quality of their food, as the food and exercise must in general be proportioned to each other; but in all cases care must be taken that the horse's labour do not exceed his strength. Young horses are not equal to much exertion, and should therefore be exercised but lightly. Many horses have been destroyed by the neglect of this precaution, especially in the army, where it is not unusual to receive horses as recruits of four or even three years of age. These horses, when they reach the regiment, to which they are probably brought from a considerable distance, are in general weak and in low condition, and are probably suffering from some acute disease, brought on them by exposure to cold and wet during their journey. They are of course very unfit for labour, and require at least three or four weeks rest, before they can with propriety be brought to go through their exercises in the riding school. According to Mr White, however, they are seldom allowed the half of that time, but are brought too hastily into the school, without reflecting that, as they are unaccustomed to such exercises, or indeed at that early age to any kind of work, it must become exceedingly fatiguing to them; and to young horses in a state of debility, especially if they are not immediately attended to, when brought sweating from the riding school, such labour must often be followed by the worst consequences.

When a horse cannot be conveniently taken out to the fields or roads, for the purpose of exercise, expedients have been thought on to exercise them within the stable, or in a yard adjoining. The stable can answer for this purpose only when it is very large, and he may then be made to trot backwards and forwards till

till he begins to sweat, with some advantage. We have heard of the governer of a certain town, who fell on a good expedient to exercise the horses of a large body of cavalry that had been received into the town, just before the enemy laid siege to it. As there was no possibility of riding out the horses, he caused a number of the troopers to stand about the horses, two or three at each horse, and whip them so as to make them fly from one side of the stall to the other, till both men and horses were sufficiently heated. It is said that by this means the horses were kept in a pretty good state of health, whereas they would otherwise have been much diseased.

When a horse comes in from work in a profuse perspiration, he should not be suffered to stand to cool at the stable door, but should rather be walked gently about if the weather will permit of it, or else be tied up in his stall with a cloth thrown over him. If he is in a violent sweat, it is a good practice to stroke off the sweat with a sharp-edged stick, as is usually performed on race horses immediately after running the course. If he is much fatigued, it will also be not amiss to give him a little strong beer, a small draught of which will considerably refresh him. The French commonly give wine in these cases; but their wine is very weak, and is probably not so wholesome for horses as our ale.

It is very common with the drivers of coaches, and many grooms, to throw cold water over the legs of horses, when they come to the end of their journey, sweating and fatigued. Some even ride them into the water on these occasions, or throw it over a great part of their body. This is a very dangerous practice, and gives occasion to several diseases of the legs, joints, and feet. It is more especially to be avoided when the horse has been long sweating, as when in this state he is too much weakened to bear the shock of the cold water with impunity. When a horse is overheated without much sweating or fatigue, the practice would probably not be attended with danger, and bathing him with cold water at that time would perhaps be even beneficial, especially if he were immediately rubbed dry, and covered with a light cloth. But as it is difficult to hit this nice point, this practice must be employed with caution, and should never be trusted to the indiscriminate prudence of a groom or coachman. The instances of horses having been plunged into cold water when overheated, without sustaining any injury, are easily explained from the above remark.

M, Lafosse makes the following remarks on the exercise of horses. "A horse on a journey may travel five hours at a time, if not hurried onwards; a manege horse one hour; a cavalry horse may manœuvre two hours; a coach horse, at a slow pace, six hours. But it is proper that saddle horses should not be overloaded, and that the load of a horse in harness should be in proportion to his strength, in order to perform those proportions of labour, to establish which is a difficult point; all depends on quickness. We will say generally, that a saddle horse, well formed, and muscular, may thus carry at a slow rate, two-thirds of his own weight, and run in a chaise with double and one-half of his weight. It is easy to see from this, that the load of a saddle horse should be less if he is put on the trot, and less still if he is made to gallop. The draught horse, on the contrary, lightens his load by speed, which, however, he cannot long continue without tiring, and being out of breath.

"The disorders which proceed from hard work are, founder, fret, and most inflammatory diseases. There are others that proceed from sudden transitions from heat to cold, or, on the contrary, such as inflammation of the lungs, colds, glanders, rheumatisms, and dropsy of the breast. These are particularly frequent and dangerous to cavalry horses. They have existed at all times; but the present system of manœuvres renders them much more common than formerly; they are a species of endemial disorders, which alarm many regiments, and make them dread the consequences. But there can be no doubt they may be avoided in a great degree,

1. By taking no horse into a regiment under four years old, and those only which are well formed.
2. By giving them forage of good quality.
3. By airing them in the stable, and
4. By avoiding to put them in a sweat, which is a state contrary to nature. This forced perspiration dries up and impoverishes the blood, spoils the finer fibres, the vessels lose their reaction; hence the stagnation of the humours, which produce tumours and farcy. It would be advisable then to avoid accidents after a repetition of military exercises, by walking the horses quick, and afterwards slowly, until they have regained their natural warmth. By this means a repercussion of the humours may be avoided. For the same reason, a horse should neither be watered, fed, or dressed, while sweating; on the contrary, if he must be put into the stable, take off the saddle, rub him down with straw, and cover him with a cloth *."

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* *Veterinarian's Pocket Manual*, p. 11.

## PART V. VETERINARY MATERIA MEDICA.

IN treating of the substances employed in the cure of the diseases that affect domestic animals, we shall first describe the usual forms in which they are administered, with the most approved methods of exhibiting each, in the various cases to which they are applicable. We shall then enumerate the remedies themselves, arranged under certain heads or classes, as is usually done by writers on the materia medica; for the sake of bringing together under one view, those articles which are suited to the same purposes. We shall not at present, however, describe the articles made use of, as most of them are employed in general medicine, and a particular account will be given of them in the article MATERIA MEDICA. Our object here will be to point out the doses required for the animals of whose diseases we are about to treat; and the particular cases to which they are adapted. To each class we shall subjoin a number of receipts to which we shall have occasion to refer, when we come to the treatment of the diseases.

250 Forms.

The most usual forms in which medicine is exhibited, to horses and cattle, are those of powder, ball, drench, clyster, ointment, poultice, and fomentation.

## POWDERS.

251 Powders.

There are not many substances which admit of being administered in form of powders; for as it is necessary to mix these with the food of the animal, they must of course be composed of such articles as do not impart to the food any very strong or disagreeable taste. These substances chiefly given in the form of powders are antimony, sulphur, nitre, and some of the aromatic seeds, &c. They should be reduced to the finest powder, and should be thoroughly mixed with the corn or bran that is placed before the animal. Those powders which do not readily dissolve in water, such as antimony, sulphur, and the powder of seeds, should be moistened before mixing with the food, as in this way less of the medicine will be wasted. Emetic tartar, and all articles that require to be given in a small determinate dose, cannot properly be administered in this form.

In giving powders mixed with the food of horses, much will depend on the delicacy of the animal's taste, and on the state of his stomach at the time. Some horses will readily take their food mixed with medicinal powders, while others refuse every article offered to them in this form. When this is the case, or when the medicine thus administered appears to disagree with the animal's stomach, this mode of giving it must not be repeated; but the medicine must be administered in some other form.

Powders are also sometimes used externally either to sores and ulcers, or blown into the eyes.

## BALLS.

252 Balls.

The form of ball or bolus is one of the most common in which internal medicines are administered in farriery. It is extremely convenient, as there are very few articles that do not admit of being given when mixed up into a ball; as they are, from the peculiar conformation of the animal's throat, more easily administered than any other form that can be given by the mouth. Some articles, however, especially such as easily evaporate at the usual temperature of the air, as ether and volatile alkali, and such as speedily liquefy or deliquesce by exposure to a moist atmosphere, are not so properly given in the form of balls. Substances, too, which require a very large dose, do not easily admit of this form, and are best given in infusion, or mixed with water in the form of a drench.

It is best to prepare balls as they are required, or at least not many days before they are needed, as by exposure to the air they become hard, and do not easily dissolve in the stomach; they may even pass through the bowels nearly unchanged. But what is of still more consequence, giving a hard ball may endanger the animal's life, by its sticking in his throat. Mr White says, that he has known several instances of horses being destroyed in this way. Sometimes the horses jaws are so narrow as not to admit of introducing the hand between them. In this case, the ball may be fixed lightly on the end of a stick or cane, moderately pointed; or what is still better, placed loosely in a kind of cup fixed on such a stick or cane; and thus thrust to the back of the throat.

253 Mode of admin-is-ing ba

The ball should be made not round, but nearly of the shape of an egg, and rather less in size. The mode of administering balls to horses requires some dexterity. To give a ball with ease, the operator should extend his fingers so as to surround one end of it, while the whole hand and the thumb opposite to the finger that surround the ball must be contracted into as small a space as possible, as the smaller the hand the greater will be the ease with which the operation is performed, both to the farrier and the horse. The animal's mouth is usually kept open by means of an instrument called a *balling iron*, that is formed like a ring, with an opening sufficiently large to admit the hand, and which is covered with cloth, and placed between the horse's jaws; thus preventing him from shutting his mouth, or hurting the operator with his teeth. When the ball is held in this way, in the right hand, the tongue of the animal is to be drawn out with the left hand towards the left side, and the ball is to be adroitly placed beyond the root of the tongue, and immediately on quitting the ball, the tongue is to be let go, and the horse allowed to raise his head. The ball is now in such a situation that it cannot be thrown back, and will be gradually swallowed. In holding the tongue it is proper to keep it pretty firmly against the lower jaw, as this position greatly facilitates the operation. Balls are usually wrapt up lightly in paper, to prevent their disagreeable taste, but the paper should be very thin and delicate, that it may easily give way when the ball enters the stomach. Wafer paper, which is employed for administering boluses in the human subject, would be an improvement in farriery, which may be easily adopted, as it is by no means expensive.

When the balls are composed of very hot or stimulating ingredients, it is proper to give the horse drink before administering them. It is best to give the drink first, as horses in particular will not readily drink after receiving a ball. If the ball has been composed of any medicine that possesses a corrosive quality, or is otherwise very irritating, as arsenic, corrosive sublimate, blue vitriol, or the like, it is necessary to give the animal, previous to the operation, a considerable quantity of some mucilaginous drink, as of water-gruel, or linseed tea.

When a ball is properly administered, it gives the animal very little fatigue, and may be repeated much more frequently than any other form of medicine. It is therefore extremely convenient.

The ingredients composing a ball should be mixed up with some sugary substance, as molasses, honey, or extract of liquorice softened in water, rather than with any gummy or mucilaginous substance, as these latter soon become hard by exposure to the air.

When a number of balls of the same kind are made at once, great care should be taken in mixing the ingredients in the most accurate manner, otherwise a much greater quantity of the active part of the medicine will be found in some of the balls than in others.

Though we have mentioned the use of the balling iron, in administering balls to horses, some grooms and farriers are very expert in giving the ball without this instrument.

instrument. Where this can be done, it is certainly preferable, as the use of the iron is very apt to alarm a horse.

### DRENCHES.

254 Of drenches. This form is chiefly suited to those remedies that are easily soluble in water, or which readily mix with that fluid, and which have not any very disagreeable taste. Hence all mucilaginous substances, some resins, and many of the aromatics, may be given in this form. It is proper, in compounding a drench, that the substances composing it be thoroughly mixed with each other. It not unfrequently happens, that oils or balsams are given by way of drench, without any pains having been taken to combine them fully with the watery part of the medicine; and when substances that would admit of being finely powdered, are administered in this way, the carelessness of grooms or farriers is too often such as to give them in a very coarse state. In the former case the oil or balsam swimming in the liquid hangs about the mouth and throat of the animal, and by its unpleasant taste renders him averse to the repetition of the medicine; in the latter case, it is evident that the remedy is not reduced to that state in which it is capable of exerting its full effect.

255 Mode of administering. Drenches are usually administered by means of a horn, which is that of an ox or cow, with the larger end cut into the form of a spout. Sometimes when a horn is not at hand, a bottle is employed; but this is very improper, as in the horse's struggling, which often happens in administering a drench, the neck of the bottle may be broken, and occasion much mischief.

In giving a drench by means of the horn, the animal's tongue is to be held down with the left hand, as in giving a ball; and when his head is sufficiently raised, the drench is to be poured cautiously into his mouth. Every stable should be provided with a drenching horn.

In preparing drenches, farriers almost always make use of ale or beer, as the menstruum or diluent; but this is often very absurd, and can be proper only in the preparation of cordial drenches. Those of a cooling nature should be mixed, either with common water, or with some mucilaginous infusion.

Drenches are seldom given with dexterity, and thus a considerable quantity of the medicine is frequently spilt. This circumstance renders them often very inconvenient, particularly in cases where there is any swelling or painful affection either of the mouth or throat. Under such circumstances it is scarcely advisable to administer medicine in the form of a drench; as, independently of the resistance given by the horse, which will certainly waste much of the medicine, the forcing of a drench down his throat, when it is in an inflamed or irritable state, may be followed by very unpleasant consequences. Mr Clark says that he has frequently observed a simple solution of nitre in water, sweetened with honey or molasses, when given in cases such as we have described, to occasion violent coughing, trembling and panting, insomuch that the poor animal was like to drop down, merely from the acute pain he suffered, from a medicine being administered to him in the form of a drench at such a critical period.

Even the position in which the horse's head is placed to receive a drench may, in these cases, excite the most violent pain, from the distention which the muscles of the throat undergo, when the head and tongue are held in so awkward a situation.

The great advantage of a drench is, that remedies exhibited in this form produce their effect much more speedily than when given in the form of a ball, which may take a considerable time to be dissolved in the juices of the stomach. Drenches are therefore particularly suited to urgent cases, in which it is necessary to give immediate relief.

### CLYSTERS.

256 Of clysters. This form is suited to a great variety of purposes, and is not administered so often as with propriety it might be given. Not only purges, which are very commonly administered in this way, but also every class of remedies, may be exhibited in the form of a clyster. The clyster should be composed of no substances that are not either entirely soluble in water, or may be so thoroughly mixed with any watery fluid, as to pass readily through a slender tube.

The instrument employed for administering a clyster is, as in the human subject, a pipe and bladder, but the bladder should be that of an ox, and of the largest size; to the extremity of which must be fitted a pewter pipe about a foot long, and about half an inch in diameter, having the extremity which is to enter the gut made completely smooth, that it may not injure the internal coat of the bowel.

257 Back-raking. Previous to administering a clyster, it is often necessary to free the great gut from a quantity of hardened excrement which it may contain. This is best performed by means of the hand, and the operation is called *raking*, or *back-raking*. The hand is easily introduced, as the diameter of the great gut is in the horse very large. Care must be taken before introducing the hand, to grease it well with oil or hogs lard, and to have the nails cut perfectly close, for fear of injuring the gut. This mode of extracting the hardened excrement is frequently required, and will succeed when medicine would probably only serve to increase the animal's distress.

258 Large syringes are frequently employed for the purpose of administering clysters; but such instruments are exceedingly improper, as their tubes are very short, and they are very difficult to manage, especially if the animal should prove restless from pain, as frequently happens in cases of colic; where, as we shall see, clysters are very frequently required.

Clysters are peculiarly requisite in those cases where medicine cannot be conveniently given by the mouth; as in locked jaw, or when there is any obstruction in the throat, or wound of the tongue. In such circumstances horses may frequently be kept alive for many weeks, by the frequent exhibition of nourishing clysters.

### OINTMENTS.

259 Ointments. Ointments are employed in farriery, merely as an application to sores, or in some cases of eruptions of the skin. They cannot be employed as in the human body, to introduce remedies into the system; as on account of the hair that covers the body of quadrupeds,

long-continued friction in this way cannot easily be employed.

### Poultices.

260 Poultices. Poultices are frequently employed, either for the purpose of maintaining a long-continued heat and moisture about a part in which we are desirous to produce suppuration, or for correcting the unpleasant smell that sometimes arises from foul ill-conditioned ulcers; or, lastly, they are applied to check inflammation. In the first case they are always applied warm, and should be renewed repeatedly, till the proper effect is produced; as if old poultices are suffered to remain long on a suppurating part, they tend to check the suppuration instead of assisting it. In the two latter cases poultices are usually applied cold.

Poultices should always be composed of such substances, as admit of being reduced to a soft mass, either by boiling or pounding, as otherwise they would fret and irritate the parts to which they are applied. This must be particularly attended to in such poultices as are laid over large open ulcers, or any part that is highly sensible.

### Fomentations.

261 Fomentations. These are intended to relax and soften the parts to which they are applied, and in this circumstance they nearly resemble the first kind of poultices, only that fomentations are always in a liquid form, being composed of some infusion or decoction of herbs. The mode of applying a fomentation is, by wetting a large flannel cloth in the warm liquor, wringing it slightly, and then applying it as warm as can easily be borne over the part to be fomented.

262 In the following list of the articles of the veterinary materia medica, we shall call the substances by those names by which they are usually known to the common people; but we shall add by way of synonyms the scientific names, as derived from the modern systems of natural history and chemistry. In fixing the doses of each article, we shall, unless particularly mentioned to the contrary, only specify the dose proper for horses and cattle; but it would be proper for the reader to keep in remembrance, that the dose for a sheep or a dog will be about one-half or one-third of that for a horse or cow.

In classing the remedies we shall adapt the arrangement given in a late compendium of the materia medica. Most writers on the materia medica of horses, have arranged their articles in alphabetical order. Mr White has done this, in his excellent veterinary materia medica and pharmacopeia. Such an arrangement does very well, if intended to answer the purpose of a dictionary; but for practice, it is better to have the articles classed according to the sensible effects which they appear to produce in the system; as in this way the practitioner has before him all those remedies that are of the same nature, and may select from among them such as he thinks will best suit the particular case that he has in hand.

It may be necessary to observe, that the weight intended in this part is troy weight divided according to the apothecaries, and the measure English wine measure.

### 1. Emetics.

263 It will have appeared from our description of the stomach of the horse, that this animal is in general incapable of vomiting. Emetics, therefore, as calculated for him, form no part of the veterinary materia medica. We do not know that emetics are given either to sheep or cattle, but to dogs they may be often given with advantage. A few substances, however, will answer this purpose, as in general a little grass, or a little mustard mixed with warm water, will be sufficient to vomit a dog. The following substances may be ranked in this class for dogs.

*a.* Antimony. *Sulphuret of Antimony.*

Emetic Tartar. *Tartrate of Antimony and Potash.*

Dose from two to four grains.

*b.* Antimonial Powder. *Oxide of Antimony with Phosphate of Lime. James's Powder.*

Said to have been given with success in the distemper.

Dose from eight to ten grains, repeated every three or four hours, according to the evacuation produced.

*c.* Mercury.

Turbith Mineral. *Yellow Sulphate of Mercury.*

Used also for the distemper, and in cases of recent poisoning.

Dose about half a drachm. Also recommended in canine madness.

### *Receipt.*

1. Take of turbith mineral, five grains;
   And emetic tartar, one grain.
   Give in a little milk after bleeding.

### 2. Expectorants.

These are remedies that are calculated to produce or keep up a discharge of mucus from the lungs, or windpipe, and are thus suited to relieve coughs and thickness of wind or asthma.

*a.* Ammoniac. *Gum Ammoniac.*

A gum-resin. Dose from three to five drachms, in the form of a ball. Commonly combined with squill, or some other powerful expectorant, preceded by a purging medicine. Particularly suited to chronic coughs.

*b.* Asafoetida. *Ferula Asafœtida.* Lin.

A gum resin; dose about half a drachm, in a ball.

*c.* Balsam of Peru. *Myroxilon Peruiferum.* Lin.

Dose from one to two drachms in combination in a ball, assisted with other expectorants. In chronic coughs.

*d.* Balsam of Copaiva. *Copaifera balsamum.* Lin.

Dose about an ounce, in the same form and cases as the last.

*e.* Balsam of Sulphur.

Dose from half an ounce to an ounce.

ateria edica.

*f.* BARBADOES TAR. *Petroleum Barbadense.* Lin.
Employed sometimes in chronic cough; but not so good as other expectorants.

*g.* GARLIC. *Allium sativum.* Lin.
The cloves of the root beaten to a paste; dose from one to two ounces; made into a ball with liquorice powder, or boiled in water into a drench. In similar cases.

*h.* SQUILL. *Scilla maritima.* Lin.
Dried root powdered; dose about a drachm, in a ball, with other mild expectorants.

*i.* STORAX. *Styrax officinale.* Lin.
Strained storax. Dose two drachms, in a ball. As a substitute for balsam of Tolu, in obstinate coughs.

266 eipts.

*Receipts for Expectorants.*

2. Take of gum ammoniac, three drachms;
    Castile soap, two drachms;
    Powdered squill, a drachm.
  Mix with honey or molasses into a ball.

3. Take of camphor, powdered squill, each a drachm;
    Balsam of copaiva, half an ounce;
    Aromatic powder, two drachms.
  With honey, mix into a ball.

4. Take of balsam of sulphur, 4 ounces;
    Barbadoes tar, two ounces;
    Oil of aniseed, two drachms;
    Powdered liquorice root, enough to make a mass, to be divided into balls, each weighing about an ounce and a half, for a dose.

5. Take assafœtida, half an ounce;
    Powdered ginger, a drachm and a half;
    Prepared ammonia, half a drachm;
    Honey, &c. enough to make a ball.

267 rifics.

## 3. SUDORIFICS.

These are such medicines as are intended, either to keep up or bring back the insensible perspiration, or to excite profuse sweating. They are also called diaphoretics. See MATERIA MEDICA.

Few medicines are employed in farriery with a view to excite sweat. In the dog, it is well known that this effect can scarcely be produced by any means; and in the horse it is found extremely difficult to produce any sensible sudorific effect by means of medicine. This may indeed be excited by violent exercise and warm clothing; but these are ill suited to the cases in which sweating would be most desirable. The insensible perspiration may, however, be gently encouraged by some powerful sweating medicines; and in cattle these may not unfrequently be given with advantage.

*a.* AMMONIA.

MINDERERUS's SPIRIT. *Acetate of Ammonia.*
Recommended by Mr White as a gentle diaphoretic. Dose from eight to ten ounces in form of a drench. In febrile complaints.

*b.* CAMPHOR. *Laurus Camphora.* Lin.
Dose from one to two drachms, in form of a ball. In fevers.

*c.* ANTIMONY. *Sulphuret of Antimony.*
Very commonly given to horses for the purpose of improving the fineness of their coat. Dose about an ounce, in powder, mixed with the food.

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*d.* EMETIC TARTAR. *Tartrate of Antimony and Potash.*
Dose from one to two drachms; in a ball or drench.

ANTIMONIAL POWDER. *Oxide of Antimony with Phosphate of Lime.*
Dose about two drachms.

*e.* UNWASHED CALX or OXIDE of ANTIMONY.
Dose two or three drachms; in composition as below.

*f.* NITRE. *Nitrate of Potash.*
Dose about one ounce in a ball, with one or two drachms of camphor; or alone in a drench.

*g.* OPIUM. *Papaver somniferum.* Lin.
Seldom given alone, though it might probably be administered with great propriety, in doses of two scruples to a drachm.

*Receipts for Sudorifics.*

268 Receipts.

6. Take of nitre, half an ounce;
    Camphor, a drachm and a half;
    Calomel, powdered opium, a scruple;
    Molasses, enough to make a ball. In fever.

7. Take of unwashed calx of antimony, two drachms;
    Camphor, a drachm;
    Opium, half a drachm;
    Compound powder of tragacanth, two drachms;
    Honey enough to make a ball.
  In fever. To be repeated occasionally.

8. Take of emetic tartar, from one drachm to two;
    Compound powder of tragacanth, three drachms;
    Honey enough to make a ball.

9. Take of emetic tartar, a drachm and a half;
    Ginger, two drachms;
    Camphor, half a drachm;
    Opium, a scruple;
    Oil of caraway, ten drops.
    Molasses enough to make a ball.
  For horses that are hide-bound, and have unhealthy-looking coats.

10. Take of antimonial powder, two drachms;
    Caraway seeds, powdered, half an ounce;
    Ginger, a drachm;
    Oil of aniseeds, twenty drops;
    Honey enough to make a ball.

11. Take of unwashed calx or oxide of antimony, two drachms;
    Prepared ammonia, ginger, of each a drachm;
    Opium, half a drachm;
    Powdered aniseeds, half an ounce;
    Molasses, enough to make a ball.

## 4. DIURETICS.

269 Diuretics.

These are remedies that are intended to produce a more than ordinary discharge of urine. See MATERIA MEDICA.

Diuretics are frequently given to horses, not only in cases of dropsical swellings, especially of the legs, but in grease, and in many eruptive diseases; in running thrushes, crack, or ulcers about the heels; in baldness of different parts of the body; and in some cases where there appears to be a difficulty in staling.

They are usually given in the form of balls, but some of them by way of powder mixed with the food. Before exhibiting diuretics, bleeding is sometimes requisite. These cases will be stated in their proper place. It is also proper, during the use of diuretics, that the animal should take regular exercise; and occasional drink should be given to promote their operation. The use of them should not be continued too long, as they are found to produce considerable weakness.

*a*. Balsam of Copaiva. See *Expectorants*.

This medicine, when given as directed under expectorants, frequently acts as a diuretic.

*b*. Camphor. See *Sudorifics*.

Dose about two drachms, mixed with nitre in a ball. In spasmodic difficulty of staling.

*c*. Nitre. *Nitrate of Potash*.

Dose about one ounce, in the form of powder, ball, or drench. In fevers and strangury.

*d*. Potash. *Subcarbonate of Potash*, or *Vegetable Alkali*.

Dose a drachm or two.

*e*. Rosin.

Dose from two to four drachms repeated occasionally, in the form of powder, with the food.

Rosin is a good diuretic in cases of swelled legs and greasy heels, but is seldom given, except to cart-horses.

*f*. Soap. *Castile Soap*.

Dose from two to six drachms, in composition.

*g*. Tobacco. *Nicotiana tabacum*. Lin.

Sometimes given by grooms for fining a horse's coat.

*h*. Turpentine.

- a. Common turpentine.
- b. Venice turpentine. Dose from half an ounce to an ounce; in the form of emulsion.

*i*. Oil or Spirit of Turpentine.

Dose from one ounce to two.

### *Receipts for Diuretics.*

12. Take of Castile soap, powdered rosin, of each three drachms;
    Nitre, half an ounce;
    Oil of juniper, a drachm.
    First beat the soap and oil of juniper together, and then add the other ingredients, to make a ball.

13. Take of nitre in powder, half an ounce;
    Camphor, oil of juniper, of each one drachm;
    Castile soap, three drachms.
    Rub the camphor and oil together, then add the soap and nitre, and as much flour as is sufficient to make it into a ball.

Take of rosin and nitre, each half an ounce.'
Mix into a powder, to be taken with the food.

### 5. Purges.

270 Purges. These medicines are well known. They are generally considered of two kinds; laxatives, or such as gently move the bowels, and are intended merely to empty them of excrement; and purges, or such as, besides this effect, are intended to stimulate the exhalent vessels of the intestines, and produce a considerable discharge of liquid stools, (see Materia Medica). As either order may in general be given so as to produce either of these effects, according to the quantity in which it is administered, we shall consider them together.

Purgative medicines are given with considerable advantage to all the domestic animals, in many cases of disease, which will be pointed out hereafter. They are very commonly, however, given to horses, by grooms and ordinary farriers, by way of alterative or preventive of disease; or in order, as they think, the better to prepare them for some unusual exertion. The reason given for this practice is, that the horse is foul in the body, or full of humours, and the purgatives are given to expel this morbid accumulation of humours.

271 Impropriety of indiscriminate purging in horses. "This sort of evacuation (says Dr Bracken, who is one of the first that pointed out the absurdity of this practice), seems very much to quadrate with the outward senses, and makes the ignorant part of mankind, whose heads are fuller of humours than their horses, imagine that purging medicines carry off the offending matter in most disorders; never considering the general use, which ought still to be kept in mind, viz. that in proportion to any one evacuation being heightened or increased, most or all of the natural evacuations are proportionally diminished."

It must be remembered that the intestines of the horse are exceedingly long, and the large intestines are so constructed as in many cases to retain the food or excrement for a very considerable time. Purgative medicines given to a horse are often retained for 24 or 30 hours; and if these have been of an irritating quality, it is evident that the unnecessary exhibition of them may often produce considerable mischief. Mr Blaine says, that when horses die after the exhibition of strong purges, which according to him is not unfrequently the case, he has always found the large intestines more or less inflamed.

It is found that after giving a horse a strong purge, he is often incapable of returning to his usual work for many days; it is even said for a month. Hence it will easily appear how absurd is the practice of those who physic their horses without necessity. Mr John Lawrence is, however, still an advocate for purging horses now and then, and is of opinion that the mischief done by purges is to be attributed to the coarseness of the medicine, rather than to its purging effect. He declares, that after 30 years experience, he has never known purging do harm, if the aloes employed was of the finer sort.

Veterinary practitioners differ with respect to the time of administering a purge. Mr Blaine recommends it to be given in the morning, when the horse is to be allowed to fast from 9 or 10 o'clock to 12 or 1. Then a lock or two of hay, or about two handfuls, is to be given him, and after this he is to have the ball, with a

horn

horn full of warm ale, or water-gruel, immediately after it. He is then to fast for another hour, when he is to be allowed the moderate use of hay. He should have all his drink a little warm; should be walked about gently during the remainder of the day, and should have a warm mash at night. Next day he is to be again moderately exercised at intervals, till the purge begins to operate; but if the weather is severe, he must be covered with body clothes, and care must be taken not to have the stable too warm when he returns. Mr Clark recommends a mash of bran to be given about an hour before the ball, and says that in this way he has always found the medicine to operate in a gentle and easy manner.

272
Strong exercise before purging improper.

It is a common practice with many people to ride their horses very hard before giving them a purging medicine, with the view, as they term it, to stir up the humours, which being thus set afloat, will more easily be carried off by the purge. To say no more with respect to the absurdity of the doctrine, we may remark that the practice itself is highly dangerous, as a purge administered after such violent exercise, will seldom fail to produce inflammation in the bowels, fevers, or some other disorder, which, though it may not at the time prove fatal, may lay the foundation of blindness, incurable lameness, or some other disorder that may render the horse useless. Violent exercise, after administering a purge, is equally to be avoided, as it may produce sweating, and thus counteract the purgative effect; or, what is as bad, it will tend to increase the weakness that seldom fails to be brought on by purging.

We have been the more particular in our observations on purging horses, as it is a matter of considerable consequence, and as the effect of indiscriminate purging in this animal is little understood.

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*a.* ALOES. *Aloe perfoliata.* Lin.

- a. Socotorine aloes. Dose from five to nine drachms.
- b. Barbadoes aloes. Dose from half an ounce to an ounce.

Of these the latter is commonly employed for horses. It is best given in form of a ball, mixed with soap, as prescribed at present. In most cases where purges are required.

*b.* CASTOR OIL. *Ricinus communis.* Lin.

Dose from a pound to a pound and a half. In fevers and worms. Though Mr White says, he has given it in the latter case without effect.

*c.* EPSOM SALT. See SULPHATE *of Magnesia.*

*d.* GAMBOGE. *Stalagmitis cambogioides.* Lin.

Seldom employed in horses, though recommended by Mr White as a useful medicine in worms.

Dose from two to three drachms, in a ball with Castile soap.

*e.* JALAP. *Convolvulus jalapa.*

Dose in the dog twenty to thirty grains.

*f.* COMMON SALT. *Muriate of Soda.*

Dose from four to six ounces in a drench, or in a larger dose by way of clyster.

*g.* SOAP.

Chiefly used to combine aloes and other purgatives into a ball.

*h.* MERCURY, or *Quicksilver.*

*i.* CALOMEL. *Sub-muriate* or *mild muriate of mercury.*

Dose from one to two drachms, usually mixed with other purgatives.

In liver complaints, obstinate cases of grease, chronic inflammation of the eyes, and dropsical swellings of the hind-legs.

*k.* GLAUBER'S SALT. *Sulphate of Soda.*

Dose about a pound. Best given in the form of a clyster. In fevers, and inflammatory complaints.

*l.* EPSOM SALT. *Sulphate of Magnesia.*

As the last.

*Receipts for Purges.*

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Receipts.

14. Take of Socotorine aloes, five drachms;
Castile soap, half an ounce;
Oil of caraway, ten drops;
Molasses enough to make a ball.
A moderate dose for young or delicate horses.

15. Take of Socotorine aloes, an ounce;
Castile soap, half an ounce;
Calomel, a drachm and a half;
Oil of mint, twenty drops;
Molasses enough to make a ball.

16. Take of Barbadoes aloes, half an ounce;
Compound powder of tragacanth, two drachms;
Salt of tartar, a drachm and a half;
Syrup enough to make a ball.

This is given as a laxative by Mr White, who declares that he never saw any ill result from giving Barbadoes aloes, though Mr Blaine and Mr Lawrence are of opinion, that Socotorine aloes is always to be preferred.

17. Take of water-gruel, a gallon;
Glauber's salt, half a pound;
Oil of olives, or linseed oil, a pint.
To be given warm by way of clyster. In fevers and inflammation of the bowels.

18. Take of powdered jalap, a drachm;
Powdered ginger, half a drachm;
Syrup of buckthorn, enough to make a ball.
For dogs.

### 6. ERRHINES.

275
Errhines.

These remedies are suited to produce a considerable discharge from the nostrils, and with this view are sometimes prescribed to horses in cases of staggers or violent headaches. They must, however, be given with caution, and not till after bleeding and other evacuating means have been used. They are always administered in the form of powder, which is blown up the nostrils, usually through a quill.

*a.* ASARABACCA. *Asarum Europæum.* Lin.

The dried leaves in powder.

The snuff, usually sold by the name of cephalic snuff, is chiefly composed of asarabacca mixed with some aromatic

aromatic herbs, and will answer the purpose of an errhine pretty well.

*b.* Tobacco.
Common snuff.
In affections of the eyes.

### 7. Sialogogues.

276 Sialogogues.

These remedies are given with a view of increasing the flow of saliva or slaver. They are seldom employed in veterinary medicine, though it is probable that salivation might be productive of good effects in the locked jaw, so fatal to horses, and in the *distemper* in dogs.

*a.* Ginger. *Amomum zingiber.*
Sometimes tied about a horse's bit by way of a masticatory, as it is called.

*b.* Mercury.
Calomel is the only mercurial that can properly be employed to excite salivation in the horse and dog; and it will scarcely produce this effect, if given by the mouth. It is best to rub the gums with it twice or thrice a-day, till the proper effect is produced. See Stimulants.

### 8. Emollients.

277 Emollients.

These are such remedies as are calculated either to relax the body, or to abate acrimony. The former are sometimes divided into diluents and relaxants; the latter are usually called demulcents, although diluents are also commonly given to obviate acrimony.

*a.* Barley. *Hordeum distichon.* Lin.
The use of barley as an article of food, has been already noticed. A decoction of it forms a part of most emollient drenches and clysters.

*b.* Chamomile. *Anthemis nobilis.* Lin.
The dried flower. In infusion or decoction by way of fomentation.

*c.* Gum Arabic. *Mimosa nilotica.* Lin.
In powder. Dose two or three ounces or more, by way of a drench.

*d.* Gum Dragant. *Astragalus tragacantha.*
In infusion, so as to form a mucilage. In inflammatory affections of the lungs, bowels, or bladder.

*e.* Hog's Lard.
An ingredient in most ointments and liniments.

*f.* Linseed. *Linum usitatissimum.* Lin.
In infusion, by way of drench or clyster. In purging or scouring.

*g.* Liquorice. *Glycyrrhiza glabra.* Lin.
The root in infusion, or powder.
Seldom employed except to render drenches more palatable, or in powder to mix up balls.

*h.* Marshmallows. *Althea officinalis.* Lin.
The dried root in decoction, by way of drench or clyster. In internal inflammations, or irritation from strong purges.

*i.* Olive Oil.
A principal ingredient in ointments and liniments, and also frequently given by way of drench or clyster.

*k.* Starch.
Very serviceable by way of clyster dissolved in warm water, either to obviate acrimony in inflammation of the bowels, and scouring; or by way of nourishment, combined with a little opium, in cases where food cannot be given by the mouth.

*l.* Warm Bath.
Seldom employed, on account of its inconvenience, although it would be probably one of the best remedies in spasmodic complaints.

### *Receipts for Emollients.*

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19. Take of linseed, four ounces;
Boiling water, three pints.
Infuse for some hours, and add to the strained liquor, of nitre an ounce, honey sufficient to make a palatable drench. For two doses.

20. Take of marshmallow root sliced, four ounces;
Water three pints.
Boil together till the liquor be reduced to a quart, and to the strained decoction add of
Powdered gum arabic, an ounce;
Linseed oil, two ounces;
Honey sufficient to make it palatable. For two doses.

The above decoction, before the other ingredients are added, forms a good emollient fomentation.

21. Take of starch, two ounces;
Water-gruel, two quarts;
Mix for a clyster.
To be given frequently in scouring or purging.
If they are not kept up for a sufficient time, two or three drachms of laudanum must be added.

### 9. Cooling Remedies.

279 Cooling remedies.

These are called refrigerants by medical writers, and it is supposed that they act by diminishing the temperature of the body. See Materia Medica. They are peculiarly suited to cases of fever and inflammation.

*a.* Nitre.
Frequently employed in fevers and inflammations, except those of the kidneys, and in catarrh. Dose about an ounce, dissolved in water-gruel, or some mucilaginous decoction, by way of a drench.

*b.* Sal Ammoniac. *Muriate of Ammonia.*
Externally, as a lotion, against inflammation.

*c.* Spirit of Salt. *Muriatic Acid.*
May be employed as a refrigerant in fevers, when largely diluted with water or water-gruel.

*d.* Sugar of Lead. *Acetate of Lead.*
Employed externally, dissolved in soft water; by way of lotion or embrocation, for strains or bruises; and in the form of a poultice with oat-meal, to check inflammation.

*e.* Goulard's

e. **GOULARD'S EXTRACT**, or *Vegeto-mineral water*,
Is merely another form of the same remedy.

f. **VINEGAR**. *Acetous acid.*
Employed externally in similar cases.

g. **VITRIOLIC ACID**. *Sulphuric acid.*
Useful in similar cases with the muriatic acid, but requires to be largely diluted.

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### *Receipts for Cooling Remedies.*

22. Take of nitre, an ounce;
Emetic tartar, two drachms.
Dissolve it in a sufficient quantity of water-gruel, for a drench.

23. Take of sugar of lead, half an ounce;
Vinegar, two ounces;
Rain-water, a quart.
Dissolve for a lotion.

24. Take of sal ammoniac, an ounce;
Vinegar, four ounces;
Spirit of wine, two ounces;
Soft water, half a pint.
Dissolve for a lotion.

Both these lotions are employed in external inflammation.

25. Take of cream of tartar, two drachms;
Nitre, an ounce;
Water-gruel, a quart.
For a drench in fevers.

26. Take of emetic tartar, a drachm;
Glauber's salt, eight ounces;
Water-gruel, a quart.
In similar cases attended with costiveness.
To be repeated every six hours.

27. Take of extract of lead, half an ounce;
Distilled vinegar,
Olive oil, of each two ounces.
Mix well together, into a liniment.
For sore backs.

28. Take of marshmallow ointment, half a pound;
Sugar of lead rubbed fine, an ounce.
Mix for an ointment.

281 Astringents

### 10. ASTRINGENTS.

Astringents are such medicines as are supposed to produce a degree of rigidity in the muscular fibres, and thus to increase its power of action, or to prevent morbid discharges. Such as are intended to prevent unusual discharges of blood are called styptics. For the action of astringents, see MATERIA MEDICA.

a. **ALUM**. *Supersulphate of Alumina and Potash.*
In powder, from half an ounce to an ounce, in the form of drench or ball.
In purging, diabetes, &c. Externally by way of lotion, or in a fine powder sprinkled on the part. In grease.

b. **BISTORT**. *Polygonum bistorta.* Lin.
The root in powder, from half an ounce to an ounce; or in a larger dose, in the form of decoction, for a drench.

A powerful astringent in cases of purging, and recommended in hemorrhages.

c. **GALLS**. *Quercus cerris.* Lin.
*Nut galls.*
In powder, infused in boiling water as an external application.

d. **IRON**. *Muriate of Iron.*
A powerful astringent, though rarely employed in veterinary practice. It may be given in cases of obstinate purging, or diabetes, in doses of a drachm or two, by way of drench.

e. **JAPAN EARTH**. *Mimosa catechu.*
Improperly called an earth, as it is a vegetable extract. Given in powder, from two drachms to four, in purging and diabetes.

f. **KINO**.
An extract similar to the former, and adapted to similar purposes.

g. **LOGWOOD**. *Hæmatoxylon Campechianum.* Lin.
Extract of logwood. Dose from two to four drachms, in a ball.

h. **OAK BARK**. *Quercus robur.* Lin.
In powder. Dose about two ounces, in the form of a ball. Externally by way of decoction.

i. **POMEGRANATE**. *Punica granatum.* Lin.
The dried fruit in powder. Dose from half an ounce to an ounce. Chiefly given in the scouring incident to horned cattle.

k. **TORMENTIL**. *Tormentilla erecta.* Lin.
The root in the form of decoction, by way of a drench. An ounce or an ounce and a half in three pints of water, boiled to a quart. In similar cases with the last.

l. **VITRIOLIC ACID**. *Sulphuric Acid.*
*Diluted Vitriolic Acid.*
Used externally by way of lotion, in obstinate cases of grease, and to foul ulcers. Not given to the horse internally.

m. **ZINC**.

**WHITE VITRIOL**. *Sulphate of Zinc.*

Chiefly employed externally, in inflammations of the eye, and as a lotion to foul ulcers, and to check inflammation. Seems to have little effect on the horse, but may probably be given to cattle with some advantage in cases of debility.

282 Receipts.

### *Receipts for Astringents.*

29. Take of powdered oak-bark, an ounce;
Powdered ginger, two drachms;
Opium, a drachm;
Solution of glue, enough to make the mass into a ball.
In profuse staling, with a drench of oak-bark decoction after it.

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30. Take of kino, two drachms;
Alum, half an ounce;
Ginger, a drachm;
Castile soap, softened with water, two drachms;
Powder of oak-bark, enough to make a ball.
In scouring or purging.

31. Take of white vitriol,
Sugar of lead, each one drachm;
Soft water, half a pint.
Mix.
For eye-water, in inflammation of the eyes.

283 Strengthening remedies.

### II. STRENGTHENING REMEDIES.

These are commonly called tonics by medical writers. Many of them are astringents, and have been already enumerated.

*a*. GALANGAL. *Maranta galanga*. Lin.
The root in powder; dose about an ounce. In weakness of the stomach.

*b*. GENTIAN. *Gentiana lutea*. Lin.
The root in powder; dose from half an ounce to six drachms.

EXTRACT OF GENTIAN. Dose, a drachm or two, in a ball in composition. In indigestion and weakness of the stomach.

*c*. HORSE CHESNUT. *Esculus hippocastanum*. Lin.
The bark in powder, or its decoction. Dose of the powder about an ounce.

*d*. IRON.

SALT OF STEEL. *Sulphate of Iron*.
Dose about half an ounce. Generally in composition. In similar cases.

*e*. MYRRH.
A gum resin. Dose in powder, from two to four drachms, in a ball. In weakness of the stomach, and general debility.

*f*. OAK BARK. *Quercus robur*. Lin.
Dose in powder about an ounce.
In general debility, succeeding to violent diseases.

*g*. PERUVIAN BARK. *Cinchona officinalis*. Lin.
Dose of the powder from one ounce to two. Seldom employed in veterinary practice on account of its expence. Said to be inferior to many other tonics in the horse.

*h*. QUASSIA. *Quassia excelsa*. Lin.
The wood and the bark of the root. Dose in powder two or three drachms, in a ball, or infused in water by way of a drench.

*i*. BLUE VITRIOL. *Sulphate of Copper*.
Recommended as a powerful tonic, but requires caution in its use. Dose about half a drachm, gradually increased according to its effects. A considerable quantity of drink should be given, either before or after it.
In cases of debility that resist other tonics.

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### *Receipts for Tonics.*

32. Take of powdered gentian, half an ounce;
Ginger, two drachms;
Honey or molasses, enough to make a ball.

33. Take of powdered horse chesnut bark, an ounce;
Myrrh, in powder,
Castile soap, each a drachm;
Water, enough to make a ball.

34. Take of powdered cassia buds, a drachm;
Extract of gentian, a drachm and a half;
Honey, enough to make a ball.

35. Take of powdered oak bark, an ounce;
Aromatic powder, two drachms;
Salt of tartar, a drachm;
Molasses, enough to form a ball.

36. Take of salt of steel, two drachms;
Infusion of quassia, (two drachms to a quart of water) a quart;
Dissolve for a drench.

285 Stimulants.

### 12. STIMULANTS.

These are such remedies as are suited to increase the action, either of the whole circulating system, or of some particular part or organ. They are at present usually divided into *diffusible* and *permanent*, the former being such as produce a considerable stimulating effect, which is soon followed by a degree of quietness or torpor, proportioned to the quantity that had been administered; as wine, alcohol, ether, and probably opium; the other sort being such as produce no very considerable effect, unless repeatedly exhibited for some considerable time.

Most of the stimulants are called *cordials* or *aromatics*; and under this class, we rank those medicines which have been called *carminatives*, or which are calculated to expel wind from the stomach or bowels, *epispastics* or blistering substances; and under this class we may also reckon most of those remedies that are called *alteratives*, or such as are supposed to produce some change in the constitution or habit of body. The stimulating remedies employed in farriery, as in human medicine, are very numerous.

*a*. AMMONIA, or *Volatile Alkali. Prepared Ammonia. Carbonate of Ammonia.*
Dose from half a drachm to two drachms, in a ball newly prepared. In the latter stages of fever, attended with great debility.

*b*. ——— *Spirit of Sal Ammoniac. Water of Carbonate of Ammonia.*
Chiefly used externally.
*Caustic Volatile Alkali. Water of Ammonia.*
Used externally mixed with oil into a liniment, in cases of strains, bruises, and swellings of the back sinews.

*c*. ANISESEED. *Pimpinella anisum*. Lin.
The seed in powder. Dose about an ounce, in a ball.
*Essential oil of aniseseed.*
Dose from half a drachm to a drachm, in the same form. In flatulence and indigestion.

*d*. BALSAM

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*d*. Balsam of Copaiva. See *Expectorants*.
In flatulent colic or gripes.

*e*. Barbadoes Tar.
Externally mixed with oil of turpentine or sweet oil into an embrocation. In strains and bruises.

*f*. Cantharides, or *Spanish fly*. *Lytta vesicatoria*.
Tincture of cantharides. Externally by way of embrocation in similar cases.

Blisters are well known to be those remedies that irritate the skin to which they are applied, so as to raise the scarf-skin into a bladder containing a watery fluid, which is the serous part of the blood. By abstracting this from the general mass of circulation, they produce an evacuation, proportioned to their extent, from the part to which they are applied, and are thus extremely useful in producing a determination of blood from some neighbouring and more important part.

Blisters are of considerable use in veterinary practice. According to Mr White they are very efficacious in dispersing callous swellings, the effects of strains, bruises, &c. Their beneficial effects are very great in removing the inflammation of such parts as are remote from the surface. In inflammations of the internal parts of the foot, they generally give relief when applied to the pastern, especially if the auxiliary remedies are not neglected, such as rasping the hoof, paring the sole, soaking the horny part of the foot in warm water, or by the application of a poultice to it, and administering a purging medicine. For curbs, wind-galls, spavins, &c. no remedy is more efficacious than blistering. It is also productive of salutary effects in inflammation of the internal organs. For instance, when the lungs are inflamed, the determination of blood to the diseased part is lessened by extensive blistering of the sides, and considerable relief is afforded in this way.

By the unskilful treatment of broken knees, a callous swelling is often left in the part, for the removal of which it is always necessary to have recourse to blistering. If blisters are freed from all caustic ingredients, and properly made, no injury to the hair will result from their application; and if one should fail of producing the desired effect, the practice may be followed without danger till that object is attained.

*g*. Blue Vitriol. *Sulphate of Copper*.
Employed externally to foul ulcers, either in solution, or by touching their edges with a crystal of it; to produce healthy granulations. Also in some inflammations of the eye by way of lotion.

*h*. Burgundy Pitch.
As an ingredient in stimulating ointments and plasters.

*i*. Capsicum, or Cayenne Pepper. *Cap. annuum*. Lin.
The dried pod in water.
Dose about a drachm, in a ball, with milder stimulants. In flatulence and indigestion.

*k*. Caraway. *Carum carui*. Lin.
The seeds and their essential oil.
Dose of the oil from half a drachm to a drachm, in a ball, as prescribed presently. In weakness of the stomach, flatulence, and indigestion.

*l*. Cassia. *Laurus cassia*. Lin.
The bark and flowering buds in powder.
Dose, from one to three drachms. Used as an ingredient in many cordial medicines. Chiefly for affections of the stomach.

*m*. Cloves. *Eugenium caryophyllata*. Lin.
The flowering buds.

*n*. Oil of Cloves.
Dose, 20 or 30 drops. In gripes and sickness of the stomach.

*o*. Cummin. *Cuminum cyminum*. Lin.
The seeds and their essential oil.
In a dose of from half a drachm to a drachm, in similar cases.

*p*. Oil of Cummin.
Dose, from half a drachm to a drachm. In flatulent colic.

*q*. Fennel. *Anethum fœniculum*. Lin.
The seeds in powder.
Dose, an ounce or two.

*r*. Ginger. *Amomum zingiber*. Lin.
The root in powder. One of the most useful stimulants, and preferable to most others in veterinary practice.
Dose, a drachm or two. In weakness of the stomach, indigestion, and flatulent colic.

*s*. Grains of Paradise. *Amomum grana paradisi*. Lin.
The seeds. Chiefly employed as a stimulant for cattle, as a cordial.
Dose from three to six drachms.

*t*. White Hellebore. *Veratrum album*. Lin.
The root in powder. Chiefly used externally in blisters, and for diseases of the skin. Formerly employed as a purge for horses, but now deservedly exploded, as by far too violent.

*u*. Horse Radish. *Cochlearia armoracia*. Lin.
The fresh root in infusion or distilled water. In flatulence and indigestion.

*v*. Mercury.
*Calomel*. Dose, from 15 grains to half a drachm. In farcy, glanders, &c.

Wherever calomel or other mercurial preparations are given, the animals should be kept warm, should drink their water a little warmed, and should take regular exercise in dry weather.

*w*. Corrosive Sublimate. *Muriate of Mercury*.
Employed internally in solution, in doses of about 15 grains, gradually increased. In farcy and glanders. Externally by way of lotion, to foul ulcers and eruptions of the skin.

No preparation of mercury seems to produce so great a degree of weakness in the horse as this. Its effects must therefore be carefully watched; and besides the regulations laid down above, the horse must be kept on a more nourishing diet than usual.

*x*. Red Precipitate. *Nitrated Oxide of Mercury*.
Externally to ulcers, either sprinkled on their surface, or

or mixed into an ointment; in which latter form it is very useful in chronic inflammation of the eyes.

*y.* NITRATE OF MERCURY. See *Receipts*, N° 49.

*z.* MINT. *Mentha sativa.* Lin.
The essential oil.
Dose, about a drachm. In weakness of the stomach, &c.

*a a.* MUSTARD. *Sinapi nigrum.* Lin.
The seed in powder.
Externally mixed with water into a paste, or sinapism, in cases of internal inflammation.

*b b.* PEPPERMINT. *Mentha Piperita.* Lin.
The essential oil.
Dose, about half a drachm. In similar cases with mint.

*c c.* PEPPER. *Piper nigrum.* Lin.
Dose, from half an ounce to an ounce, in powder. In flatulent colic.

*d d.* SPIRITS. *Whisky, Gin, or Brandy.*
Dose, from a gill to half a pint. To cattle in the flatulence proceeding from eating too much green food.

*e e.* SALT. *Muriate of Soda.*
Given with good effect to sheep in the rot.

*f f.* TAR.
Commonly given by country farmers to cattle when hoven from clover.

*g g.* TURPENTINE.
*Oil of Turpentine.*
Dose, an ounce or two. In flatulent colic. Externally by way of embrocation. In cases of indurated swellings, strains, and bruises; and for cattle after the bite of the gad-fly.

286 Receipts.

### *Receipts for Stimulants.*

### *Cordial Balls.*

37. Take of caraway seeds powdered, six drachms;
Powdered ginger, two drachms;
Oil of cloves, 15 drops;
Treacle enough to make a ball.

38. Take of powdered aniseseeds, half an ounce;
Turmeric, an ounce;
Powdered cassia, two drachms;
Treacle enough to form the ball.

39. Take of caraway seeds, and grains of paradise, each in powder, three drachms;
Ginger, a drachm;
Oil of mint, 30 drops;
Honey enough to form the ball.

### *Stimulating Ointments and Liniments.*

40. Take of yellow basilicon, half a pound;
Red precipitate finely ground, two ounces.
Mix well together.
For foul ulcers.

41. Take of hog's lard, four ounces;
Oil of turpentine, an ounce.
Melt together on a slow fire.
In similar cases.

42. Take of oil of turpentine,
Oil of olives, each two ounces.
Mix for a liniment.
For strains and bruises.

43. Take of verdigrise finely powdered, an ounce;
Venice turpentine, half an ounce;
Olive oil, an ounce.
Melt the turpentine and oil together, and when nearly cold, add the verdigrise.
For foul ulcers.

44. Take of hog's lard, four ounces;
Bees wax, an ounce;
Venice turpentine, three ounces;
Red precipitate finely ground, two ounces.
Melt the three first together, and when nearly cold, sprinkle in the powder.

This is Mr White's receipt for the digestive ointment, commonly employed by farriers for dressing rowels and ulcers.

45. Take of camphor, an ounce;
Oil of turpentine, two ounces;
Rectified spirit, four ounces.
Dissolve. For old strains.

### *Stimulating Lotions.*

46. Take of blue vitriol, an ounce;
Water, four ounces;
Vitriolic acid, 10 drops.
Mix.
For similar cases, and for the mange.

47. Take of blue vitriol, half a drachm;
Water, half a pint.
Dissolve for a lotion.
In inflammation of the eyes.

48. Take of tincture of opium, two ounces;
Water, six ounces.
Mix for an eye water.
In similar cases.

49. Take of aquafortis, two ounces;
Quicksilver, one ounce.
Dissolve in a gentle heat, taking care to avoid the fumes.

This forms a *nitrate of quicksilver*, and when diluted with a proper quantity of water, is one of the best applications for the foot-rot in sheep.

## 13. ANTISPASMODICS.

287 Antispasmodics.

These are such remedies as are calculated to remove spasmodic affections of the muscles, or convulsive affections, and are therefore frequently employed in cases of locked jaw, epilepsy, &c. Few remedies of this class are used in veterinary practice. Such as are more peculiarly of this nature are mentioned below. They generally consist of stimulants or of anodyne remedies.

*a.* CAMPHOR.
Dose, about two drachms, in a ball combined with opium and stimulants. In locked jaw.

*b.* ETHER. *Sulphuric Ether.*
One of the most powerful antispasmodics.

Dose,

Dose, about an ounce, mixed with a pint of water. This should be given as expeditiously as possible, otherwise much of the ether will evaporate. In obstinate cases of flatulent colic.

*c.* Opium.
Dose a drachm or two. The latter quantity generally in clysters.

Tincture of Opium.
Dose, from half an ounce to an ounce, repeated occasionally. In most spasmodic complaints.

Oil of Turpentine.
Dose, about two ounces. In flatulent colic.

288 Receipts.

### *Receipts.*

50. Take of camphor, a drachm;
Essence of peppermint, two drachms.
Grind together, and add
Of water, a pint;
Ether, half an ounce.
Mix.
To be given immediately.
In violent cramp of the stomach.

51. Take of tincture of opium, an ounce;
Oil of juniper, two drachms;
Dulcified spirit of nitre, a drachm;
Water a pint.
Mix.

52. Take of tincture of opium, two ounces;
Cold water-gruel, a quart.
For a clyster.
To be repeated frequently.
In locked jaw.

289 Anodynes.

### 14. ANODYNES

Are those remedies which are given for the purpose of procuring sleep, or alleviating pain. They are commonly called *narcotics*, and many of them are by most medical writers denominated *sedatives*.

*a.* Fox-Glove. *Digitalis purpurea.* Lin.
Leaves in powder.
Dose, half a drachm, increased gradually according to its effect. In violent internal inflammations and swelling of the legs.

*b.* Hemlock. *Conium maculatum.* Lin.
Leaves in powder.
Dose, about a drachm, gradually increased.

*Extract of Hemlock.*
Dose, about a drachm.
In obstinate coughs attended with irritability.

*c.* Henbane. *Hyoscyamus niger.* Lin.
The leaves in powder, or the seeds.
Dose, about a drachm.

*Extract of Henbane.*
Dose, about a drachm.
A solution of this extract has been found useful, applied to the eye, in chronic inflammation.

*d.* Hop. *Humulus lupulus.* Lin.
The dried cones in powder.
Dose, a drachm or two, in a ball.
The hop has been shewn to be a powerful narcotic, and has succeeded in producing sleep in some cases where opium has failed. It has not yet been introduced into veterinary practice; but we think it deserves a trial, as being much cheaper than opium.

*e.* Opium.
Dose, about a drachm by the mouth, and two drachms in a clyster.

*f.* Poppy. *Papaver somniferum.* Lin.
The dried heads boiled in water, by way of fomentation.

290 Receipts.

### *Receipts.*

53. Take of opium, a drachm;
Powdered aniseseeds, half an ounce;
Castile soap, two drachms;
Molasses, enough to make a ball.

54. Take of camphor, a drachm and a half;
Opium, a drachm;
Ginger, two drachms;
Honey, enough to form the ball.

55. Take of tincture of opium, two drachms;
Decoction of poppy heads, a quart.
Mix for a clyster.

56. Take of extract of hemlock, two drachms;
Peppermint water, half a pint;
Ether, half an ounce.
Dissolve the extract in the water, and add the ether at the moment of exhibition.
For a drench.
In putrid fever, or gangrene.

57. Take of bruised poppy heads, four ounces;
Hemlock leaves green, a large handful.
Boil gently in a gallon of water for about an hour, and strain the decoction.
In wounds and bruises attended with considerable irritability.

291 Worm medicines.

### 15. WORM MEDICINES.

There are few cases in which worm medicines are given in veterinary practice. In the horse they are seldom required, and do not often prove effectual. In the dog, indeed, they have been applied more frequently, and may be used with more probability of success. The remedies of this class are generally of two kinds, either such as are violent purgatives, and in this way expel the worms by the violence of their operation; or, they are such as act mechanically on these animals, irritating and tearing their tender bodies, and thus forcing them to relinquish their situation.

*a.* Castor Oil.
Dose, about half a pound.

*b.* Gamboge.
Dose, two or three drachms in a ball.

*c.* Mercury. *Calomel.*
Dose for a horse, two or three drachms; for a dog, about half a drachm, in a ball with purgatives.

*d.* Salt.

Dose,

Materia Medica.

Dose, from four to six ounces, in a drench, or double the quantity by way of clyster.

Said to have proved frequently successful in expelling worms, when followed by a brisk purgative.

*e.* SAL INDUS.

A salt lately procured from the East Indies, said to be successful in expelling bots from horses; but Mr White thinks that other worms have been mistaken for bots, in the cases where it has been successful.

Dose, about four or five ounces in a drench.

*f.* TIN. *Powder of Tin.*

Dose, about an ounce, mixed with honey.

This promises to be one of the most effectual medicines in cases of tape-worm, that are so common to dogs.

292 Receipts.

*Receipts.*

58. Take of calomel, jalap, each half a drachm;
Honey enough to make a ball.
For dogs.

59. Take of tin powder,
Quicksilver, of each two drachms.
Grind together till they be thoroughly mixed; then add enough of sugar to form a powder, to be made up into a ball with castile soap, softened with water.

60. Take of sal indus, four ounces;
Alum, half an ounce;
Water, a pint.
Dissolve for a drench. For the bots in horses.

293 Chemical remedies.

### 16. CHEMICAL REMEDIES.

Many remedies are given internally, or applied externally, which seem to act merely chemically, either by combining with an acid or alkali, and thus neutralizing it, by checking putrefaction, or correcting the ill smell that is produced by it; or, in external applications, by destroying or corroding the parts to which they are applied. This class will therefore comprehend,

1. All those medicines that have been called *antacids* or *absorbents*, which are given to correct acidity in the stomach and bowels.

2. *Antalkalines*, or those acid substances that are given more rarely to correct alkalescence.

3. *Antiseptics*, or those that are supposed capable of obviating putrefaction.

4. *Caustics* or *escharotics*, which are intended to corrode the skin, or to take down fungous or proud flesh in ulcers.

*a.* ALUM.

*Burnt Alum.*

Sometimes applied to ulcers, to wear down proud flesh.

*b.* AMMONIA.

*Spirit of Sal Ammoniac. Water of Ammonia.*

Dose, a drachm or two, in a drench, for acidity in the stomach and bowels.

*c.* ANTIMONY.

*Butter of Antimony. Muriate of Antimony.*

Sometimes applied to foul ulcers. A violent caustic.

*d.* CHARCOAL.

Given internally in powder, to correct the bad smell in violent purging; and when powdered fine, may be sprinkled on large stinking sores, with the same intention.

*e.* LIME.

*Lime-water.* Dose about a quart, in acidity of the stomach.

*f.* CHALK.

*Carbonate of Lime.*

Dose, an ounce or two.

In violent purging attended with acidity.

*g.* SILVER.

*Lunar Caustic. Nitrate of Silver.*

Employed to eat down proud flesh, or destroy horny excrescences.

*h.* SPIRIT OF SALT. Dose about two drachms, mixed with a quart of water by way of drench.

*i.* VINEGAR.

Given internally as an antiseptic, diluted with an equal quantity of water, or used externally to wash foul ulcers.

*k.* VITRIOLIC ACID.

Dose, a drachm or two, as under spirit of salt.

*l.* YEAST OR BARM.

Employed to make fermenting poultices in cases of stinking ulcers.

294 Receipts.

*Receipts.*

61. Take of prepared chalk, an ounce;
Powdered ginger, two drachms;
Honey enough to make a ball.
In purging attended with griping.

62. Take of purified soda in powder,
Powdered gentian root, each two drachms;
Powdered cassia, a drachm;
Treacle enough to form a ball.
In indigestion, with acidity of the stomach and bowels.

63. Take of charcoal in powder,
Powdered oak bark, each an ounce;
Treacle enough to make a ball.
In violent purging, producing very fetid stools.

64. Take of oat meal,
Powdered charcoal, of each four ounces;
Thin yeast, a sufficient quantity to make a poultice.
To be applied to foul ulcers.

65. Take of aquafortis, an ounce,
Filings of copper, half an ounce.
Dissolve in a gentle heat, taking care to avoid the fumes.
For a caustic, in cancer of the foot. It may be made into an ointment for the same purpose, by mixing with hogs lard.

66. Take of fresh burnt quicklime powdered,
Soft soap, of each equal parts.
Mix at the time of using.
A mild caustic, useful in destroying parts of the skin where necessary.

67. Take

67. Take of corrosive sublimate, half a drachm;
Ardent spirits, two ounces.
Dissolve for a lotion.

Useful as an application to the callous edges of ulcers.

295
Miscellaneous remedies.

### 17. MISCELLANEOUS REMEDIES.

*a*. EGGS. The YOLK.

Sometimes employed among the common farriers as a remedy for broken wind, but appear to be useful only for the purpose of combining oily substances with water.

*b*. ELECAMPANE. *Enula helenium.* Lin.

The root in powder. In the form of ointment for the itch or mange.

*c*. GLASS.

Powdered glass is sometimes blown into the eyes of horses, to remove specks on the cornea.

*d*. LEAD.

*White Lead. White Oxide of Lead.*

Sometimes used by way of ointment in some diseases of the skin.

*e*. DIACHYLON PLASTER. *Litharge Plaster.*

Employed in making charges or strengthening plasters.

*f*. BAYS. *Laurus nobilis.* Lin.

*Oil of Bay.*

Sometimes used in ointments for the mange.

*g*. STAVESACRE. *Delphinium staphisagria.* Lin.

The seeds in powder. Employed to destroy vermin, being sprinkled on the skin.

*h*. ZINC.

*White flowers of Zinc. White Oxide of Zinc.*

In ointment, to sores and ulcers.

*Calamine. Impure Carbonate of Zinc.*

Employed to make the common brown cerate.

296
Receipts.

### *Receipts.*

68. Take of sulphur vivum finely powdered,
Powdered elecampane root, each two ounces;
Hogs lard, enough to form an ointment.
For the mange.

69. Take of sulphur vivum powdered, four ounces;
Salt butter, six ounces;
Train oil,
Oil of turpentine, each one ounce.
Mix well together into an ointment.

These two ointments are useful applications in the mange.

70. Take of hogs lard, four ounces;
Tar, two ounces.
Melt together into an ointment.

Employed to anoint the backs of sheep or cattle, when bitten by the gad-fly.

71. Take of Burgundy pitch, four ounces;
Barbadoes tar, six ounces;
Bees wax, two ounces;
Red lead, four ounces.
Melt the pitch, tar, and wax together, and when the mixture is nearly cold, stir in the red lead, and continue stirring till it is firm.

This is Mr White's receipt for making charges, or strengthening plasters.

In cases of wind-galls and old strains.

297
Impropriety of giving medicines to horses unnecessarily.

Before concluding this part, it will be proper to make a few observations, on the custom that prevails so much among grooms and farriers, of administering medicine to horses, by way of preservatives of health, or preventives of disease. It is very common among these gentlemen to bleed or physic a horse at least twice a-year, viz. in the spring and fall, though he be in never such good health, or good condition; to give him sulphur and antimony now and then *to keep his coat fine;* and to administer a cordial ball, or a dose of *diapente* occasionally to *improve his appetite.* If he is to undergo any unusual exertion, as riding or hunting, it is judged necessary by these sagacious practitioners to prepare him for the work, by bleeding, purging, and sweating below a load of body clothes in a close, hot stable. In pursuing this custom, they indeed only imitate what they practise on themselves on similar occasions. As they deem it necessary to have themselves bled every spring and fall, or once a quarter, to take physic once a-month, and to sweat themselves to make them ride or run more lightly in a jockey match, they naturally conclude that their horses should be treated in the same manner, and should undergo the same preparation.

If an animal is in a perfect state of health, nothing more is required to render him capable of performing the functions for which he is intended. It is only when there appears some derangement of the system, or when the state of the body is such as to threaten the attack of some dangerous disease, that it is necessary to call in the assistance of medicine. We shall soon have occasion to mention cases of this kind, and to shew how the threatened danger is to be avoided. It must be remembered that those substances that are called medicine, are such as produce some effect on the body, that is in general either unnatural, or is greater than what commonly takes place in a state of perfect health. If then we give medicines to an animal in this healthy state, we either excite the organs to some unusual exertion, or we check those exertions that are natural and healthy; and in either case, we must do harm. Besides the custom of giving medicines when they are unnecessary, renders them less efficacious when they are absolutely required, to ward off or obviate any disease. It is found that most remedies, when employed habitually, require to be increased in quantity in order to produce the same effect, and if continued too long they sometimes cease to produce their effect at all. With respect to some remedies, it is found that their habitual use is attended with dangerous consequences. Frequent bleeding tends to produce fatness, and a plethoric state of the body; the frequent use of cordials and astringents stimulates the circulation too much, and produces such a rigidity of the fibres, as lays the foundation of apoplexy, palsy, and other dangerous disorders. It is well known too, that when the action of the stomach is too much excited by the habitual use of stimulants, it in time loses its tone, and becomes incapable of healthy digestion, unless roused by a greater quantity of its accustomed stimulus. It is therefore obvious that when an animal is in perfect health, all that is required to keep him so, is the proper regulation of diet, exercise, cleanliness, and other circumstances that have been mentioned in the fourth part of this article.

298
Case.

We cannot better illustrate the absurdity of the usual methods

methods of preparing horses for a race, than by the following case, which fell under the observation of Mr Clark of Edinburgh. "Two military gentlemen betted their horses to run against each other on the sands of Leith for a considerable sum, and this was to take place three weeks after the bet. The horses were to be ridden by their own grooms. Captain R's was a poney about 13½ hands, Captain M's was a gelding about 15 hands high. Both grooms were bred at Newmarket, and were keen advocates for bleeding and purging, though both the horses had been kept on dry food, and in the best order, and the interval of time for such treatment was very short. This bleeding and purging was in order to prepare them the better for running. Captain M's horse was bled once, and purged twice. Captain R's was bled once and purged once. Both were sweated in the stable with a great load of clothes; and their stables, though separate, were kept uncommonly hot, and closely shut up day and night, though it was in the midst of summer. From this treatment the horses soon lost their appetite, and in the course of eight or ten days their strength was so much exhausted, that they were scarcely able to go through their usual exercise on the sands. In this situation Captain R. considered his bet as lost, and expected nothing less than the loss of his poney, on which he set a high value. Luckily, however, the groom, who was rather corpulent, had put himself under a course of physic, to bring himself down to the proper weight, and was unable to proceed in his plan of purging and sweating the horse. The poney was therefore provided with another groom, and was put under the care of Mr Clark, who, seeing the absurdity of the plan which had hitherto been observed, ordered his clothing to be reduced to a single rug, and the stable windows to be thrown open, to admit the fresh air. The poney soon recovered his appetite; and his activity, strength and spirits were in a great measure restored. Captain M's horse in the meantime was continued under the debilitating regimen. When the race came to be decided, though at starting the odds were considerably in favour of Captain M's horse, yet his opponent won the race with considerable ease.

## PART VI. OF THE DISEASES INCIDENT TO DOMESTIC ANIMALS.

299 In treating of the diseases of domestic animals, we shall class them in two great divisions; in the first of which we shall consider most of those morbid affections which are usually called *local* and *symptomatic*, or in general those simple affections of the several functions, that are most easily understood, and require the least complicated mode of treatment. In the second of these divisions we shall treat of the more complicated diseases, or those in which the whole system is more or less affected, and of which the treatment is more difficult, and in general more precarious.

300 Classification of symptoms. When an animal is diseased, he is affected with some or other of the following symptoms.

301 Of sensation.

### 1. *Of Sensation.*

He labours under too acute sensibility; or,
He is affected with pain or itching.
His sensibility is unusually diminished.
His sense of smelling is more or less impaired.
He hears with difficulty, or not at all.
His vision is more or less impaired.
He is unusually watchful.
His sleep is disturbed; or,
He is unusually heavy and drowsy.

302 Of motion.

### 2. *Of Motion.*

He is either affected with irregular, involuntary motions or spasms; or,
His moving powers are impaired.

203 Digestion.

### 3. *Of Digestion.*

His digestive organs perform their functions too quickly.
His digestion is impaired; or,
He does not digest at all.
He is affected with sickness,
with flatulence, or wind in the stomach and bowels.

304 Of absorption.

### 4. *Of Absorption.*

He is unusually *fat*; or,
unusually *lean*.
He is affected with some watery swelling.

305 Of circulation.

### 5. *Of Circulation.*

His circulation is too rapid; or,
It is too slow; or,
It is irregular.
He has some effusion of blood.

306 Of respiration.

### 6. *Of Respiration.*

His breathing is hurried; or,
It is difficult.
He is affected with cough;
with sneezing,
hickup.
His breath is hot; or,
It is cold.
His skin is unusually hot; or,
It is unusually cold.

307 Of secretion and excretion.

### 7. *Of Secretion and Excretion.*

His secretions and excretions are either unusually copious.
He stales profusely.
He has a purging; or,
His skin is unusually moist.
The secretions and excretions are morbidly diminished.
He stales with difficulty, or not at all.
He is costive.
His skin is unusually dry.

### 8. *Of Generation.*

308 Of generation.

His venereal appetite is excessive; or,
It is morbidly impaired.
He is impotent.

When a practitioner comes to examine one of these animals whose health is deranged, he will naturally inquire into all or most of the above particulars, and they will in general apply to all the four animals of which we are treating. There are some other questions which peculiarly relate to horses, and which it more especially becomes a farrier to ask; as,

309 Enquiries proper to be made by a farrier.

Whether his flanks work.
Whether his ears are cold, or are in constant motion.
In what manner he walks.
Whether he looks earnestly at his sides.
Whether his eyes appear drowsy.
In what manner he carries his head.
Whether he kicks his belly.
Whether he appears desirous to lie down, but afraid to do so.
Whether he sometimes lies down on one side, and then immediately turns to the other.
Whether he lies down and flies up again repeatedly.
Whether he leans upon the manger.
Whether he stands off from the manger.
Whether he paws his litter.
Whether his nose runs.
Whether or not he passes much wind.

It will also frequently be of consequence to ascertain the following particulars.

Whether the horse is usually in a poor condition.
How did the disorder begin?
How long it has continued.
How long it is since he ate or drank.
Has he ever had the disorder before?
If he has, What was usually given him on these occasions?
Does the disorder come on at any particular times?
Has he been observed to pass any worms?
How long has he been bought, and what price was paid for him.
Was he bought of a horse-dealer, or of a private person?
Of a friend, or at the public market?

310 Having ascertained the necessary particulars, it is proper to consider whether the disease is of such a nature as has in general been easily removed; or whether the expence and time of cure will be sufficiently compensated by the value of the horse; for it must be remarked, that in general a horse or other domestic animal is worth no more than the price he would fetch at the public market. Unless, therefore, the animal is a favourite, or has some particular good quality which greatly enhances his value, it may happen that the expence and trouble of cure may amount to more than the animal is worth. In such a case it would be both prudence and mercy to kill him, unless we wish to attempt his cure for the sake of experience. These observations of course equally apply to cases that are generally deemed incurable.

Having found that the disease is of such a nature as to give hopes of a speedy or perfect cure, it will next be proper for the practitioner to consider what is the speediest, safest, and cheapest method of treatment. In particular, he ought to consider whether any immediate remedy be necessary, in order to check the violence of the distemper; more especially whether any immediate evacuation is required, as bleeding, purging, blisters, rowels, &c.

He must also be particular in examining whether the disease be of a contagious or infectious nature, that the affected animals may be kept in a separate place from those which have not been attacked.

311 As the general nature and theory of disease will be considered at large under the medical department of this work, we have only in this article to detail the symptoms as they occur in the domestic animals; to point out the causes and seat of the disease, as far as they have been ascertained by observation and dissection; and to lay down the most approved methods of treatment adapted to these animals. Observations with respect to the theory of diseases would here be out of place, and we shall seldom hazard them, except in some of those specific complaints which appear to attack solely the animals of which we are treating.

312 Classification of the diseases.

It may not be improper to remark, that diseases, like the objects of natural history, have been arranged in two methods. One of these is the natural method, in which they are classed according to their seat or causes. The causes of diseases are the foundation of Dr Darwin's system. In the first section of this part we shall attempt to class the morbid symptoms according to their seat, or the functions which they attack. The other method of arrangement, or the artificial method, is that in which diseases are arranged according to some obvious and remarkable symptoms. This is best calculated for the purpose of recognizing the disease when seen, and is the method employed by some nosologists. The diseases in the second section of this part will be arranged in this way.

## SECT. I.

### CHAP. I. *Of Morbid Affections of Sensation.*

313 Morbid sensibility.

MOST animals are occasionally subject to a morbid increase of sensibility, either of the whole nervous system, or of some particular organ. This morbid sensibility is generally called by medical writers, *irritability;* but this name is improper, as it implies an affection of the muscular parts; whereas the symptom we are now considering is an affection of the nervous system.

Some horses naturally possess a morbid degree of sensibility, which appears by their starting on the sudden approach of any object, by the peculiar tenderness of their skin that makes them wince and tremble under the currycomb, and by the extreme sensibility that they evince at the least touch of the whip or spur. Such horses are in general very active and spirited; but they require a cautious and prudent rider, who must rather endeavour to soothe and encourage them, than use any harsh or violent means.

This increased sensibility is not easily removed by art, but

but generally decreases as the horse grows older. It is best counteracted by living in a large well-aired stable, by being kept on hard coarse food, and by lying with as little litter below him, as is sufficient to prevent him from injuring himself against the pavement of the stable. In dressing him, the currycomb should not be too sharp, and should not be employed too freely.

When excessive sensibility arises from a delicacy and weakness of habit, strengthening medicines will be of use, and cordials may occasionally be employed.

There is a symptom nearly allied to this, which sometimes appears. The animal affected gathers himself together, and brings his four legs as close as possible below him, and creeps as it were all on a heap. This symptom often attends nervous diseases, and severe affections of the bowels. It is generally considered as a sign of great danger, and is not unfrequently the forerunner of mortification.

At the commencement of several acute diseases, especially those of the brain, animals betray an unusual sensibility to the effects of light and sound. When this happens, the place where they are kept should be darkened, and they should be as little as possible disturbed with noise.

314 Restlessness or anxiety.

There is a peculiar *restlessness and anxiety* with which animals are sometimes affected. This is not unfrequently their only complaint, or at least we cannot perceive that they are affected with any obvious or well-marked disease, but it is most commonly a symptom attending violent disorders, especially of the inflammatory kind; and generally preceding the fatal termination of dangerous chronic diseases. Animals thus affected are continually moving about, and often lie down; if they are at liberty, they seek out the most sequestered and gloomy parts of the pasture, and frequently change their place: if they are tied up, they appear to listen to, or observe, every thing that passes round them; they are restlessly attentive to the various objects near them; but although their eyes appear fixed, and wide open, they do not stedfastly regard any object; they are perpetually turning from side to side, and if they feel pain in any part, they often turn their heads mournfully towards it, sometimes groaning or panting. If this state has continued long, the animals become still more restless, are perpetually shifting about, scraping with their feet, or pawing the litter; their ears become cold, and their hairs bristle up.

These latter symptoms are considered as denoting great danger, especially when the animal looks stedfastly at his sides, or stares with his eyes without appearing to take particular notice of any object.

When anxiety appears to be the only symptom, without any signs of inflammation or convulsive affection, it is generally a mark of nervous weakness, and requires cordial and strengthening remedies, nourishing diet, and gentle exercise without labour: but if it is a symptom of some violent disease; it can only be removed by the general treatment of that disease; and in this view, will come to be considered hereafter.

315 Depression of spirit.

316 Fatigue.

Animals are sometimes affected with dejection or loss of spirit. This is not unfrequently the attendant of fatigue brought on by excessive labour or unusual exertion; and is therefore most commonly seen in horses. It appears by the animal's leaning his head on the manger, standing still in the same place, and appearing to move with pain or difficulty. His limbs are stiff, his skin hard and dry, his eyes look sad, he has no appetite for meat; if he lies down, he remains immoveable, or if obliged to rise, immediately falls again when left to himself.

In general, if the fatigue produced be not extremely great, it gradually goes off with rest and quiet, especially if it has been found practicable to employ the means that are presently to be recommended; but if the exertion to which the animal was exposed, has been too great for its strength, the consequent depression may prove highly dangerous, or even fatal. In this state his urine is crude and watery, and, if a male horse, he seems scarcely to have the power of *drawing* for the purpose of making water; and his excrements are dry and scanty. If taken out in this condition, he moves with pain and difficulty, trots slow, or lifts his feet very little above the ground, carries his head very low and his ears depressed over his forehead; he often stumbles, and not unfrequently falls on his knees, and appears very little sensible of the whip or spur. If a horse in this state has any sores or ulcers about him, they become hard, or flabby, assume a dull appearance, and the matter proceeding from them becomes thick and viscid. Rowels very frequently dry up; and if he is affected with any eruption of the skin, this commonly disappears.

To prevent the bad consequences that are likely to follow the state which we have now described, it is proper, as soon as we find a horse much fatigued, to spread a bed of litter for him to rest on: and as soon as possible give him a cordial ball, or drench. The strength of this must not, however, be in proportion to the degree of fatigue or depression, as experience has shown, that when a powerful cordial is given in a state of excessive weakness, it proves too much for the animal, and frequently excites fevers or inflammation. The horse's limbs should be bathed with warm water, and then rubbed throughly dry. After this he should be left to his repose, and if it be not too late at night, he may in a few hours have a warm bran mash. When a little recovered, he must be gently rubbed all over, but especially his limbs, without currying; he should be put upon a nourishing diet, and exercised but little. These means, varied according to circumstances, will in general bring the horse round, unless the symptoms are extremely violent; when they will commonly terminate in fever, or in some chronic disease, especially dropsy.

The train of symptoms which we have been describing, are most commonly the effect of fatigue; but they may arise from other causes. They are more or less the attendants of decay, and they are generally the forerunners of fever or inflammation of the brain.

317 Insensibility, drowsiness.

Sometimes these animals are affected with a great degree of insensibility or torpor; they are heavy and listless; lie much; are not easily disturbed; are inattentive to the objects around them; seem to be insensible to pain, and move heavily and unwillingly. These symptoms require particular attention, as in most cases they denote some dangerous affection of the brain, and are very commonly followed by apoplexy or *staggers;* or by epilepsy; or they are the attendants (especially in sheep) of water in the head. Wherever they are observed to take place in an animal that has been full fed, with little exercise, especially if he appear fat and full of of blood, and the pulse be found full and strong, the eyes red or heavy, there is danger of apoplexy; and the animal should immediately be bled and purged, be gradually put on a lower diet, and use gradually more exercise. These changes must be made by degrees, because too sudden changes may produce the very effects against which we are guarding.

A great degree of torpor and insensibility is often produced by excessive cold, or by being kept long in an impure atmosphere. Where they have taken place from either of these causes to a dangerous degree, the application of heat must not be too sudden, as it will tend to extinguish the small remaining spark of life, and produce apoplexy, or mortification, where any external part has suffered from cold.

318 Giddiness, or turn-sick.

The head may be affected with dizziness, or giddiness, commonly called *turn-sick*, from various causes. It may arise from great weakness, or it may be the consequence of plethora, or fullness of blood. In the latter case, it is a pretty sure mark of approaching apoplexy or staggers; and the animal must immediately be bled, and put on a lower diet, with gentle exercise. In sheep, dizziness is a common symptom of sturdy, or water in the head, a complaint which will be considered hereafter. It will be evident that when this affection appears in animals that are lean, meagre, and in low condition, it shows the necessity of a more full and nourishing diet.

319 Blindness.

The only morbid affection of the external senses, that we shall here consider is blindness, a defect which is of most consequence in the horse, though it may occur in all the domestic animals.

320 Marks of a sound eye.

The eyes of a horse, when perfectly sound, have the cornea or outer covering, and the humours that are seen through it, perfectly clear and transparent; there should be no specks, or *dragons* as they are called, in either; no greenness or glassy appearance of the pupil, and this should readily contract when suddenly exposed to a clear light. Buffon observes, that in a sound eye, two or three soot-coloured spots appear through the cornea above the pupil.

321 Partial blindness.

When a horse has a defect in his vision, without being perfectly blind, he appears dull, fearful and restive, starts at suddenly approaching any object, carries his head high, or to one side; moves his ears alternately, or turns one forwards, while the other is turned backwards, and usually hangs back on his bridle or halter, and lifts his legs up very high.

Partial blindness is a symptom of several diseases in the horse: it usually attends great weakness, especially when this has been brought on by hard work and low feeding; it is a common attendant on locked jaw, and generally precedes the staggers. It of course is one of the effects of old age.

When proceeding from debility, it generally goes off in proportion as the strength is restored by rest and proper nourishment; when it is a symptom of other diseases, it goes off when they are removed. The blindness of old age is incurable, and in the horse we believe no method has yet been discovered of relieving the defect by art.

It is generally allowed, that it is better to have a horse totally, than partially blind; as when quite blind, he is not liable to start, or be shy; and when sure footed, well shod, and managed by a careful rider, there is little danger of his stumbling or falling.

322 Total blindness.

Total blindness either proceeds from a defect in the optic nerve, by which this is rendered incapable of receiving the impression of light, or from an opacity or muddiness in the cornea or humours, by which the transmission of light through them is obstructed.

323 Glass eyes.

The first species of blindness, or that depending on a defect in the optic nerve, is generally called by farriers *glass eyes*, and by medical writers, it is termed *amaurosis*, or *gutta serena*.

It is known by the peculiar glassy appearance of the eye, which seems perfectly clear, so that an ordinary observer would not suppose that there was any defect in the horse's eye. On examining the eye however more attentively, it will be found that the pupil is considerably dilated, and preserves the same size in every change of light; not contracting, as usual, when the light to which it is exposed becomes stronger. There is also a greenish appearance of the eye in this disease.

The causes of glass eyes are not well ascertained. It has followed a blow on the head, or inflammatory affections of the brain or its membranes; but it has come on sometimes imperceptibly, and where these diseases, or any other evident cause has not appeared.

This disease in the horse has hitherto proved incurable.

324 Cataract.

The most common cause of blindness in the horse, is an opacity of the lens, or crystalline humour of the eye. This disease is known by the name of *cataract*, and is sometimes called by farriers, *moon blindness*, or a horse that has a cataract is said to be moon-eyed.

It is in general easily discovered that a horse labours under a cataract, as, when the disease is confirmed, an obscurity or muddiness may be seen in the centre of the pupil, occupying more or less of the opening, according as the cataract is more or less extended. The opaque spot is generally of a dull white or yellowish colour. Sometimes the crystalline humour is so fixed to the iris, or that moveable coloured part in the middle of the eye, as to obstruct its motion, and then the pupil retains the same size in every light; or if the adhesion is partial, the pupil of the eye assumes a regular shape. It must be observed, that in this disease, the iris is not always so immoveable as in glass eyes; though when the cataract is fully formed, the pupil is generally enlarged, and contracts very little on the approach of a strong light. Sometimes the lens comes through the pupil altogether, and floats in the watery humour, in the fore part of the eye.

The cataract in horses is said to be always a consequence of inflammation in the eye, which will be considered in the second section of this part.

The only method that appears likely to remove the cataract, is an operation by which the opaque lens may be thrust down below the pupil, or entirely extracted from the eye; but neither couching nor extraction can be recommended in the horse, as the removal of the lens would still be attended with a defect of vision that would render the animal of less use, than if he were totally blind.

325 Opacity of the cornea.

Another cause of blindness, and also a consequence of inflammation, is opacity of the cornea. There may be either a diffuse whiteness or muddiness in the cornea, that is more or less extensive; or, there may be specks or warts growing on the outside of this coat, so as to obstruct the passage of the rays of light. Sometimes the opacity of the cornea is only slight, producing partial blindness; but frequently it is universal, and then the horse cannot see at all. This universal opacity of the cornea is sometimes, though improperly, called *cataract*. It sometimes disappears for a time, and the eye seems nearly as clear as ever; but it generally returns in no long time.

General opacity diffused through the substance of the cornea, does not readily yield to remedies. Attempts have been made, by scarifying the vessels on the white of the eye, or by stimulating applications to the cornea, to rouse into action the absorbent vessels of the eye, and thus remove the opacity: but these attempts seem to have been attended with little success. Specks or warts on the cornea, if they are not too large, may generally be removed by the knife, or by repeatedly blowing into the eye a powder composed of powdered glass and white vitriol. But, if these specks are attended with any general opacity of the cornea, little benefit is to be expected from these operations.

326
**Warts.**

As the skin is so intimately connected with sensation, we shall here consider some of the more simple affections of that organ, that are not generally attended with fever. It is not uncommon for excrescences or warts to grow on the skins of domestic animals, particularly on horses and oxen. Sometimes they are hard and firm; at others they are soft and sprouting: in some their root is smaller than their head; in others the base is the largest part. The sprouting kind of warts are called by the farriers *anger-berries*, *ambury* or *ambery*, and are not uncommon among oxen. As these are largest at the base, they can, like all of that description, be removed only by touching them daily with some caustic, as lunar caustic, or butter of antimony. Where the wart has a small root, it may be best removed by tying a strong waxed thread round the root, tightening it now and then as it gets loose till the wart drops off. It is in general not proper to remove warts by the knife, unless they are of such a firm consistence as not to bleed on being cut, and to admit of the application of caustic after cutting.

327
**Mallenders and sallenders.**

There sometimes appears on the skin of the horse, a scurfy eruption at the bending of the knee, or the bending of the hock. The eruption generally appears in both places at once, and is called by farriers, the *Mallenders* and *Sallenders;* a term which they have borrowed from the French. When considered separately, the eruption of the knee is called the *mallenders*, and that of the hock the *sallenders*.

These eruptions may generally be traced to want of cleanliness, and are, in most cases, easily removed, by washing the parts with soap and water, and applying an ointment, composed of mercurial ointment and camphor; or either of the ointments marked N° 41. and N° 70. in the receipts.

328
**Hide-bound.**

When a horse's skin is hard, dry, and unusually tight about the body, the animal is said to be hide-bound. This tightness about the skin is usually the effect of hard work and improper food; and commonly attends lingering diseases, in which the fat is gradually wasted or absorbed. It must therefore be considered rather as a symptom of disease than as a disease itself: but, as is the case with most remarkable symptoms, it has often been regarded as a primary disease; to remove which, by sweating and relaxing remedies, is the principal object of the practitioner.

The proper remedies for this affection, when it is not a symptom of some lingering disorder, are nourishing diet, with plenty of green food, particular attention to cleanliness, by frequent dressing, and the occasional use of boiled barley and warm mashes.

329
**Surfeit.**

Horses that have a lean, unthrifty-like appearance, with their coats looking rough and rusty, are said by the grooms to labour under a *surfeit*. Whence has arisen the application of this strange term to an appearance that seems so opposite to what is generally understood by a surfeit, we are not aware; but an affection of the skin, under the name of surfeit, is thus described by Mr Lawrence: "Its confirmed state is attended with eruptions, and sometimes with swellings of the legs and joints, and in the latter case is usually to be looked upon, as the termination of some chronic disease, or a consequence of the improper use of mercurial physic. Surfeits are styled *dry* or *wet;* in the former, the skin is covered with a thick dry scurf, with scabs, and small hard tumours like warbles; in the latter, a sharp briny ichor issues from the poll, neck, withers, quarters, and hinder legs, in the bend of the hock, causing great stiffness and inflammation; this is probably analogous with scurvy in the human body, and will often attend cart-horses, with foul and unwholesome blood, at stated periods. The too free use of beans will produce the wet surfeit.

"The cure of *surfeits* depends almost entirely upon internal alteratives, with a very small attention to external applications. As to the latter, perhaps, frequent cleansing, with a good strong lather of soap, is generally sufficient, but where the eruptions are hard and fixed, and the scabs do not peel off, I know of nothing better than to rub them frequently with the strong mercurial unction, keeping the horse well clothed, and giving warm water in the interim. The warm bath if the animal is strong *."

33
**Mange in horses.**

One of the most common diseases of the skin among domestic animals, is what is commonly called the *mange* in horses, cattle and dogs, and the *scab* or *itch* in sheep. Its symptoms differ but little in the different species of animals, and we do not remember to have seen the disorder well described by any writer. The following description of the mange in horses by Mr Feron, is perhaps among the best that have been published. "The mange is a contagious chronical disorder which manifests itself on the skin, on which sensible eminences of a roundish figure rise up; these being scratched, a fluid oozes out, of a hot and corroding quality, that excoriates the sound skin wherever it runs, in a little time forming a dry, scaly, crusty eruption, which in its progress spreads over the whole surface of the body: and the skin becomes unequally thick, thin, hard, and soft. If the disorder has been neglected, or ill-treated, the animal falls off from his food, grows lean, and the legs swell: in this state the patient has frequent fits of shivering and trembling, and a slight fever arises, terminating in farcy or the glanders, by which he is easily destroyed †."

331
**In cattle.**

A disease similar to this, if not of the same kind, affects cattle, especially such as are ill-fed, and not kept clean. It is commonly called, by herdsmen, the *scab*

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* Lawrence on Horses, vol. ii.

† Feron's Farriery.

or *scurf;* and is thus described in a popular treatise on cow-doctoring.

Skin stiff, and sits fast to every part of the carcase, as if too small for the body. It makes its first appearance about the head and jaws of the animal, with a scurfy, pale, and dry texture; and the beast begins to scratch against every thing that comes in its way: it then shews itself along the back, and behind the shoulders; and if timely aid be not procured, the animal will tear its skin till it bleeds violently, which ought to be prevented, if possible, as the scabs which are the consequence of bleeding, much retard the efficacy of the ointment, and the loss of time confirms the disorder.

332 In sheep. This disease is incident to sheep in some particular pastures, situations, and seasons, more than to others. The predisposing cause seems to be a relaxed habit of body, produced by poverty or leanness, though some sheep are subject to it that are fat and otherwise in good condition. The disease seldom seems to originate with such sheep, but to be conveyed to them by infection *.

333 In dogs. Dogs are exceedingly subject to the mange, and readily catch it from each other. The appearance of the disease in dogs, is familiar to every one, as there are few more common and disgusting sights than a mangy dog. A dog in this state is very unfit for any active exertion, as the affection of the skin renders him stiff and sore even in his limbs. A friend of ours had a greyhound, that, when he was clean, was one of the swiftest runners in the country, and had gained the prize in many a coursing match. This dog caught the mange, and while in this situation was several times sent in pursuit of a hare; but now, puss generally escaped him.

This disease has sometimes been attributed to animalculæ, such as are found in the symptoms of the itch upon the human skin; and analogy seems to be in favour of this idea. It is, however, evidently connected with poor living, and want of cleanliness.

334 Treatment. In the treatment of the mange, we are to rely chiefly on the use of external applications, such as ointments, composed of sulphur, of some preparation of mercury, or hellebore roots. The receipts marked N° 68. and 69. are well adapted to the cure of this disease. Sometimes internal remedies, such as sulphur and gentle laxatives, are required; and the greatest attention must be paid to cleanliness, diet, and exercise. It may be necessary in some cases, especially where the animals that have caught the disease, are very full of blood, to bleed and give cooling physic previous to the application of ointment; and in all cases the skin should be thoroughly washed with soap and water, both before and after anointing. The animals should always be confined till they are quite free from the disease.

Mr Feron, who considers the mange in horses as a general affection of the system, and not merely a local disease of the skin, strongly recommends the use of blisters, which he has seen act as a specific. "The local treatment, and the only one to be depended upon (says this gentleman), consists in a judicious application of blisters, used after the following manner; viz. if the whole body is affected, the one half must be blistered one day, and the other in three days after. This must be done at different times, in order to prevent the cantharides from operating too violently upon the kidneys and bladder; but if this happens, let the animal be bled, and clysters frequently injected. But the best way to avoid this, is to leave off all kinds of internal medicines, during the action of the blisters. When they begin to operate, the skin must be fomented with warm water three times a-day, in order to wash out a quantity of yellow matter, discharged by the action of the blisters, and to encourage the growth of new hair." We do not pretend to dispute the efficacy of Mr Feron's blistering practice in removing the mange, but we doubt whether the blistering one half of the body with cantharides may not be productive of more serious consequences than the disease which it is intended to remove. At any rate, the expence of the method, and the torment which it must occasion to the poor animal, must greatly prevent the general application of the remedy.

In Mr Findlater's Survey, quoted above, are the following judicious observations on the treatment of sheep labouring under the scab.

"Sheep that are regularly tarred, or smeared, are seldom infected with this disease. If the disease be partial, perhaps the best remedy would be to clip the affected parts as bare as possible, and rub them occasionally with the common smearing ointment, to which may be added a little Venice turpentine. They should also be washed, once or twice a week, with black soap and water. But if this prove ineffectual, or if the disease has gone to a great extremity, the animal should first be washed as clean as possible, in a pond, or rill of water, to purge away all the accumulated virus, or infecting matter, from the wool. A little black soap may be of great use in washing. Then the whole body may be smeared with juice of tobacco; and after the animal becomes dry, may be rubbed with butter mixed with powdered brimstone; or brimstone mixed with the smearing ointment would answer better. A little of the sulphur may meanwhile be thrown down its throat. If this treatment, being twice or thrice repeated, after an interval of several days, should prove ineffectual, recourse must be had to the mercurial ointment, composed of three ounces of hogs lard, well rubbed in a mortar, with half a drachm of finely powdered corrosive sublimate; or the same proportion of corrosive sublimate, well mixed with three ounces of the common smearing ointment, will answer equally well. The animal being smeared with this ointment, will soon be effectually cured. Meanwhile the diseased animal should be invigorated or put upon substantial food."

In a note Mr Findlater mentions an observation of Mr Loch's of Rachan, that the matter discharged in the scab mixing with the wool, and drying, forms a hard impenetrable crust, which he has observed of half an inch in thickness; that it is vain to think of curing it by any external application, till this is removed; and that you might as well attempt to cure a man of the itch, by rubbing butter and brimstone upon his coat, instead of his naked skin; that the scurf thus formed, must be removed by soaking and washing it with warm lime-water and soap, and scraping it clean to the quick with a blunt knife. It may then be successfully cured by the ointment; or, what is more cleanly and more easily prepared, by means of a lotion made by dissolving half a drachm of corrosive sublimate in a quart (chopin) bottle of whiskey and water. Mr Loch has

always

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* Findlater's Survey.

always found this lotion effectual, after two or three applications.

It has been proposed by a correspondent of the Farmer's Magazine, to inoculate sheep for the scab, in order to render it milder. Even should inoculation have this effect, which is by no means certain, it does not appear necessary, in a disease that is so easily cured.

Besides the several applications that we have mentioned, a variety of ointments and lotions are recommended by writers on dogs. Mr Beckford advises that as soon as a mangy spot appears on a hound, it should be well rubbed with a liniment composed of a pint (mutchkin) of train oil, half a pint of oil of turpentine, a quarter of a pound of powdered ginger, and half an ounce of gunpowder. It is also recommended that the dog should have a purging ball now and then, and should be kept from flesh meat. There is a variety of the mange in dogs, called the red mange, which it is said is best cured by mercurial ointments.

335 Lice and fleas. Most of the domestic animals, especially when young, are troubled with lice. Calves are sometimes lousy, if they have been hard kept during winter, by being turned out in severe weather, fed on poor diet, and not kept clean. The best means of destroying these vermin is by rubbing their hide with an ointment composed of staves-acre, or cayenne pepper, mixed up with hogs lard.

Young whelps are very subject to lice; but they may be easily removed by washing with a lotion formed by steeping a pound of tobacco in three English pints of small beer, or by rubbing the skin well with train-oil.

Fleas are best destroyed by washing the dogs frequently with soft soap and water.

Sheep are often infected with vermin of various kinds, which harass the animals exceedingly; and not only do much mischief to the wool, but even eat into the animal's skin.

336 Fly. The sheep fly abounds most in the southern parts of the island, and is chiefly troublesome to lambs. The most effectual means of protecting the lambs from the insect appears to be to smear the fleece with any kind of rancid oil.

337 Ticks. Another species of insect that infest sheep is commonly called tick, or kedd, the *hippobosca ovina* of naturalists.

The smearing ointment generally prevents, or kills this insect. But if this should not happen, or if the sheep are not smeared, insects of every kind may be effectually killed, by slightly rubbing the parts affected with mercurial ointment, composed of three ounces of hogs lard, rubbed up with half a drachm of finely powdered corrosive sublimate. To this may be added, a little of the spirit of turpentine. Coal oil is powerfully destructive to insects of every kind; but whether it may not prove injurious to the health or fleece of the sheep, has not yet been ascertained by experiment. A decoction or distillation from the gall-plant, which abounds in many mosses and muirs, is known to be very fatal to insects of every kind; and a sheep may be safely washed with this juice. The juice of tobacco is also much recommended as a poison for those insects which infest sheep.

The last species of insects are chiefly hurtful to sheep of a year old, or more *.

Among the insects which prove most troublesome to horses, sheep, and cattle, are those of the genus *Oestrus*, some species of which are generally known by the name of *gad-fly*. The best account of these insects and their effects, that we have seen, is that of Mr Bracey Clark, published in the third volume of the Linnæan Transactions, from which the following account is chiefly taken.

Mr Clark describes five species of *Oestrus*, viz. *Oe. bovis*, *Oe. equi*, *Oe. hæmorrhoidalis*, *Oe. veterinus*, and *Oe. ovis*.

We shall at present describe the effects only of the first and last species.

33 Gad-fly, o Oestrus bovis. The *Oe. bovis*, as its name imports, chiefly attacks cattle, through the skins of which it pierces, in order to deposit its eggs. The pain which it inflicts in depositing its eggs appears to be much more severe than what is excited by any of the other species. When one of the cattle is attacked by this fly, it is easily known by the extreme terror and agitation that seizes the whole herd. The unfortunate object of attack runs bellowing from among his fellows, to some distant part of the pasture, or to the nearest water, holding his tail, from the severity of the pain, extended straight from the body, in a line with his back, with a tremulous motion, and stretching out his head and neck to the utmost. The rest of the herd, infected with the like fear, though not attacked, fly also to the water, or disperse to different parts of the pasture. "Such is the dread and apprehension of the cattle for this fly, says Mr Clark, that I have seen one of them meet the herd when almost driven home, and turn them back, regardless of the stones, sticks, and noise of their drivers; nor could they be stopped till they reached their accustomed retreat in the water."

When one of these flies happens to attack oxen that are yoked in the plough, there is often considerable danger, as the animals become quite ungovernable, and will often run directly forwards with the plough, through hedges, or whatever opposes their career.

Heifers, steers, and the younger cattle, are in general most frequently attacked by this fly, the strongest and most healthy beasts seem constantly to be preferred by it, and this circumstance is said to be a criterion of goodness held in much esteem by the dealers in cattle. Tanners also have remarked, that their best and strongest hides have generally the greatest number of holes in them.

The larvæ of this species, as of most of those we are to mention, are generally termed *bots*, but this name is most frequently applied to the larvæ of the *Oe. equi*.

The complaint produced by the puncture of this insect in the skins of cattle, is called *puckeridge*, and is not unfrequently attributed to the bite of the goatsucker. For the destruction of the larvæ thus deposited, it has been recommended to insert a red hot wire into each of the holes made in the skin; but this is a formidable remedy, and will probably do as much harm to the skin as the bots themselves. A more rational practice that is sometimes in use, is to press the parts, and rub them well with a little oil of turpentine, or some other stimulating application, or a little oil of turpentine may be injected into each hole.

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* *Findlater's Survey.*

The larvæ of the *Oe. bovis* are commonly known to the country people by the names of *wormils*, or *wormuls*, or *warbles*.

339 Oe. ovis. During the summer, sheep are often observed to gather together in clusters, endeavouring carefully to guard their heads. Mr Blaine says that this is to protect themselves against the attacks of this insect, which attempts to lay its eggs on the inner margin of the nose, which when it has effected, these eggs become larvæ, and creep up into the frontal and maxillary sinuses.

It is not easy to discover the manner in which this insect deposits its eggs, owing to its obscure colour and rapid motions, and to the great agitation into which the sheep are thrown by its attack; but the subsequent motion of the sheep, and the manner in which they attempt to defend themselves against their enemy, leave no room to doubt, that the eggs are deposited on the inner margin of the nostrils.

The moment the fly touches this part of the sheep, they shake their heads, and strike the ground violently with their fore feet, at the same time holding their nose close to the earth; they run away, looking about them on every side, to see whether the fly pursues: they also smell to the grass, as they go, lest one should be lying in wait for them. As they cannot, like horses, take refuge in the water, they have recourse to a rut, or dry dusty road, or gravel-pits, where they crowd together during the heat of the day, with their noses held close to the ground, which renders it difficult for the fly conveniently to get at the nostril.

Observations on these flies are best made in warm weather, and during the heat of the day, when by driving the sheep from their retreats to the grass, the attack of the fly, and the emotions of the sheep, are easily observed.

The nostril from repeated attacks, and the consequent rubbing against the ground, becomes highly inflamed and sore, which occasions their touch to be so much dreaded by the sheep.

It is said that this fly also deposits its eggs in the skin of the sheep, but we are not certain how far this has been proved by experience; although there is no doubt that there are sometimes found in the sheep's skin, maggots that must have been produced from eggs deposited by some insect. They prove extremely troublesome to the animal, eating into the skin, and producing ulcers. If not discovered in time they may even destroy the life of the sheep. The remedy is to clip the infected parts bare, wash them well with black soap and water, and apply the smearing ointment. If this does not succeed, recourse must be had to the method recommended in N° 337.

340 Pelt-rot. When sheep have lain about for a long time in wet and marshy pastures, or have been kept in woods or copses in a starving condition, their fleeces become so completely soaked with water, that the wool rots off from the skin. This is what is called the *pelt-rot*. If sheep be suffered to continue long in this condition, they become heavy and low-spirited, and will sooner or later be destroyed. If, however, they be attended to in proper time, they may be saved by driving them to a good straw-yard, pulling off their ragged and rotten wool, and rubbing on a good coat of tar, grease, and turpentine. Care must also be taken, to provide them with plenty of good wholesome nourishment.

341 Excoriations, chaps, &c. The skin of all animals, especially on the most delicate parts of it, is subject to excoriation or chafing. This is of most consequence in the backs of horses fretted with the saddle, and the udders of cows by rubbing against their thighs, when they are *cat-hammed*, and go close behind. Both the udder and thighs of the cow are sometimes quite raw, and ulcerated. The best remedy in these cases, is to wash the parts well with warm soap and water, and afterwards bathe them frequently with a mixture of Goulard, and camphorated spirits.

The teats of cows are sometimes *chapped*, which is commonly owing to want of cleanliness in the milkers. When this happens, the treatment recommended above for *chapping* may be followed, or, if this does not succeed, the teats may be anointed with what is called *unguentum nutritum*. If the teats are very painful, the cracks may first be bathed with a little laudanum, and afterwards filled up with fine powdered prepared chalk.

There are many other diseases that affect the skin of these animals; but some of them are so trifling as not to require particular notice, and others being intimately connected with some general derangement of the system, fall more properly to be considered in the next section of this part.

## CHAP. II. *Morbid Affections of Motion.*

THE function of motion may be morbidly affected in various ways, but all these tend more or less to impede or disturb the natural motions of the animal. 342

The muscles are often affected with irregular motions, producing violent involuntary contractions, called convulsions or spasms. These are often symptoms of some dangerous derangement of the brain or nervous system, as locked-jaw, epilepsy, canine madness, &c. Convulsions of this nature, being intimately dependent on the primary disease, can only be removed by such means, as are calculated to carry off the disease, of which they are symptoms. Irregular action of the muscles commonly attends great debility, whether it be brought on by hard work and low diet, or by disease. In either case, it is commonly a very dangerous symptom. We cannot properly consider the treatment of convulsion here; but it will be considered in the next section, when we come to treat of convulsive or spasmodic diseases.

343 Of lameness. The affection that we are chiefly called to consider in this chapter is lameness, a very comprehensive term, as it includes almost all the local affections of the extremities. Lameness is a complaint that is exceedingly common among horses and dogs, especially the former; in whom it more particularly demands attention, as it so materially affects the value of the animal. A knowledge of the nature of lameness, and the method of treating it, can only be acquired by an investigation of the cause by which it is produced.

The causes of lameness are extremely numerous and various. We shall endeavour to class them, so as to render our inquiry as little tedious and difficult, as may be.

344 Stiffness. 1st, Lameness may be produced by a stiffness of some parts of the muscles, tendons, or ligaments, arising either from excessive labour, from bruises, wounds, or some diseased affection of the joints.

It is well known, that when the muscles of an animal are exerted for any unusual length of time, or in a more than ordinary degree, they become fatigued, and cannot for some time perform the functions with their accustomed ease. In general, after proper rest, and careful treatment, the stiffness gradually goes off; and in a day or two the animal is able to exert himself as usual; but if care has not been taken to rub him well down, and provide him with a well littered bed, and especially if he has been exposed to cold while sweating and fatigued, this stiffness may continue for many days, or may even degenerate into permanent lameness. Animals that have acquired this permanent stiffness of their limbs, always move with considerable difficulty, when first taken out; but in general when they have been long in exercise, and are become warm, the stiffness and lameness in a great measure disappear, but they commonly return again when the exertion is over.

Where the stiffness has not continued long, it may in general be easily removed by frequent friction of the limbs, first with a wisp of hay and the brush, and afterwards with some warm liniment or embrocation, such as has been described among the stimulant receipts.

If it does not yield to this treatment, recourse may be had to warm fomentations, and gentle exercise must be persisted in. If the lameness should still continue, it will probably be occasioned by a strain of some ligament, or an injury done to some part of the limb.

345 Bruises. Any of the muscular parts may be bruised by falls or blows; and if the bruise takes place on the limbs, or in their neighbourhood, lameness may be the consequence. A bruise is almost always followed by a swelling of the bruised part, occasioned by the rupture of small vessels, that pour out their fluids into the cellular membrane. If the bruise is slight, the swelling will soon subside; but if the injury has been considerable, and much blood has been poured out, inflammation and consequent suppuration will take place, and the part will become an abscess. If the injury has been still greater, and the texture of the parts has been destroyed, mortification will probably come on, and if the bruise be extensive, will be attended with considerable danger.

The treatment of bruises will be different according to the degree of the injury produced. In slight cases the object will be to promote the absorption of the effused blood; and this will be best answered by bathing the part with warm vinegar and water, or camphorated spirit. If there is considerable inflammation, and it is not judged proper to encourage a suppuration, the parts must be frequently bathed with a solution of sugar of lead, with a little vinegar: or, where the part admits of a bandage, it will be better to form a cold poultice of oatmeal mixed up with such a solution, and kept constantly applied to the part and frequently moistened with the solution to prevent its becoming hard and dry. If a suppuration should appear unavoidable, it will be proper to encourage it by a frequent application of warm poultices renewed as often as they become cool, or, where these cannot be applied, by repeatedly fomenting the part with flannel wrung out of warm water. When the suppuration is complete, the swelling must be opened with a lancet, or by means of a seton; and the sore must be treated as we shall presently describe with respect to ulcers. If mortification takes place, the part must be frequently fomented with the fomentation directed in N° 57. of the receipts; and the animal's strength must be supported by nourishing food, and the occasional use of cordial and strengthening remedies. If the mortified part be very extensive, it may be necessary to make incisions towards the edges with a knife, to promote the separation of the slough; or firing may be employed, as directed for this purpose in N° 175.

It sometimes happens that after the inflammation which attended a bruise has subsided, a permanent hard tumour is left, that prevents the free motion of the muscles of the part. This may arise either from a thickening of some ligament, or the cellular texture, or it may proceed from an excrescence formed on the bone, in consequence of the bruise. The treatment in such cases will be presently described, when we come to consider splents, ring-bones, and other tumours that commonly produce lameness.

346 Tread, or overreach. Horses are very liable to receive severe bruises in the back part of the foot, either from the tread of another horse, as often happens in the army, by a horse in the rear-rank treading on the heels of one in the front-rank; or, by a horse overreaching his hind foot, and thus bruising the heels of the fore foot. From the manner in which this accident is produced, it has received the names *tread*, and *overreach*. Sometimes the bruise is so slight as to be productive of no farther ill consequence than a temporary lameness; but if the tread has been very violent, the edges of the part trodden on may be so much bruised as to produce considerable inflammations, or even a mortification. In ordinary cases it is sufficient to wash the part carefully with warm water, to clear it of dirt and gravel, then apply a pledget dipped in spirits, and bind up the foot, so as to exclude the external air; when the bruise, if slight, will probably soon heal. But in some cases matter is formed, which makes its way downwards towards the sole, forming what is called a *quittor*. Quittor may also take place from a puncture in the foot, by a nail or other pointed body, the effects and treatment of which will be presently described.

347 Quittor. In a newly-formed quittor, it is of consequence to ascertain, whether it has been produced by a prick or a tread. In the former case the matter usually makes its way upwards from the punctured part towards the coronet; and here the practice generally followed by farriers is, to sear the upper orifice with a hot iron, which answers no other purpose than to confine the matter within the wound, where it must produce extensive ulceration and destruction of important parts of the foot. In the latter case, where quittor is produced by a tread, and when the sinus formed is very superficial, the use of the cautery may be very proper; and if it can be so applied as to inflame the whole extent of the wound, it may entirely carry off the disease. According to Mr Blaine, there are two general methods of curing quittor; one by removing a part of the hoof, cutting away the diseased parts, or suffering them to slough off or exfoliate. The other, to apply caustic to the diseased surfaces, introducing it within the sinuses, thus destroying the ulcerated parts, and allowing the healthy parts to throw them off. The latter is called by farriers *coreing out a quittor*, or as they suppose that the

the core or slough that comes away formed a part of the complaint. Mr Blaine objects to removing the hoof, as it would take up a considerable time before new horn can be formed; and it is probable that in the new hoof there will be a false quarter, which will render the horse unsound, besides that, during the formation of the new hoof, fresh sinuses may be produced. In the method of cure by caustic, he thinks that the disease may be completely removed in three or four weeks, whereas the other method may require as many months. The mode of applying the caustic is, to examine carefully the extent and direction of the sinuses, and then to fill them up with powdered blue vitriol, verdigrise, or corrosive sublimate. Mr Blaine has found that a paste made of corrosive sublimate, mixed up with flour and butter, forms a very good caustic for this purpose. Some of it is to be introduced by means of a probe, to which a piece of sponge is fastened, which must be carefully introduced in every direction, so as to touch all the diseased parts, after which the whole foot is to be bound up; but the bandage must not be applied too tightly. In two or three days the dressings are to be renewed, and this is to be repeated at intervals till the sloughs come away, when a healthy action of the parts will take place, and the cure soon be completed. Another method of introducing caustic, by which the sinuses may be completely filled, is to mix up the caustic with hogs lard, and roll the mass into small pellets within gauze-paper, which may be easily introduced into the cavities.

Many farriers have fallen into a mistake with respect to the nature and treatment of *quittor*, that has been the ruin of many horses. They suppose, that during the progress of this disease, a bone is formed which they call a *quittor bone;* and they think it necessary to remove this bone, before a cure can be completed. This error seems to have arisen from an opinion of Lafosse, who conceived that the derangement which accompanied this disease originated in the cartilages being affected; which he affirmed were capable of being thus diseased, but incapable either of exfoliating like bone, or sloughing like ligament; and therefore that to promote a cure, the whole of the lateral cartilage on the affected side must be removed. But his first premises were erroneous, for cartilages are vascular, as we know by their being tinged with bile, and by their being at times absorbed; this is particularly the case with the lateral cartilages, which in almost all old horses are partly absorbed. As they are vascular, they must be capable of living action; though it is slow, and hence, where disease exists, they will exfoliate like other parts. This practice of Lafosse has in this country been for some time tried among many of the more intelligent farriers, and was still further propagated by the late Professor St Bel. Many horses have been ruined by this injudicious practice; for the future elasticity of the foot, which is in a great measure dependent on these cartilages, must be lost; besides the necessary removal of the hoof to get at the cartilage, a false quarter almost always remains *.

348 *Wounds.* Wounds are frequently inflicted in the soft parts of horses and dogs, and these are more common in the legs, feet, and joints, than in any other parts. The treatment of wounds must depend in a great measure on the part where they are inflicted, and the form of the instrument that produced them. A clean cut made in the muscular parts is easily healed, by applying slips of sticking plaster as soon as possible, so as to keep the edges of the wound close together; or where plaster cannot readily be applied, by taking a stitch or two through the edges of the wound, and tying the strings gently together. When the edges are found to adhere, the strings must be cut away, and the holes which they made will soon fill up. If any considerable blood-vessel has been wounded, it will be proper to secure it, if possible, by means of ligature, rather than by applying any styptic substance. All wounds should be made as clean as possible, before any attempt is made to heal them. Sometimes the wound is so situated that it will not admit of being sewed up; but in these cases we may in general pass silver or steel pins from the edges, at about an inch distance from each other, and twist a thread crosswise from one to the other, so as to form what is called the *twisted-suture.* In all cases where sutures are used, it will be proper to apply a sticking plaster over the edges of the wound. If the wound should not heal by these means, a formation of matter will take place, and then the sore is to be treated as a common ulcer, taking care that its edges be always kept as near together as may be, by sticking plaster or a bandage.

If the wound is very large, it may excite considerable inflammation and fever. In these cases, if the animal is plethoric, it will be proper to bleed him, or at any rate to administer cooling remedies. If, on the other hand, there has been much loss of blood, or if the wound shews no disposition to heal, and the matter formed is thin and ichorous, an opposite plan of treatment will be required. The animal must be supported by nourishing food, and strengthening remedies.

The most troublesome wounds are those of the feet and joints, as they are in general very difficult to be healed.

349 *Wounds of the feet.* Wounds in the feet are not uncommonly produced by the horse treading on sharp stones, broken glass, sharp bones or nails. These are generally punctured wounds, and will be considered presently. Sometimes a deep wound is made on the coronet, by a sharp part of the heel of the shoe on the opposite foot, or any other substance penetrating downwards between the coffin-bone and the hoof, or between the lateral cartilages of the coffin-bone and the joint. Wounds of this kind are attended with much danger, from the difficulty of evacuating the matter, that may be formed, or of producing that healthy action in the parts that is necessary to make them heal. In such cases Mr Feron recommends the application of a blister, extending from the fetlock to the foot, so as to produce external irritation, which may relieve the internal parts. In the mean time the foot is to be kept in a vessel of warm water all day, and a large warm poultice of bran and water is to be applied round it at night. The intention of this practice is to prevent suppuration, but if this should nevertheless, take place, and if matter should be formed between the hoof and the sensible laminæ; the suppuration is to be encouraged, and we are to endeavour to prevent the formation of sinuses, by rasping the hoof very thin, just below the seat of the wound, so that we may be able to make an orifice for the evacuation of the matter downwards. Mr Feron advises

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* *Blaine's Outlines,* vol. ii.

advises to delay this opening as long as possible, and when it is performed, to take care that the laminæ be properly pressed after the operation, to prevent coming out through the hoof, and forming an incurable sand-crack, or false-quarter. The bathing the foot in warm water, and the application of the bran poultice, must be continued till the foot is perfectly healed. If proud flesh should appear through the opening that has been made in the hoof, it is to be pared away with a sharp knife, then fired, and covered with a small pledget spread with soft ointment, on which is sprinkled a little powdered blue vitriol. It is evident that, during the cure, the horse must be kept perfectly at rest; and it is recommended to administer diuretics, and now and then a gentle dose of physic, to keep the bowels moderately open.

350 Wounds of the joints.

Wounds in the joints are commonly attended with very serious consequences, as it frequently happens that the capsular ligament is divided, and in this case the synovia or joint-oil constantly exuding through the opening, prevents the disposition to heal. A wound in the joints is common among horses in the army, and such as are employed in hunting; and a horse that has received such a wound in general becomes perfectly useless, from the improper method of treating these wounds that has in general prevailed among farriers. By their treatment, either an incurable sinus is produced, or a secretion of bony matter takes place within the joint, forming what is called an *anchylosis* or *stiff-joint*. The method generally practised by ordinary farriers is, to inject within the joint a mixture of turpentine and oil of vitriol, a solution of corrosive sublimate and lime water, or some other corrosive substance. The more rational of them content themselves with an injection of tincture of myrrh. All these substances produce such a high degree of inflammation within the joint, as not unfrequently to destroy the animal.

351 Mr Coleman's method of treating wounds of the joints.

Of late, a much more rational mode of treatment has been adopted by Mr Coleman, and is described in the first number of the Veterinary Transactions.

The following is the method recommended by Mr Coleman for treating wounds of the joints and capsules.

"Where a joint, a mucous capsule, or the sheath of a tendon is opened, the first application necessary is the actual cautery. The instrument most proper for the operation should be made of iron, two feet in length, rounded at the extremity about the size of a small button, with a wooden handle. The temperature of the iron should be moderately red. If it be black, the heat will not be sufficient to produce a proper discharge of lymph, to close up the wound; and if it is white, it will destroy too much of the surrounding parts, and perhaps do mischief to the ligament. Although the operation in itself is very simple, yet some knowledge of the structure and economy of the parts, for the purpose of applying the cautery with the best possible effect, is necessary. The object in view is to produce a glutinous substance to close up the cavity, and before the slough is removed, for granulations below to supply the place of the lymph; but if the ligament itself be destroyed by the cautery, it must, like other dead parts, separate from the living and come away, and then the joint will still be opened. It is, therefore, of importance not to destroy the ligament of joints with the hot iron, but confine its application to the external soft parts. In these cases, it is generally proper to cauterize the whole external surface of the wound; and if the discharge is not immediately stopped, the iron has probably not been applied sufficiently deep, or too cold, to produce a proper discharge of lymph. Where a cure is possible to be effected, the actual cautery will frequently close the cavity and stop the discharge. Sometimes, however, in the course of one, two, or three days, the discharge appears again by the sides of the lymph, and then the same operation should be repeated. In some instances Mr Coleman has had occasion to apply the hot iron five or six times, and nevertheless succeeded ultimately, without the least lameness. The same treatment is likewise to be recommended for penetrating wounds into the chest and abdomen. The lips of the wound should be cauterized, and, if requisite, repeated in the same manner as is recommended for wounds of other cavities. When the cavities of veins become inflamed, some little variation is necessary in the treatment, as accidents of that nature are frequently attended with consequences different from the opening of other cavities, and require a trifling alteration in the treatment. When a hemorrhage takes place, it may be very generally stopt by the application of the cautery; but if this fails, and the parts are too much swelled to admit of a pin, there is no other remedy than to take up the vein by a ligature above the diseased parts; and there may be instances in which it may be advisable to tie up the vein below. In general, however, the actual cautery will prevent the necessity of a ligature; and if it fails, tying up the vein will succeed only in those cases where the vein above is free from disease. In general, the vein is thickened and inflamed, and if a ligature be applied on a vessel in a state of inflammation, the disease will be formed, and the vein inflamed above. In a case that occurred to Mr Goodwin, veterinary surgeon at Oxford, where the jugular vein was tied, an abscess took place over the occipital bone, commonly termed the *poll evil*. That disease, however, most probably did not originate in consequence of the tube being obliterated, for in most successful cases of inflamed veins, the sides of the vein unite and destroy the cavity. After the orifice of the inflamed vein, from the application of the actual cautery, is closed, a considerable degree of swelling frequently remains, and this may be removed by a blister. When abscesses form in the adjacent parts, they should be treated in the same manner as common abscesses."

352 Punctured wounds.

A puncture of some part of the lower surface of the foot is a frequent occurrence. It may arise from the prick of a nail in shoeing, from a nail picked up in travelling; or from glass, flint, or any other sharp body. Injuries of this kind are proportioned in their effects, to the parts punctured, and not entirely to the depth of the wound. A puncture of the frog penetrating even to the fleshy frog, is not usually so serious as that which penetrates the sole; hence a wound any where at the hinder part may penetrate deeper with impunity than towards the centre, and likewise in the front, though considerable inflammation usually follows from this last. When the capsular ligament is wounded in these cases, the consequence may be very serious, as a stiff joint is commonly produced. When it is found that the capsular ligament has been wounded, the external opening must be enlarged, and a hot iron must be applied to the surface of the skin that covers the wounded part of the ligament, in order to heal up the internal opening. Considerable irritation commonly attends a punctured wound of the tendon, or its sheath; and it is best removed by enlarging the wound that is made through the horny part, and keeping the feet for some time in warm water. When matter appears in either of these cases, it must be let out, and the wound must be healed in the usual manner.

The most usual case of punctures is that which arises from a nail in shoeing taking a wrong direction, when instead of penetrating the outer surface of the crust, it turns inwards, and thus wounds the sensible laminæ. This is known to the smith at the time by a peculiar feel in the stroke he gives, and by flinching; when, if the nail is immediately removed, and has not penetrated far, the wound heals by the first intention; but if it is suffered to remain, it produces inflammation and suppuration. As soon as this is discovered, a depending orifice should be made for the matter, by making an opening in the line of the hole at which the nail entered. It is always prudent, when a nail has penetrated, and lameness follows without matter appearing, to remove the shoe, and enlarging the opening, to apply a pledget of tow dipped in spirits of wine, which will frequently prevent any future effects: but whenever matter has formed, it is indispensably necessary; for otherwise the matter will proceed upwards, and coming out at an opening on the coronet, it will form a quittor. When by this treatment the matter has gained a depending situation, and the inflammation has subsided, the part may be dressed with any mild ointment; but if the matter should increase in quantity, it will be proper to pour a solution of white vitriol within to promote a stoppage of the discharge, and of the extension of the ulcerative process. In every puncture, when the heat and inflammation appear considerable, bleeding at the toe is a prudent measure, as it unloads the vessels.

Dogs are frequently wounded with thorns in their feet or knees, and the thorn may be so deeply lodged, that it cannot easily be extracted. When the foot is wounded with a thorn, the best application is a plaster of black pitch, which is said to have succeeded when every thing else has failed. If there is much inflammation, it will be proper to apply a poultice over the plaster. When a dog is wounded in the knee, if there is reason to suppose that a thorn is left in the wound, the same applications will be proper: and when the thorn comes away, if there is still an oozing of fluid from the orifice, a red-hot iron must be applied, as in the wounds of the joints in horses. If no thorn is left in the wound, a little digestive ointment rubbed upon the part, and a subsequent application of a poultice made with Goulard and crumbs of bread, with proper rest, will probably soon effect a cure.

Lameness is not unfrequently produced by a stiff joint, or what the surgeons call *anchylosis*. This is generally the effect of an injury done to the articulating surfaces of the bones that compose the joint, causing the formation of new bony matter, which gets between the bones, and unites them together. A stiff joint may perhaps be sometimes prevented by the timely use of blisters and firing; but when completely formed, the lameness is incurable.

2. The second head of causes that produce lameness will comprehend strains, fractures, and luxations.

353 Strains.

Strains may take place in any of the muscular parts or ligaments, but they most commonly happen in the fleshy part of the shoulder, or in some of the ligaments of the feet.

354 Shoulder slip.

A strain in the muscles of the shoulder, has been generally called a shoulder-slip, under the idea that the shoulder-bone has been disjointed, or the blade-bone pushed out of its place; but the structure of the parts shews that the former of these accidents can scarcely happen, on account of the great strength of the capsular and other ligaments that surround the shoulder joint; and a dislocation of the blade-bone is, by the extent and strength of the muscles that unite it with the ribs, nearly impossible, unless by such a force as is sufficient to destroy the texture of the muscles, and tear the limb from the body. A strain of these muscles and of the ligament that surround the shoulder joint, is, however, by no means an unfrequent occurrence, but affections of other parts are often mistaken for a shoulder strain, as we shall see presently. A strain in the shoulder, when first received, is generally attended with considerable inflammation and swelling of the part, which are usually sufficient to distinguish it from other affections. When the strain has continued long, and the inflammation has subsided, the distinction is not so easy.

In cases of recent shoulder strains, it will be proper to draw blood from the plate vein, and if the inflammation is extensive, to administer a purge, and keep the animal rather low, to keep down the inflammation as much as possible; and it will be proper to bathe the parts frequently, with some astringent lotion, or with a warm fomentation, as directed under *bruises*. A rowel may also be placed in the chest, or a seton in the inside of the fore-leg. Complete rest is necessary; and to render this the more perfect, the horse should be fitted with a patten shoe, and should have a bed of litter constantly below him. When the inflammation has subsided, gentle friction, and the occasional use of astringent lotions, will in general soon restore the use of the limb; and as soon as the horse can bear it, moderate exercise may be employed.

355 Injuries of the ligaments and tendons.

Injuries done to the ligaments and tendons, are also usually called strains; but if we understand by this term, an extension of the strained part, the appellation is improper, since the tendons appear to be entirely without elasticity, and the ligaments nearly so. These parts cannot, therefore, be properly strained, though by unusual exertion, their texture may be so far injured as to produce stiffness, inflammation, and swelling, but will have the same effect in causing lameness, as a strain.

Injuries of this kind are more dangerous than mere muscular strains, their treatment is more difficult, and the cure more tedious. The treatment usually adopted by ordinary farriers, is to apply the same astringent and stimulating lotions, as in strains; but here they commonly do harm, as they generally produce a greater secretion of coagulable lymph, which still more obstructs the motion of the part, and renders the lameness permanent.

One of the worst cases of these injuries, is what far-

356 Clap or strain in the back sinews.

riers commonly call a clap or strain in the back sinews. When a horse trips or stumbles, and makes an unusual effort to save himself from falling, or when the heels are lowered in shoeing too suddenly, or too much at once, so as to throw too great a weight upon them, there often happens such a sudden or violent contraction of the flexor muscles as may produce a partial laceration, or even rupture of the flexor tendon, or its sheath. This injury is attended with considerable inflammation, and the consequent lameness is of the worst kind. A great stiffness and swelling is produced, and there is commonly an effusion of fluid, which is at first serous, and may again be taken up by the absorbent vessels; but if improper applications are employed, coagulable lymph may be poured out, so as to obstruct the motion of the part, and produce that swelling, or permanent enlargement, that we sometimes see in the neighbourhood of the tendon, after what is called a strain of the back sinews.

When a horse is strained in the back sinews, he puts forward his leg and foot in a loose, faint, and faultering manner. Mr Lawrence gives the following directions for ascertaining whether or not a horse is injured in the back sinews. To try how far the horse has been injured, let him be walked about for half an hour, when the swelling of his legs will in all probability subside. If you then observe the *tendo achillis*, or main sinew, distinct from the shank; if, on pressing it with the finger towards the bone, you find it firm and tense; if you discover by the feel, no soft spongy sinews between the shank and the tendon, no extraordinary pulsation, but that all is well braced and wiry, you may conclude the swellings not dangerous. A person of experience, with a nice discriminating finger, will scarce ever fail to detect lameness in the back sinews.

Mr Feron is of opinion that the injury which we have described is not done to the flexor tendon, but to the ligaments of the neighbouring joints. He says, that "on the dissection of a strain supposed to be in the back sinews, we discover no affection in the substance of this part, which on the contrary appears perfectly sound. But on examining the ligaments of the fetlock, coronet, and foot, we find them to be the seat of the disease; we find also, that if the accident has been violent, and of long duration, the whole vascular system of the leg is found affected, but never, or very seldom, the back sinews; it is in this violent state that we observe sometimes one or two swellings along the tendons. It is also on this account that the pain is so great, and so hard to be cured, in consequence of the considerable irritation which takes place in the surrounding parts. So the increase of thickness of the leg, is nothing more than the effect of the disease; but not the disease itself, as farriers, grooms, &c. suppose it to be. Nevertheless, we said before that the back sinews or tendons were void of feeling in a state of health and incapable of extension *." It may be very true that this injury is not commonly seated in the tendon; but we cannot agree with Mr Feron, that this part is never the seat of it, especially as he himself allows that a rupture of the tendon may take place, of which he has seen different instances. It is not difficult to conceive that the same exertion which when in a great degree is capable of rupturing the tendon, may in a smaller degree produce a partial laceration or a strain in the back sinews.

A horse labouring under this injury, even after the inflammation has subsided, is extremely weak and stiff in the joints of the foot; but when he has been for some time at work, the lameness in some measure goes off. This has led some persons to suppose that a strained horse may be worked sound; but this is a very erroneous opinion, and the practice of continuing to work a horse that has been newly strained, under the idea of removing the stiffness, is equally cruel and injudicious.

The treatment of strains or injuries of the ligaments or tendons must be such as will most effectually prevent inflammation, and promote the absorption of the effused fluid. Local bleeding from the veins of the part, and warm fomentations frequently repeated, seem to be the most advisable; and a bandage should be always applied where the nature of the parts will admit of it, and should be continued till the lameness is removed. Various stimulating applications have been recommended in these cases, as soon as the inflammation has subsided, such as oil of turpentine, camphorated spirit, verjuice, &c. but these must not be employed while any considerable inflammation remains. It is somewhat remarkable that Mr Feron recommends astringent and stimulating applications in the text of his work, and says there that they may be employed with safety; but, in a note at the foot of the page, he speaks of having inserted those astringent prescriptions for the purpose of satisfying the different opinions, but that he is fully convinced, by a long experience, that warm fomentations and warm poultices of bran and water, are infinitely preferable in strains or contusions, to these expensive prescriptions, and are always to be tried first.

It will be proper to elevate the heels of the horse's shoe by calkins, and Mr Blaine recommends that the heels of the hoof be encouraged to grow, or that a thick-heeled shoe be used. If there still remains much swelling, firing will prove one of the most effectual remedies, as it will both promote the absorption of the effused fluid, and will produce such a degree of constriction of the skin as will answer the purpose of a permanent bandage. In such cases the cautery must be applied, so as to make perpendicular lines on the skin.

35 Strain the sti dogs.

Dogs are very subject to strains; and where these are slight, a mixture of spirit of wine and oil of turpentine, or strong Goulard, applied before a fire, is the most useful remedy. Sometimes from blows or other accidents, such as slipping their hind-legs, or getting them entangled in the bars of a gate, hounds are lamed in their *stifle*, as it is called. In general the above applications and long rest will remove the lameness; but when a considerable quantity of coagulable lymph has been effused, it is not easily re-absorbed, and the lameness continues. When this happens, some huntsmen recommend the operation of cutting for the stifle, and Mr Daniel speaks of a huntsman who used to perform this operation very dexterously in the following manner. The bone is laid bare by a transverse cut, and upon it is found a substance, like a stiff jelly, which is the cause of the lameness, and is in fact the coagulable lymph that has been effused. This jelly is taken away, and a wire is run through the ball of the hind foot on the contrary side, and twisted in such a manner as to keep that leg from touching the ground, so that the hound may be compelled to use the stifled leg. In this way the dogs were always cured. The same huntsman recommended that

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* *Feron's Farriery*, p. 104.

that when a dog had been entangled in a gate or stile, he should, as soon as released, be taken by the hind-feet, and twisted round five or six times, turning with him; and it is said that this prevented any ill consequence from the bruises that he received in the stifle, while endeavouring to disengage himself.

358 Some of the ligaments or tendons of the extremities are now and then ruptured. This is not a common case, but it may happen, either to the suspensory ligament, or the back sinew.

359 Rupture of the suspensory ligament. A rupture of the suspensory ligament is found most likely to happen to young horses while breaking, and to cavalry horses while under training. The accident is generally called *breaking down*, as, when it happens the horse appears unable to support himself. The fetlock is brought almost to the ground, and the limb is evidently exceedingly weak; but the horse can bend his foot when he raises it. This circumstance distinguishes a rupture of the suspensory ligament from that of the flexor tendon or back sinew; as, in the latter case, the power of the flexor muscle being destroyed, the horse is unable to bend the foot.

It appears from the observations of Mr Coleman, and some experiments that have been made by Mr Feron, that the flexor tendon has little or no effect in giving support to the heels; but that this office is almost entirely performed by the supensory ligament. Hence, when this is ruptured, the horse loses one of his principal stays, and the foot is of course unable to support its usual weight, whence the horse breaks down.

A perfect cure of this accident can seldom be expected; and the only way to relieve the animal will be to obviate the inflammation as much as possible, and to elevate the limb, and especially to raise the heels, in order to relax the injured parts. An intermediate substance will in time be produced between the two parts of the broken ligament, that will enable the horse to walk and perform some of his functions, but he can never afterwards be depended on for the road or the field.

360 Rupture of the back sinew. When it is ascertained that the back sinew has been ruptured, which is discovered by the inability of the horse to bend his foot backwards, it is generally recommended to kill the horse, as a cure is by most deemed impracticable. Mr Blaine recommends to bend the limb from the ancle downwards, and to keep it in that situation by throwing the animal, when he thinks that a perfect cure might be made. There would, however, be considerable difficulty in keeping the limb in such a confined situation for so long a time as would be necessary to unite the ruptured tendon; and after all, there is the greatest probability that a very slight exertion would produce a fresh rupture.

361 Fractures. Fractures of the bones may take place in any part of these animals, but they are most common in the feet of horses and the legs of dogs.

The navicular, coffin, and small pastern bones of a horse are not unfrequently fractured, and Mr Feron speaks of a small pastern bone being broken into seven pieces. It is not surprising that these bones should be broken, when we consider the immense weight that is generally sustained by them, and the great exertions which a horse sometimes makes to recover a false step.

These bones, when broken, will be united by a callus, provided that the limb be kept in such a situation as to prevent motion; but this can rarely be effected, even in cases where the bones of the foot are fractured, still less in these cases where a fracture of the larger bones has taken place.

362 Fractures of the haunch-bone. One of the most common fractures of the bones in a horse is that of the ridge of the ilium, or haunch-bone. This bone, from the projecting angle formed by its ridge, is peculiarly exposed to injury; and when the ridge is unusually prominent, as sometimes happens, or when the horse is more than commonly lean, the probability of fracturing this bone is still further increased.

Fractures of the haunch-bone may be occasioned by falls, by blows, which are often given by brutal ostlers and carters, with the but end of a large whip, or perhaps a broomstick, and they are very commonly produced by striking the haunch violently against a post, or the edge of a wall; when the horse turns too sharply round a corner, or passes swiftly through a narrow gateway.

It may be ascertained that such an accident has taken place, by the pain the horse feels in the part, and where the fracture is considerable, by the cracking of the parts of the broken bone against each other, but still more certainly by an evident cavity of the haunch, from the depression of the ridge. The muscles of the belly in the upper part of the flank will appear sunk in, especially when the horse lies down, and will form a sort of hollow between the haunch and the ribs. The horse, when he attempts to move, will be as lame as if one of the bones of the leg were broken, owing to the extreme pain that motion excites in the muscles, that beside being severely bruised, have lost one of their principal attachments.

When an accident of this kind has happened, it is necessary to keep the animal perfectly at rest, as nothing but repose can produce a reunion of the fractured bone. The parts may be gently rubbed with some stimulating liniment, as in other cases of bruises, and some recommend the application of a charge, or strengthening plaster. It sometimes happens, where only a small part of the bone has been broken off, the horse completely recovers his former activity; but more commonly such a deformity is produced by the ridge of one haunch remaining lower than that of the other, and by the callus that forms between the end of the divided bone, as to render the horse more or less permanently lame.

When the legs of a dog are broken, it is easy by means of splints, to keep the limb in such a situation as to effect a union of the broken bone; and we have not unfrequently met with cases of this kind, where a complete cure has been effected in the course of a few weeks.

The ribs of a horse are sometimes broken, either by falls, or from the brutality of their keepers, as by striking them with the heavy handle of a whip or cudgel. If the end of the fractured rib does not penetrate into the chest, so as to wound the lungs, a cure may in general be readily effected, by fastening a bandage round the body over the seat of the fractured rib, and keeping the horse at rest and on a low diet.

363 Luxations. Luxations or dislocations of bones are exceedingly uncommon in the horse, owing to the great strength of the

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364 3. Lameness is very commonly the effect of tumours of the mucous bags or capsules, or of excrescences formed on the bones of the legs and feet, or on the hoof.

In most of the joints there are appendages or membranous bags, called *bursæ mucosæ*, or mucous bags, that are filled with a mucous fluid secreted into their cavities, for the purpose of assisting the motions of the muscles and tendons near the joint. It often happens that these mucous capsules are enlarged either from hard work, which is a very common cause of their enlargement, or from some injury done to the neighbouring parts. When the enlargement is but small, it is of little consequence, but when the bags become unusually distended, their size impedes the motion of the joints. These tumours have received different names among grooms and farriers, according to the place where they are seated.

365 Wind-galls. When the mucous bags that are situated near the pasterns become enlarged, the tumours are called *wind-galls*.

366 Bog-spavin. When the enlargement takes place in the mucous bags on the inner side of the hock, the disease is called *bog-spavin*.

367 Thorough-pin. When the tumours are seated in the upper and back part of the hock, between the gemelli muscle and the tendons of the great flexor muscle of the foot, the affection is called *thorough-pin*.

368 Capulet. When the swelling is situated at that part where the tendon of the gemelli muscles is inserted into the point of the hock, it is called *capulet* or *capped hock*.

Of all the various swellings, the wind-galls are the most likely to produce lameness, and next to them the bog-spavin. The capulet and thorough-pin are seldom of much consequence.

369 Treatment. In the treatment of wind-galls and similar tumours, the object is to remove the unusual swelling, and to prevent its return. The swelling can be removed only by evacuating the contents of the tumour, or by promoting its absorption. The former was recommended by Dr Bracken, and appears to have been successful in a few cases. The tumour is opened with a sharp knife; and when the fluid has been evacuated, an escharotic substance composed of burnt alum, white vitriol, and red precipitate, is applied to the wound, to produce such a degree of inflammation as may contract its cavity. Probably firing would have a better effect. Mr Coleman and the *elèves* of the veterinary college, are much averse to this operation, and certainly where it can be avoided it is not desirable. Absorption of the accumulated fluid may often be produced by the application of blisters, and other stimulating applications; but this is most certainly effected by producing pressure on the tumour, by means of a bandage applied round the part, with a bolster or compress immediately over the swelling. When the unusual enlargement has been reduced, its return is best prevented by firing the skin, so as to produce a considerable degree of constriction.

Horses are subject to various excrescences on the bones, or *exostoses*, as they are called, which, when they form near the joints, or below the tendons of the muscles, generally produce lameness. These excrescences have received various names, according to their situation. When they are formed about some part of the knee or canon bone, they are generally called splents, though farriers often call the excrescences at the knee *osselets*; and when there are two small bony enlargements near each other, they are called *fusees*. The excrescences at the knee are not very common, and when they occur, are generally the effect of a wound; but splents about the canon bone are very common, especially among young horses, owing to the blood-vessels in them being larger in proportion to the absorbents than in old horses; and hence the deposition of bony matter may, in certain cases of injury, be greater than what the absorbents are able to take up again. These excrescences are easily produced in young horses, by any blow or other injury that is capable of producing considerable inflammation; as striking part of the canon bone which is the usual seat of splents in what is called the *speedy cut*, or by producing unusual pressure on one side more than on the other. Although a splent may not be in the neighbourhood of any material tendon, it may still produce lameness by the pain which it excites; but when it interferes with a tendon, or some important ligament, lameness must in general be the consequence.

When an excrescence appears on any of the bones that enter into the formation of the hough, it is called a *bone-spavin*. It is most frequently found on the upper and inner part of the small metacarpal bone, or on some of the wedge-like bones on the inside of the hock. In the former situation it is often produced in consequence of the outer heel having been raised by callins; and in what are called cat, cow, or sickle hammed horses, it is often brought on by their natural deformity, though in these latter cases the excrescence is most commonly formed on the inside of the hock.

An excrescence situated on the back part of the hock towards its point, is called a *curb*. This is sometimes formed on the bone, but it is frequently only an unusual hardness and swelling of some of the ligaments.

When an exostosis forms on the lesser pastern bone, producing a hard swelling round the coronet, it is called a *ring-bone*. A deposition of bone over the lateral cartilages is sometimes also called by the same name.

The treatment of all these excrescences is much the same, and our object must be, either to excite the absorbent vessels to increased action, so as to remove the bony excrescence, or to take this away by means of an operation. The former of these is not likely to be successful,

cessful, except in the early stage of the complaint, when the bony matter is not completely hardened. If the excrescence be discovered in time, blisters are to be applied over the part, and repeated frequently, and strong mercurial ointment, or an ointment composed of corrosive sublimate and blistering ointment, is to be applied over the part, and gentle friction should be frequently employed on those parts of the limb that are above and below the swelling. By these means the excrescences may sometimes be removed; but when they have become too hard, these stimulating applications will scarcely excite the absorbents to sufficient action. The only method to which we can then have recourse is an operation long ago practised by the old farriers, apparently with considerable success. The bony excrescence is laid bare, by making an incision through the integuments, and then the excrescence is cut off by means of a sharp chissel struck by a mallet. After this the skin is to be laid down over the part, and we are to endeavour to heal the wound as soon as possible, by sticking plaster and a proper bandage. Firing is much employed by the French for the removal of ring-bones and other excrescences. Mr Lawrence recommends that in firing a ring-bone, the instrument employed should be thinner than usual, and that the lines described should not be more than one-fourth of an inch distant from each other, being crossed obliquely like a chain.

375 Corns. Sometimes an inflammation takes place on the lower part of the hoof, between the sensible and horny soles, or between the outer crust and the binders, producing a slight effusion of blood, and leaving a considerable tenderness in the part. When the hoof is examined after being perfectly cleaned, there is commonly seen a discoloured spot, sometimes red, but more usually blue, or blackish, like what is seen below one's nail, when the finger is jammed. This affection is commonly called by farriers a *corn*, (in Scotland, we believe it is called a *stone-cress*), though it is by no means similar to a corn in the human foot. Horny excrescences which might properly be called *corns*, are sometimes however produced on the horse's hoof; and of this nature, we suppose, were the *corns on the feet of Cæsar's horse*.

This complaint is always owing to an improper pressure on the horny sole, by which the sensible sole is squeezed between it and the coffin-bone. Hence a quantity of blood is effused from the vessels of the sensible sole, which, if it remains for any length of time, produces an unusual tenderness in that part of the hoof. Corns are generally produced by shoes that are too hollow next the hoof, so as to allow a stone to get between the shoe and the sole, and thus press upon the latter; or it may be produced by the shoe being made too short or too narrow, and thus indenting itself upon the sole between the binders and the crust.

The best manner of treating a corn appears to be, to remove that part of the sole which is immediately below the seat of the affection with a drawing knife, taking care to cut farther than the seat of the effused blood; then to insert a pledgit dipped in tincture of myrrh, into the opening. No pressure must be applied upon the part, and a piece of the shoe opposite the corn should be cut out, to prevent pressure from taking place. The horse must be allowed to stand quiet, on a level surface, and must not be worked till the horny part of the sole that has been cut away shall be renewed; and even then it would be proper to turn him to grass for some time, without shoes, or with very small tips of iron at the toes.

376 4. Lameness may be produced by many injuries of the feet, brought on by hard work, bad shoeing, or other ill treatment.

When horses are ridden hard on pavement, or hard dry roads, especially if the frog has been pared down, or even the crust cut away too much in shoeing, the battering produced on the hoof frequently brings on an inflammation of the sensible part within. This may happen also to cart horses made to draw heavy loads, under similar circumstances.

377 Grogginess. When the horse's hoof is not very delicate or tender, this battering sometimes only produces a stiffness, or swelling of the legs, and contraction of the sinews. This state is commonly called *grogginess*, or a horse that has his feet thus battered, is said to be *groggy*.

378 Founder. If inflammation is excited within the hoof, a most painful species of lameness is produced commonly called *founder*, or the horse thus lamed is said to be *foundered*. The complaint is also called *foot-founder*, to distinguish it from a disease which we shall describe hereafter, and to which farriers sometimes give the name of *body-founder*. This inflammation may take place in any of the feet, or in all; but it is most commonly produced in the fore-feet: and as, from the pain which the horse experiences, he endeavours to throw as much as possible of his weight, upon his hind-feet, and appears unable to support himself on his fore-feet, he is said to be *down before*.

379 Symptoms. This complaint most commonly takes place in horses; but it may take place in cattle or sheep, brought on by hard driving, on hard stony roads, when sent to fairs, or markets. In these animals, however, the complaint seldom proceeds to such a height as in horses; and it is in them more easily relieved.

The symptoms of *founder* are thus described by Mr Feron. "Foundered horses have a general stiffness of the fore-hand, attended with a considerable acute pain of the joints, ligaments, and muscles, connected with it. The pain which the animal suffers on moving the joints, obliges him to keep the flexor muscles in a constant relaxed state, which position ultimately produces an entire debility and stiffness of every joint which composes the fore extremity of the animal. If the horse has been neglected, or the disease so rapid in its progress that it cannot be removed, the symptoms will increase so rapidly, that in a very little time we may observe the cuticular veins become turgid and varicose, similar to the lymphatic enlargement in farcy. In this state, exercise considerably increases the pain and violence of the symptoms, the animal falls off his food, his health becomes very much impaired, and a general decay of the whole limbs, particularly observable in the extensor muscles of the fore-arm, soon renders the animal useless for activity *."

When the complaint affects the fore-feet, the horse throws his hind-feet as far forward as possible, which leads those who do not understand the nature of the complaint to suppose that the horse is affected with a weakness in his loins. When it is seated in the hind-feet the horse throws his body forward, in order to relieve

* Feron's Farriery, p. 120.

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lieve the hind-feet of their weight. In this case the horse is supposed to labour under an affection of the chest, which has been called *chest-founder*.

The complaint usually comes on very rapidly, and sometimes appears a few hours after hard riding, or after the application of other causes, that will immediately be mentioned.

It may be easily known that a horse is foundered, as he can scarcely walk on first coming out of the stable, and evidently labours under great pain. Like many other affections that produce lameness, the horse appears to be relieved by exercise, but this relief is only temporary; and exercise only tends to increase the disease.

Mr Feron says, that, on dissecting the feet of foundered horses, he has frequently found the membranes of the joints thicker than in their natural state, and sometimes a disposition to *anchylosis*, or stiff joint; which in some of the joints was evidently observed.

380 Causes.

The *founder* is very commonly produced by battering the hoofs on hard ground. It may be brought on by any causes that are capable of exciting inflammation in the internal sensible parts of the foot. It is frequently produced by washing the legs of a horse, while sweating; and according to Mr Feron, this is so evident, that if we observe the horses belonging to public coaches, in whom this practice is very common, we shall see that sixteen out of twenty labour under the torture of this disease. Founder may also proceed from allowing the horse, while sweating and fatigued, to stand long in a cold, damp air.

381 Treatment.

In the treatment of founder, the great object is to remove the inflammation, which is best done by bleeding in the veins of the foot, and the application of blisters about the joints. The shoe of the affected foot must be removed, and the toe of the crust may then be pared to the quick, in order to produce a discharge of blood from the vessels of the affected part. It will be proper to pare the whole of the crust as thin as possible, especially at the heels and quarters, in order to allow the frog to come in contact with the ground. Blisters are now to be applied round the fetlock, down to the foot. Mr Feron recommends immersing the feet in warm water 14 hours after blistering, keeping them there all day, and applying a large warm poultice of bran and water at night. Mr Blaine, on the other hand, advises the use of cold astringent lotions, as Goulard or sal ammoniac in vinegar. Sometimes the pain in the feet is so violent, that the horse can scarcely bear to support himself upon them, and indeed if he could remain quiet, it would be better to let him lie down. But if he proves restless, he may be partly supported by means of a sheet drawn round him, with its corners pulled up to the ceiling of the stable by pulleys, so as to let the horse's feet just touch the ground.

The horse must be kept rather low, and if the inflammation is very great, or if there is any fever, it will be proper to administer cooling remedies, such as the drenches marked 22 and 25 in the receipts. The belly must be kept moderately open, and all exercise must be avoided.

Sometimes after the inflammation has subsided, the lameness still continues. This may be owing to the formation of horny matter between the sensible and horny sole. Mr Blaine recommends that this be removed by cutting away the horny sole; but we much doubt whether this operation would be attended with the desired effect.

Stubbed feet in dogs.

*Founder*, properly so called, can take place only in those animals that have horny hoofs; but a similar affection not unfrequently occurs in the feet of hounds, after a long and fatiguing chase. It consists in an inflamed state of the feet, produced by long running, especially over hard or stony ground. When the dogs come home, their feet are hurt and swelled, inflamed, and sometimes cracked or chopt. The dog evidently feels considerable pain, and if he lies down for a little, he can scarcely be made to rise again. Dogs in this state are said to be stubbed in the feet, and are often so much lamed, that they cannot be taken out again for some days.

When the inflammation is but slight, it requires but little attention, as the dog will himself allay the swelling and pain by constant licking. When, however, the feet have been much bruised, the cracks pour out a bloody or purulent matter, and the case requires greater attention. The feet should be first bathed with warm water, and great care taken that no dirt or gravel be suffered to remain between the claws or in the cracks. After bathing, the feet may be rubbed with some digestive ointment, and a cold poultice composed of crumbs of bread well moistened with vinegar and water, should be tied round the affected foot.

The hoof of the horse frequently becomes lengthened, and contracted at the heels and quarters. This unnatural shape is commonly the effect of bad shoeing, by which the frog is deprived of the necessary pressure on the ground, and thus the heels are prevented from expanding, while the nails that are fixed in the quarters contribute to prevent expansion there, and thus the hoof is unnaturally lengthened at the toe. This contraction is considerably increased by the heat of ordinary stables, and by the evaporation that takes place from the hoof while the horse stands within doors, on account of the vacancy left below the frog, while the heels are elevated above the ground. Contraction of the hoof causes lameness, by producing an unnatural degree of pressure on the sensible parts within, especially on the sensible frog, which is not unfrequently inflamed in these cases.

The remedy for this defect is, to bring the frog gradually to press upon the ground, by lowering the heels; but as, in the very sensible state to which the feet are commonly brought by contraction, it might be dangerous to apply pressure to the frog at once, it is advisable to lower the heels gradually, in the manner directed in N° 146. If the frog is much diseased, as sometimes happens, a bar shoe should be employed, by which means slight pressure may be made by fixing an iron plate from the heels of the shoe towards the toe. The best means of producing pressure in these cases would probably be to employ Mr Coleman's artificial frog. The upper part of the hoof should be rasped thin, especially at the quarters, as these parts of the hoof will then be more easily expanded by the motion of the lateral cartilages. The lower part of the hoof should also be kept moist, especially the frog.

Mr Blaine remarks, that dark chesnut horses are more subject to contracted feet than others, and he relates a case of a mare belonging to himself, who had all her feet contracted. These he endeavoured to expand by by means of jointed shoes, furnished with a sliding bar, which was kept in its situation by means of pegs, so that in this way the heels of the shoe might be gradually widened, by moving the cross bar farther on towards the toe. This method is very ingenious, but Mr Blaine acknowledges that it did not fully answer his purpose.

When the heels have been gradually lowered so far, that the frog can bear the proper pressure, the horse should continue to wear a thin-heeled shoe; but if he is not required to be worked, it would be better to send him out to grass without shoes, where the pasture is not too dry.

384 Running thrush.

It often happens in cases of contracted feet, and in some other cases, when the frog does not receive the due degree of pressure, that a running takes place from the cleft of the horny frog, occasioned by a degree of inflammation which is followed by a secretion of purulent matter. This complaint is commonly called a running thrush. While it extends no farther than the horny frog, it is seldom attended with any serious consequences; but if it be neglected, the matter extends through the horny to the sensible frog and sensible sole, and produces canker or quittor.

Some horses have naturally a running from the cleft of the frog; and so long as this is slight, and the parts are kept clean, it is of little consequence. We know there are some persons who conceive a *slight running thrush*, as rather beneficial to a horse, and do not esteem it as a mark of unsoundness; but we cannot agree with these gentlemen in either particular, as, though the complaint does not in itself absolutely render a horse lame, so long as his feet are properly atttended to, it will, if neglected, degenerate into a foul ulcer, the matter of which may easily penetrate into the internal parts of the foot. A *running thrush* is very commonly the consequence of bad grooming, and suffering dirt and gravel to lodge in the cleft of the frog; and it is still more frequently produced in the common method of shoeing, by cutting and paring away the frog.

In the treatment of a running thrush, the principal objects are, to remove the cause that first produced it, and to stop the discharge of purulent matter. The latter is easily effected by applying to the part some stimulating liniment. Mr Blaine recommends for this purpose a composition of two ounces of tar, with six drachms of vitriolic acid, which is to be applied hot every day, by pouring it into the cleft of the frog from a spoon. The discharge, though easily stopped in this way, will soon return, unless the proper degree of pressure be given to the frog; and this is to be brought about by proper attention to shoeing the horse with thin heeled shoes, taking care that the heels be lowered gradually, and slight artificial pressure be made on the frog, till it is become sufficiently healthy to bear the natural pressure of the ground.

385 Canker.

When the matter of a running thrush insinuates itself upwards to the sensible part of the foot, it forms what is called *canker*, in which there is a considerable inflammation, producing a luxuriant unhealthy fungus, springing up from all the diseased surface that is exposed, and producing a great degree of tenderness, and what may be called a rottenness of the hoof. If this disease continues for any considerable time, it attacks the whole substance of the foot, extending to the tendons, ligament, and bones, till at last the foot may absolutely drop off with disease. Mr Coleman considers canker as generally the effect of too much moisture applied to the foot or hoof.

To check the progress of a canker, the whole of the excrescence that appears on the external part of the hoof, is to be cut away close to the surface from which it springs, and such parts of the horny sole as appear to be detached from the sensible sole, should be removed, to prevent the matter from lodging in the internal parts. When the diseased part is fairly exposed to view, it is to be washed with a solution of some metallic caustic, such as nitrate of mercury, N° 49. of the receipts, or a solution of lunar caustic, in the proportion of a drachm to two ounces of soft water. This is best applied by moistening a pledget of lint or two, and confining this upon the cankered surface, by applying a regular pressure by means of cross bars of iron introduced beneath the shoe. A continuance of these applications, while the frog is gradually exposed to pressure, will in general soon stop the progress of the disease, and when this is removed, the horny parts of the hoof that had been cut away, will be gradually removed; and by shoeing the horse properly afterwards, the disease will be prevented from returning.

Cattle and sheep are subject to a disease very similar to canker in the horse, producing a discharge of fetid matter from between the claws of the hoof, or sometimes from only one claw.

386 Fouls.

This affection in cattle is commonly called *the fouls*, or the cattle are said to be *foul in the foot*. Managers of cattle commonly divide this disease into two kinds, the soft, and the horny, which are said to require different modes of treatment. In the *soft fouls*, a running of very offensive matter takes place from the heels, or between the claws of the hoof; and the animal appears exceedingly lame. The treatment in this case, consists in cutting away all the soft and spongy parts, and then applying a caustic liquid, such as will presently be described, for the foot-rot in sheep. The parts are then to be covered with a pledget spread with mild ointment, or, what is very common among farmers, a piece of fat bacon may be wrapt round the part, tied on the foot, and suffered to remain for two or three days. In the mean time the animal should stand very clean, and be allowed to rest as much as possible.

The *horny fouls* seem to be very analogous to corns in horses. The animal is very lame, and, on examining the foot, the hoof feels very hot, and, when hard pressed, the beast evidently feels much pain. There will commonly be found some part of the horn penetrating into the softer parts of the foot, either at the heel, or between the hoofs. In the treatment it is necessary to cut away these parts of the horn, as well as any part under which there appears much inflammation. For this purpose, it will probably be necessary to cast the animal, but care should be taken that he be thrown on a soft place. After the hoof has been pared away, a rag moistened with vinegar and water should be tied on, and the animal must be sent to grass in a soft smooth pasture. If the inflammation and pain are very great, it may be necessary to bleed from the veins of the foot.

387 Foot-rot in sheep.

In sheep it is called the foot-rot, and is generally produced by their being kept on a wet soil. It is remarkable that salt marshes do not produce it. According to Mr Lawrence, frequent travelling to and from the fold, or by suckling ewes from the hot dung of a sheep-house, will occasion it. Some are of opinion, that it originates from the same cause which occasions chilblains in the human feet; and this opinion is maintained in the essay on the diseases of sheep, affixed to Mr Findlater's Survey of Peebles, where it is stated, that the remote cause of the disease is weakness, and the immediate cause cold and wet, as standing in cold weather upon wet pastures, with the feet constantly soaked in water. Dr Wilkinson of Enfield considers moisture as the predisposing cause, and has found the disease to be produced from the sheep continuing in long grass during a mild winter. The same cause generally, although perhaps gradually, operates upon the whole flock, and then it has been supposed that the disease is contagious. The late Lord Somerville had a piece of pasture which always produced the foot-rot on any sheep that were put into it; but the disease was entirely prevented or rooted out by a careful selection of the sheep in order, by paring the hoofs of those that began to be affected, and by the use of caustics not too corrosive. These appeared to be the most proper means of stopping the complaint, and the best caustic application is said to be the nitrate of mercury. It is evident, that during the application, the hoofs of the sheep should be kept as clean as possible. Whether its greater or less prevalence depends on the less or greater attention paid to the sheep, is not perhaps fully ascertained. It is, however, certain that the sheep of some districts are entirely free from it. We are informed, that in Tweeddale the complaint is scarcely known.

388 Pummiced feet.

There is a disease in the horse's foot, in which the coffin bone is forced backwards, and made to press unnaturally upon the heels, by which its edges being subjected to unusual pressure, become partly absorbed. Hence this bone, losing its support, becomes pressed in its concave part, where inflammation is produced, and bony matter is thrown out, rendering the lower part of the coffin-bone convex instead of concave, and the sole is rendered unusually thin. This disease is called *pummiced feet*, and may be brought on in three ways; from improper shoeing, from inflammation, as in case of founders, and from a natural defect in the foot itself. It is said to be very common in wet soils. It is very commonly produced by applying the shoe red hot to the horse's foot. Its immediate cause appears to be an inflammation of the sensible laminæ, by which a quantity of coagulated lymph or of bony matter is thrown out, that forces back the coffin bone in the manner above described. When the disease is completely formed, it does not appear capable of being radically cured, but only admits of palliation. Mr Blaine recommends, that the growth of the sole should be encouraged by every means, but the foot should not be kept improperly moist. The best means would be, the turning the horse out without shoes in dry pasture. No part of the heels or sole should be removed in this case, as the parts are already too slight. A shoe should be formed, if possible, that presents a hollow surface to the foot, and a plain one to the ground. This may be done, by making it of rather an increased thickness, which will admit of its being hollowed within, and bevilled from the outer to the inner edge of the web.

389 Sand-cracks.

Sometimes perpendicular fissures or cracks are seen in the hoof, extending between the fibres in a parallel direction from above downwards. These are called sand-cracks, and generally take place near the quarter, more frequently on the outer than the inner side, and oftener in the fore than the hind foot. These cracks sometimes come on suddenly, and then generally denote a contraction of the hoof. They are also said to have arisen from a wound in the vessel or part of the coronary ligament, bringing on a secretion of horny matter, which gets between the fibres of the hoof, and causes them to separate.

The means of preventing the crack from extending, are to thin the hoof where the crack has taken place as much as possible, and to make a transverse section a little way across at the upper part. If the crack should still continue to gape, it must be carefully covered, and the hoof bound round, so as to close it as much as may be, and the portion of the crust that rests on the shoe should be chambered away a little, by which means the divided parts will be more likely to come together.

390 False quarter.

When a wound has been inflicted on the coronet, the coronary ligament commonly becomes injured, and its vascular part does not secrete so much bony matter as usual. Hence there is a space left between the old horny matter of the hoof, and the new that is formed from other parts; and this produces what is commonly called a *false quarter*. A false quarter may also be produced, in consequence of a quittor extending upwards through the coronet. As the sensible laminæ within the hoof are liable to be pressed in this vacant space between the horny edges, thus causing violent pain, the false quarter is attended with a lameness of the worst kind; for as this interference of the lamina sometimes takes place suddenly, while the animal is in motion, the pain makes him shrink, and he not unfrequently comes down.

The only way of remedying this defect is, to excite such an action in the coronary ligament as may dispose it to throw out new horny matter, and thus fill up the vacant space. This is best effected by removing the surrounding horn, and applying blisters to the coronet, while the part of the hoof that is opposed to the shoe should be hollowed away as much as possible, to admit of the separated parts approaching each other.

Cutting.

When a horse in motion, especially in trotting, brings one foot so near another as to interfere, and thereby graze or wound one of the feet, he is said to cut. Sometimes the feet of a horse are in this way severely wounded, and temporary lameness is produced. In cutting, the horse may either wound the heels of the fore feet, with the toe, or side of the hind shoe, which is the most common case; or he may wound the fore part of the hind-foot, just above the hoof, by striking it against the heel of the fore shoe; or, lastly, he may bring two of the feet so closely together, as to wound the inner side of either.

Cutting may arise from a bad habit, or from a natural deformity of the feet, but it is very commonly the consequence of bad shoeing. When horses cut from turning out their toes, which is by much the most common cause, they are observed to have the inner quarter of the hoof lower than the outer, and the fetlock joints are thus nearer each other than those of horses which have their limbs straight. These facts led farriers to a conclusion, that if the inner quarters were raised to a level with the outer, and especially if made even

even higher, the fetlock joints would be thrown further apart, so that the foot would pass the supporting leg without striking: Accordingly, it has been usual to make the inner quarter of the shoe higher than the outer, and this has been the common practice for a long time. Mr Morecroft, by making trial of a shoe, of a shape the reverse of what we have described, namely, having the outer quarter thick, and the inner thin, completely prevented cutting in the horse, on whom those shoes were tried, and the utility of the improvement has been confirmed by succeeding trials. According to Mr Blaine, the principle on which this is supposed to act is, that when a horse is at rest, he supports his weight equally on both feet; but having his inner quarter much raised, in the common mode of attempting to remedy the defect of cutting, when one foot is elevated he must be supported obliquely on the other, and hence have a tendency to fall outwards; to prevent which he brings the moving foot nearer the supporting one, by which he strikes it. Considering it in this point of view, it is not difficult to account for our author's mode of reasoning on his method, which, by elevating the outer instead of the inner side of the supporting foot, must necessarily give it a disposition to lean inwards, and fall to the inside, which will throw the moving further from the supporting foot. But, ingenious as this mode of reasoning may be, it is to be feared, that by thus throwing an increase of weight on the inner side, we shall sometimes be in danger of producing evils, that will counterbalance the prevention of cutting *.

392 Lameness may be produced by any one of the causes that we have mentioned, but it may happen that a combination of two or more of these causes takes place at the same time in different parts of the same limb: thus the foot may be pricked with a nail, and a strain may take place nearly at the same time, in the sinews of the leg, or the ligaments of the joints; for the pain excited by the nail first makes the horse trip or stumble, and then, by his making a sudden exertion to save himself, or ease the pained foot, a strain of the ligaments or sinews frequently takes place. A similar complication is often produced in a horse that is affected with spavin, or other bony excrescences, as his exertion to save the limb that feels painful from the rubbing of the muscles or tendons against the spavin, may produce a severe strain in the muscles of the shoulder.

As the causes of lameness are so various, and the real seat of it frequently very obscure, a practitioner should be extremely cautious how he gives a decisive opinion with respect to either, before he has well examined the parts where lameness may take place, and enquired into every circumstance that may assist him in forming his opinion. For want of such precaution, and from a superficial examination of the part that is supposed to be the seat of the affection, egregious blunders and dangerous mistakes are not unfrequently committed, and applications have been made to parts that are really sound, when it is afterwards discovered, to the confusion of the practitioner, that the real cause of the lameness was in a different place. Nothing is more common than for ordinary farriers to apply their liniments and embrocations to the shoulder, when in fact the affection that causes the lameness is seated in the feet.

As, perhaps, in nine cases out of ten, the foot is the part that has received the injury, this should first be examined with the strictest attention, the hoof should be made perfectly clean, especially in its under surface, to see whether there be any crack or fissure, any discoloration, any particular heat, &c. The pastern and all round the coronet should be also carefully inspected; and, if nothing is found, the examination should be repeated next day, or even a third time. The foot is more particularly to be suspected of being the seat of the complaint, when the lameness makes its appearance soon after the horse has been shod, or has had his shoes fastened; as the foot may be lamed by a nail in shoeing, though the point of the nail has not penetrated to the quick. The nail may be so thick, or may pass so near the quick, as to press in a small part of the hoof upon the soft parts, thus producing exquisite pain, and perhaps inflammation. It is therefore proper also to remove the shoe from the foot of the affected limb, and if the cause of lameness is not very evident, to wait a few days to see whether the removal of the shoe has produced any alteration for the better.

No certain rule can be laid down for judging of the seat of lameness from the motion of the affected limb, though this is considered by some as one of the surest marks. The deranged motion in one part of the limb very commonly arises from sympathy with another part that is the real seat of the affection.

393 String-halt. We have now, we believe, mentioned all the important cases of lameness, except the *string-halt*, or *click spavin*. This is an affection of the hind quarters, producing a sudden jerking of the legs upwards, when the horse attempts to move. It appears to be a nervous affection, and seems to be somewhat analogous to the *chorea*, or *St Vitus's dance*, in children. We do not know that this affection has ever been cured, but it is said that it may be palliated by allowing the horse to run much at large, and letting him remain untied in a large stable. Mr Lawrence recommends that, after a hard day's work, both hind legs be immersed in a warm bath up to the hocks, and kept there as long as the water continues warm, when they are to be rubbed perfectly dry, and the same bath and rubbing repeated in the morning. He also advises anointing the back sinews, and about the hocks, with strong camphorated ointment.

394 Ulcers. We have occasionally, in this and the preceding chapters, spoken of abscesses and ulcers, and their treatment; and we can add little here on that subject, as it will be fully treated of in the article SURGERY; and the instructions to be there laid down will apply nearly as properly to the inferior animals as to man. We may just remark, that foul ulcers, and such as do not heal kindly, are perhaps more common in some of the inferior animals than in man; and hence they require in the former applications of a more stimulating nature, to excite a proper degree of healthy action in the ulcerated part. There are a few particular ulcers which call for consideration in this article, and we cannot, perhaps, treat of them in any part of the treatise more properly than under the morbid affections of motion.

395 Poll-evil. There sometimes takes place an inflammation, and consequent suppuration in the mucous capsules, at the articulation of the head with the first vertebra of the neck, near the insertion of the cervical ligament. This affection is commonly called the *poll-evil*. It is almost

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* *Blaine's Outlines*, vol. ii.

always the consequence of an injury done to the back of the head, by a horse's hanging back in his collar, by striking his head against the rack or manger; and is very frequently produced by a blow given on the head by brutal coachmen or carters. An ulcer in this part is often very difficult to heal, and when it extends beyond the skin, the matter sometimes insinuates itself below the ligament of the neck, and on each side of it, and it not unfrequently produces a caries or rottenness of the vertebræ. The cure of the poll evil is most easily effected when the inflammation is first discovered, before a suppuration takes place; as, when once matter is formed, it commonly produces sinuses in the loose cellular substance about that part of the head, and these are not easily healed. When, therefore, we have reason to suppose that inflammation has begun in the skin of this part of the neck, every means must be employed to prevent its progress towards suppuration. A blister should be immediately applied over the part, and when this has done its duty, a solution of sal ammoniac in vinegar, or vinegar and water, should be applied by means of a cloth kept constantly wet. If a suppuration appears inevitable, it must be encouraged by fomenting the part frequently with warm water, or by the repeated application of warm poultices; and when the swelling appears sufficiently ripe, it must be opened, which is best done by introducing a seton from the highest to the most depending part of the tumour, as directed in N° 173. The cord of the seton must be examined every day, wiped dry, and rubbed with a little digestive ointment, and the sore should be carefully excluded from the air.

If the suppuration has proceeded any length, before it is discovered, there will probably be a number of sinuses, or *pipes*, as they are called, with matter lodging in each. If it can be easily effected, it would be proper to lay these open, and make them communicate with each other, or, if their direction can be ascertained, a seton may be passed through each. When a proper opening has been made for the matter, and care taken that none of it lodges, the sore will soon heal, by the application of the proper stimulating ointments.

It is sometimes necessary to employ the knife in this case; but when this is done, the greatest care should be taken not to wound the ligament, or, as the farriers call it, the *fix fax* of the neck. The best method of avoiding this is, to have the animal's head fastened very high to the rack, by which the ligament will be more slack, and the finger can be easily introduced below it, so as to be a guide to the knife.

396 Fistulous withers.

We mentioned in N° 341. the chafing of the back with the saddle. There is another injury of a similar kind, that is often suffered by the withers, from the saddle being allowed to press on them too long. This pressure and rubbing sometimes produces an inflammatory swelling, which, if it be not soon discussed, goes on to suppuration, and produces a sore which farriers call *fistulous withers*, or a *fistula in the withers*. This is also a very troublesome ulcer, as the matter sometimes penetrates below the shoulder, and makes its way down the bones of the fore leg; or, by insinuating itself among the vertebræ of the back, renders them carious. The treatment in this case is much the same as in the last; the inflammation should be discussed as soon as possible, and if matter forms, it should be evacuated by means of setons. It is frequently required to pass a seton through the tumour on each side of the withers, in order to produce a proper inclination of the orifice, to carry off the matter. When sinuses form, they must be opened, as in the case of poll-evil.

397 Canker of the ear of dogs.

There is sometimes a species of ill-disposed ulcers in the external part of the ears of dogs, very difficult to heal. It is generally called *canker*. These, when they heal, leave hardened edges, which frequently break out again in the course of a few months. The best application in this case is lunar caustic applied to the edges, to encourage them to slough off; but if this should not be found sufficient, the best remedy will be to sear off the diseased parts with a red-hot knife, or they may be cut by a simple incision.

## CHAP. III. *Morbid Affections of Digestion.*

398

In order that the food may be well digested, when received into the stomach, it is necessary that it undergo the previous operation of chewing; unless it be of such a nature, as to be easily soluble in the gastric juice, without this previous preparation. The latter is the case only with dogs, whose food consisting almost entirely of animal matter, requires little or no chewing. But the food of horses, sheep, and cattle in general, requires to be well chewed, either when first swallowed, or in sheep and cattle by subsequent rumination.

399 Sores

The mouth in these animals is sometimes so swelled, or otherwise affected with sores or cracks, that it is with difficulty the animals can chew their food. Sometimes there are bloody chinks or chops in the palate, occasioned by thistles or other prickly plants, which are mixed with the hay, or grow up among the grass. These should be washed on their first appearance with salt and vinegar, applied by means of a rag tied to a stick. If neglected, these chops frequently become inflamed and ulcerated. If pimples arise, they must be opened when they begin to suppurate, by means of a pointed cautery. There are sometimes found within-side the lip of cart horses and other ordinary cattle, soft tumours, or pustules with black heads, which are called *giggs*, *bladders*, or flips in the mouth. They do not always occasion much inconvenience, but sometimes they grow to a large size, so as to grow troublesome, and prevent chewing. When this is the case, they must be removed, either by fastening a thread about their roots, as directed in the treatment of warts, where they are of such a form as to admit of a ligature; or by the knife, applying afterwards the hot iron or cautery. In performing this operation, care must be taken to draw the tongue to one side, so that it may not be wounded. After removing these excrescences with the knife and cautery, the mouth may be washed with a solution of white vitriol or alum. Excrescences of a similar kind, called *barbs* or *paps*, sometimes grow below the tongue, and must be removed where practicable by means of a ligature, as it is dangerous to employ the knife. When these excrescences are neglected, there sometimes arise in the mouth little ulcers with white specks, very similar to the aphthous crusts that form in the human mouth. It is recommended by some writers to use the cautery on these occasions; but probably a detergent lotion, such as we have just recommended, will answer the purpose of removing them.

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400 Wounds in the mouth. The mouth or tongue of horses is sometimes wounded with the bit or curb. When this happens, a lotion made with alum dissolved in water, and sweetened with honey, may be employed; and the bit should not be used again till the mouth is healed.

401 Lampas. Many veterinary writers have described the disease in the horse's mouth called the *lampas*, which is stated to be an inflammation and swelling of the first bar of the mouth in a young horse, so as to prevent his chewing. We believe that Lafosse and Dr Bracken were the first to deny the existence of such a complaint, which is now generally discredited among most of our modern writers. We have no doubt that such a swelling may take place; but it can scarcely be attended with the ill consequences commonly attributed to it, or require such vigorous treatment as is usually recommended.

402 Choking. It may happen, that any of these animals shall have a difficulty of swallowing, from various causes; either from an unusual narrowness in the gullet, or from the morsel attempted to be swallowed being too large. The latter very frequently happens to cattle who are fed upon turnips or potatoes; and the choking thus produced sometimes proves very dangerous, as, if the obstruction is not speedily removed, the animal will die for want of breath. The method commonly employed among country farmers for *unchoking* cattle, as they term it, is to thrust down the throat a large stiff rope, ravelled at the end, and well greased. This often succeeds, but it is a clumsy method; and if the rope, by having been long used, or becoming dry, should lose its stiffness, it will be bent in endeavouring to force down the obstruction; or, if the ravelled end be not pretty large, or the obstructing morsel of an irregular shape, the rope may pass between the side of the gullet and the obstruction, without this being removed. Several intelligent farmers have therefore laid aside the use of the rope, and have contrived an instrument similar to the probang employed by surgeons. An instrument of this kind has been already mentioned, in the description of Mr Hunter's feeding byre in N° 236. An account of one that appears to us to be more useful and ingenious, has been communicated to us by the reverend Charles Findlater, minister of Newlands in Tweeddale. It is the contrivance of Mr Charles Alexander, a farmer in Mr Findlater's neighbourhood, and has long been employed by him for the purpose of relieving choked cattle. The following is Mr Alexander's construction of his instrument, as politely described to us by Mr Findlater.

403 Mr Alexander's probang. Take three small canes, of the thickness of the little finger, or thereabouts, of the length of $5\frac{1}{2}$ feet, that they may reach down the throat, and into the stomach of the largest ox. These canes are to be bound together by strong smooth twine rolled tightly about them (the circles of the twine touching each other), from top to bottom. Bees wax is then to be rubbed along the twine, to fill up any inequalities, and the whole rod is to be well oiled before it is used. There is a round knob at each end, the larger $2\frac{1}{2}$ inches in diameter for larger cattle; the other less for lesser cattle. These knobs are formed of the twine rolled hard, and when formed may be strengthened in their position, by being sewed by means of a shoemaker's awl or *brog*, and a wax bristled thread, such as they employ. The thread knobs are made tapering up the canes from their bread extremity; but it must be remarked that the surface of this extremity is not rounded like a clue, but hollowed into the form of a cup. The intention of this hollowed form is, to make certain of catching hold of the obstructing body; as, if the knob was round, it might pass by it. After the knobs are formed, they are covered with soft leather, which by its flexibility will adapt itself to the hollow end of the knob as soon as it reaches an obstacle. The knobs must be securely fixed to the canes, for if they fall off, they leave an indigestible substance in the stomach. Such is Mr Alexander's probang, the only improvements on which that we would advise are, to make the knobs of sponge, firmly fastened to the canes, by passing twice through holes bored in them, and adding at each end two or three bights of twine, for the purpose of catching hold of any obstacle, thus making the instrument almost exactly like a surgeon's probang. We think the sponge preferable to the twine, as it will not be so liable to injure the animal's throat by its hardness, will adapt itself more readily to the form of the obstacle, and may be more firmly fixed to the canes.

404 Over-feeding or fog-sickness. When cattle are put into a field of young clover, or rich grass, especially if they have previously been kept on poor or dry fodder, they are apt to eat voraciously of their new repast, and the young succulent food, when received into the stomach, soon ferments, and produces such a quantity of air, as to swell the stomach to a violent and dangerous degree. Cattle thus affected are said to be *over-fed*, *hove*, or *blown*; or the affection of the stomach thus produced, is called *over-feeding*, or sometimes *fog-sickness*. If not speedily relieved, the animal's stomach not unfrequently bursts, from the inability to evacuate the accumulated air; for there seems, in these cases, to be a constriction of the gullet, so that the air cannot escape upwards, while the number of stomachs, and the spasmodic contraction producod by the unusual distention, prevents its passage by the anus.

The necessity of speedily relieving the animal, prompted the employment of what must at first have been considered as a very desperate remedy; namely, stabbing the animal. An opening is made with a sharp penknife into the paunch, in the thin part between the last rib and the huckle-bone; and through this the air rapidly escapes. Sometimes the barrel of a quill is inserted into the wound, to prevent its closing before all the air that is produced during the fermentation of the food, has escaped.

Stabbing the animal, is a remedy that should not be had recourse to, but on the most urgent necessity; as the wound can seldom be made with such nicety as not to wound some important organ, especially some large blood-vessel. Indeed frequently the distention of the stomach, and consequently of the skin and muscles of the belly is so great, that the moment the knife is introduced, a dreadful rent takes place, producing such a wound as may be attended with fatal consequences.

Happily this operation is not often necessary, as it is found that the administration of some internal stimulating medicine will check the fermentation of the green fodder, and promote the absorption of the extricated air. Many farmers have for some time given tar with this intention, administering an egg shell full to each beast; of late, however, the use of ardent spirits has been introduced, and it is found that a pint or mutchkin

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of whisky or gin, mixed with an equal quantity of water, is the most efficacious remedy. Laudanum has also been recommended, but probably it is not superior to common spirits (D).

It has been the practice with some farmers, to introduce on these occasions, the common rope employed in cases of choking, into the stomach, and move it up and down, so as to produce a gradual evacuation of the air; but we should suppose that the evacuation produced in this way must be extremely slow.

405
Dr Monro's flexible tube.

Dr Monro senior, professor of anatomy in the university of Edinburgh, some years ago contrived an elastic tube, that might be introduced down the throat into the stomach of the animal, and thus speedily and effectually evacuate the air. A description of this instrument, and the manner of employing it, appeared in an Edinburgh newspaper, we believe, with the doctor's authority. It has since been published in a popular treatise on the diseases of black cattle, entitled "Rowlin's Complete Cow-Doctor," from which we have taken it.

The doctor begins by observing, that the swelling of the belly is owing to the distention of the stomachs by fixed air, disengaged from the succulent grass in consequence of fermentation, the discharge of which by the mouth seems to be prevented by a spasmodic contraction of the upper orifice of the stomach. He concludes that the cattle may with certainty be saved, if the air be drawn off in due time, without injuring the stomach and bowels; and he affirms that this may be done with great ease by passing a flexible tube down the gullet into the stomach.

The tube is to be composed of iron wire, as large as a common stocking wire, or about one-sixteenth part of an inch diameter, twisted round a smooth iron rod, three eighths of an inch diameter, in order to give it a cylindrical form; and after taking it off the rod, it is to be covered with smooth leather.

To the end of the tube, which is intended to be passed into the stomach, a brass pipe, two inches long, of the same size as the tube, and pierced with a number of large holes, is to be firmly connected.

To prevent the tube from bending too much, within the mouth or gullet, in time of passing it down into the stomach, an iron wire, one eighth of an inch diameter, and of the same length as the tube, is put within it, which is to be withdrawn, when the tube has entered the stomach.

He has found that the space from the fore teeth of the under jaw, to the bottom of the first stomach of a large ox, measures about six feet, and he has passed such a tube, five feet and nine inches long into the gullet and stomach of a living ox. The tube ought therefore to be six feet long, that we may be sure of its answering in the largest oxen.

After the tube is passed into the stomach, it may be allowed to remain for any length of time; as when it is pressed to one side of the throat, it does not intercept the breathing of the animal. The greatest part of the elastic and condensed fixed air, will be readily discharged through the tube; and if it be thought necessary, the remainder of it, or the superfluous drink, may be sucked out, by a bellows fixed to the upper end of the tube, with a couple of valves, one at its muzzle, and the other at the side of it, so disposed as to allow the air to pass in the direction from the stomach upwards.

By means of such a tube, the air is not only more certainly discharged than by stabbing the animal; but the dangers avoided which the stabbing occasions, not so much by the irritation which the wound creates, as that the air, and the other contents of the stomach, getting into the cavity of the belly, between the containing parts of the bowels, excite such a degree of inflammation as frequently proves fatal to the animal. This tube may be also useful for the purpose of introducing stimulant medicines in the stomach, when the contraction at the upper orifice would prevent their being given without some such contrivance.

An instrument of this kind is sold in London, at Macdougal's N° 15, Great Wind-Mill Street. It should be made of various sizes, for sheep as well as cattle. According to Mr Blaine, Mr Eages of Graffham farm, near Guildford, has simplified this mode of relief much, by the invention of an instrument, for which he was rewarded by the Society for the Encouragement of Arts, with fifty guineas. This is simply a cane of considerable diameter, and six feet in length for oxen; to which is affixed a knob of wood, at the end to be introduced into the stomach. That for sheep is considerably smaller, and three feet long. This instrument, for its simplicity, is much to be preferred, as it is found to occasion the evacuation of the air as effectually as the other. In cases of emergency, and in a judicious hand, the flexible part of a common cart whip might answer the end.

Flatulence may be produced in horses, by eating greedily of rich food, to which they have been unaccustomed, or after having fasted long; especially if they drink much water immediately after. A horse in this state should not be taken out to work, as, from the distention of the stomach, there is danger of injuring the horse's wind, or even in some cases of bursting the stomach. If the distention has not proceeded to a great length, and if the horse is not costive, gentle friction on the belly, and administering a ball made of some of the cordial seeds, will generally procure relief; but if the complaint proceeds to a great height, and there is griping pain, attended with costiveness, it becomes a case of flatulent colic; the descriptions and treatment of which will be considered in the next section.

406
Acute indigestion.

When this flatulence comes to a great height, it forms the disease that is commonly called acute indigestion. It very commonly arises from the horse eating voraciously, after having been kept without food for many hours; especially if the food then given him be of a flatulent kind, such as grains or draff, young sweet grass, clover, or the like. The horse's stomach being naturally small, is easily distended by an unusual quantity of food, or by the air disengaged from such as easily runs into fermentation. Hence arise swelling and tightness of the stomach, and acute pain. The horse discontinues eating,

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(D) The use of spirits in these cases was, we believe, first introduced by Dr Whytt of Edinburgh, who was in the habit of administering a pint (mutchkin) of gin on these occasions.

Diseases.

eating; holds out his head, and appears exceedingly distressed; he looks anxiously and mournfully at his side, stamps with his feet, and breaks out into cold sweats. If he is not soon relieved, the head becomes affected, and there appear evident marks of pressure on the brain. Symptoms very similar to those of staggers follow; and the horse commonly dies apoplectic, or the stomach bursts.

As this affection is so dangerous, immediate relief is necessary. Stimulant medicines, such as are called carminatives, as oil of aniseseeds, essence of pepermint, or oil of turpentine, should be immediately administered; and if there appears much determination of blood to the head, which may be known by a swelling and heaviness of the eyes, and the violent throbbing of the arteries of the temples, it will be necessary to draw blood pretty largely by opening one of these arteries. If the horse is bound in the belly, he must be raked, and have a strong purgative clyster with some aromatic substance in it, as aniseseeds, or caraway seeds.

407
**Poison.**

All these animals may occasionally swallow poison, and the treatment in these cases must depend in a great measure on the nature of the poisonous substance, where this can be ascertained. It is seldom that a horse, cow, or sheep is poisoned; but in the dog, this may frequently happen, either from accidents, or design. Dogs often pick up *nux vomica*, (which is the poison mostly used by warreners), and which usually causes convulsive fits, and soon kills. Apply immediately the following remedy. As much common salt as can be got down; hold the head upwards, and force open the mouth, and by fixing a stick across, prevent its shutting, whilst the throat is filled with salt; a sufficient quantity to purge and vomit will soon dissolve, and be swallowed; the stomach once cleared by a free passage obtained by a stool, warm broth should frequently be given to prevent the faintness which might otherwise prove fatal. Two table spoonfuls of *castor oil*, added to the salt, would very much accelerate its action downwards *.

Arsenic is frequently given to dogs by design, or it may be picked up by them in places where it has been laid for rats. If the accident is discovered soon, the dog may sometimes be recovered by giving him a vomit of white vitriol, and drenching him well with sweet oil and milk; and when most of the poison appears to have been thrown up, the rest may probably be rendered harmless by repeated doses of liver of sulphur.

If a horse is poisoned, the danger is very great, as from his inability to vomit, the stomach cannot be cleared of the poison. But fortunately this accident scarcely ever happens; as arsenic, the most common poisonous substance, will produce little effect on the horse, unless given in a very large dose.

408
**Worms.**

The stomach and bowels of all these animals may be infested by worms, but these are most common in the horse and dog.

The worms that most commonly infest the horse are what are commonly called the *bots*. They are not properly worms, but are the larvæ of several species of the *Oestrus* or *Gadfly* mentioned in N° 337.

409
**Bots, Oe. equi.**

The horse is attacked by 2 or 3 species of *Oestrus*, but more especially by the *Oe. equi*, which deposits its eggs in such a manner as that they shall be received into the animal's stomach, where they form the bots.

Diseases.

The method pursued by the parent fly, in order to lay its eggs in the most favourable situation for being received into the stomach of the horse, is extremely curious. It is thus related by Mr Bracey Clark, who appears to have witnessed the process.

"When the female has been impregnated, and the eggs are sufficiently matured, she seeks among the horses a subject for her purpose, and approaching it on the wing, she holds her body nearly upright in the air, and her tail, which is lengthened for the purpose, carried inwards and upwards. In this way she approaches the part where she designs to deposit the egg, and suspending herself for a few seconds before it, suddenly darts upon it, and leaves the egg adhering to the hair, by means of a glutinous liquor secreted with it. She then leaves the horse at a small distance, and prepares a second egg, and poising herself before the part, deposits it in the same way. The liquor dries, and the egg becomes firmly glued to the hair. This is repeated by various flies, till four or five hundred eggs are sometimes deposited on one horse. The skin of the horse is always thrown into a tremulous motion on the touch of this insect, arising from the very great irritability of the skin and muscles at that season of the year, occasioned by the continual teasing of the flies. The inside of the knee is the part on which these flies seem to prefer depositing their eggs, and next to this the side, and back part of the shoulder. It is curious that these parts are what are most exposed to be licked by the animal. In licking, the eggs adhere to the animal's tongue, and are carried into the stomach with the saliva.

"The bots attach themselves to every part of the horse's stomach, but are usually more numerous about its farther orifice, and are sometimes, though less frequently, found in the bowels. Their number varies considerably; sometimes there are not above half a dozen; at others they exceed 100. They most usually hang in clusters, fixed by the small end to the inner membrane of the stomach, to which they adhere by means of two small hooks.

"The body of the *larva* is composed of eleven segments, all of which, except the two last, are surrounded with a double row of thorny bristles, directed towards the truncated end, and are of a reddish colour, except the points, which are black. These *larvæ* evidently receive their food at the small end by a longitudinal aperture which is situated between the two hooks or *tentacula*. The lips of this aperture appear somewhat hard, horny, and irregular.

"Their food is probably the chyle, which being nearly pure aliment, may go wholly to the composition of their bodies without any excrementitious residue, though on dissection the intestine is found to contain a yellow or greenish matter, which is derived from the colour of their food, and shews that the chyle as they receive it is not perfectly pure.

"The slowness of their growth and the purity of their food must occasion what they receive in a given time to be proportionally small; from which probably arises the extreme difficulty there is found in destroying them by any medicine or poison thrown into the stomach. After opium had been administered to a horse labouring under a case of locked jaw for a week, in doses of one ounce every day, on the death of the animal I have found the bots in the stomach perfectly alive. Tobacco has

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* *Daniel's Rural Sports.*

has been employed in much larger quantities in the same complaint, and has been also longer continued, without destroying them. They are also but rarely affected by the drastic purgatives, which bring away in abundance the *Teniæ* and *Ascarides* [*]."

Mr Clark does not apprehend they are so very injurious to the horses as is generally conceived. When removed from the stomach a deep impression remains where they adhered, but whether they ever irritate it so as to bring on a fatal spasm of the stomach itself, or of the *pylorus*, or, by collecting round this passage, prevent the food from entering the intestine, has never been investigated with sufficient accuracy. The ignorant surprise of farriers on opening the stomach after death, and being presented with so singular an appearance as the bots, has without doubt very often occasioned the death to be attributed to these, though it is certain but few horses on our commons can escape them.

Instances have occurred of violent inflammation excited in the stomach by the bots. An example of this is related by Mr James Clark. He was once desired by a farrier in the neighbourhood who was indisposed, to visit a horse that had been a patient of his for some days, and report the situation he was in. When Mr Clark entered the stable, the servant was giving the horse a drink, which he was afterwards informed was composed of an infusion of linseed, in which was dissolved one ounce of nitre, with honey to sweeten it; and in the last hornful was poured, from a small phial, about half an ounce, or more, of spirits of hartshorn. The horse seemed very uneasy after the drink, he was soon seized with a violent trembling and shaking, a profuse sweat broke out over all his body, and run down his sides, as if water had been poured on him; at the same time his legs and ears were quite cold; he lay down seemingly in great agony; he was soon after convulsed all over, and died in about half an hour from the time the drink was swallowed. Mr Clark obtained leave to take out his stomach where he was, on condition he should sew up the skin afterwards, in order to prevent any bad smell in the stable, till he could be carried off. On inspecting the stomach, the coats of it were found greatly inflamed, and a mortification had taken place on one side, where it appeared of a darker colour, and here there was a small hole, through which a lead probe passed into the cavity of the stomach from the outside; the coats of the stomach were considerably thickened, and of a darkish red colour resembling the liver; at the same time the stomach was considerably distended and full of food: on turning it inside out, an incredible number of *bots* were found sticking all round the sides and lower part of it, so that it appeared entirely covered with them, sticking as closely to one another as bees in a honey-comb; and so firmly were the heads of these vermin fixed in the coats of the stomach, that endeavouring to pull some of them off when alive, they broke in two, and their heads remained sticking in the coats of the stomach.

The great irritation produced by such a number of these worms sticking in the coats of the stomach had no doubt occasioned at first an inflammation there, and from its continuance this was tending to a mortification, before the drench was given, and would have occasioned the horse's death [†].

**410 Oe. Hæmorrhoidalis.**

Another species of *Oestrus*, viz. the *hæmorrhoidalis*, also produces eggs, which when received into the stomach of the horse become bots. This insect has been termed *hæmorrhoidalis* from the appearance of the bots when coming out of the anus of the horse, when they are very like the swelling produced by the piles or hæmorrhoids. It was supposed by Linnæus and some other naturalists, that this and the last species introduced their eggs into the bowels of the horse, by entering the *rectum, mire per anum intrans*; but this opinion is now fully refuted.

The part chosen by this insect for this purpose, is the lips of the horse, which is very distressing to the animal from the excessive titillation it occasions; for he immediately after rubs his mouth against the ground, his fore-legs, or sometimes against a tree; or if two are standing together, they often rub themselves against each other. At the sight of this fly, the horse appears much agitated, and moves his head backward and forwards in the air, to baulk its touch, and prevent its darting on the lips; but the fly, watching for a favourable opportunity, continues to repeat the operation from time to time; till at length finding this mode of defence insufficient, the enraged animal endeavours to avoid it, by galloping away to a distant part of the field. If it still continues to follow and tease him, his last resource is in the water, where the *Oestrus* is never observed to follow him.

The teasing of other flies will sometimes occasion a motion of the head similar to this; but it should not be mistaken for it, as it is never in any degree so violent, as during the attack of the *Oestrus*.

At other times the *Oestrus* gets between the fore legs of the horse while he is grazing, and thus makes its attack on the lower lip; the titillation occasions the horse to stamp violently with his fore feet against the ground, and often strike with his foot, as aiming a blow at the fly. They also sometimes hide themselves in the grass; and as the horse stoops to graze, they dart on the mouth, or lips, and are always observed to poise themselves a few seconds in the air, while the egg is preparing on the point of the *abdomen*.

When several of these flies are confined in a close place, they have a particularly strong fusty smell; and I have observed both sheep, and horses, when teased by them, to look into the grass, and smell to it very anxiously; and if they by these means discover the fly, they immediately turn aside, and hasten to a distant part of the field.

The eggs of this species appear of a darker colour than the former, and we are unacquainted with the circumstances attending their passage to the stomach.

The *larvæ* of the *Oestrus hæmorrhoidalis*, as well as the former species, appear to have been termed among the Romans, *cossus*, which seems to have been a general expression for any kind of soft imperfect animal, and to have been very analogous, and as extensively applied as the word *grub* is at present in the English language [*].

**411 Symptoms of bots.**

The presence of bots in the horse's stomach and bowels, is not always easily ascertained, as it is certain that great numbers have been found in the stomach after death, without appearing to have produced any unusual symptoms in the animal while alive. When, however, they have collected in any great numbers, or when the animal's stomach is peculiarly irritable, they are attended with the following symptoms. The horse has a disposition

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[*] *Linn. Trans.* vol. iii. p. 298.

[†] *Clark on Prevention.*

[*] *Linnæan Trans.* vol. iii. p. 310.

position to rub his tail frequently, without any apparent humour or eruption that should make it itchy; he eats heartily, and is yet always lean and out of condition. His coat is rough and staring, such as we have described it to be in what is called a *surfeit*. There is also a sickly paleness of the mouth and tongue, attended with an unwholesome cadaverous smell. The horse appears tucked up in his flanks, which often heave; he turns his head now and then, and strikes his belly with his hind feet. These latter symptoms indeed, as they only indicate griping pains, and often occur in ordinary colic, are not to be relied on, unless accompanied with the former. In cases of worms, it is said that the dung is yellowish, like melted sulphur, or is otherwise discoloured and very offensive. The surest mark, however, of the presence of bots is their being voided by the anus, where they are sometimes found sticking.

411 Treatment.

As the bots are extremely tenacious of life, it is very difficult to expel them, and where they do not occasion any considerable irritation or other bad symptoms, it will be better to let them alone till they come away spontaneously. But when it is judged necessary to attempt their expulsion, this may be done by administering the sal indus, as directed in N° 60. of the receipts, and after it a strong dose of calomel and aloes.

We have said the bots are not properly worms; but there are several species of worms that are very frequent in dogs, and are now and then found in the horse. These are the *lumbrici*, or *long round worms*; the *ascarides*, or *thread worms*; and the *tæniæ*, or *tape-worms*.

412 Lumbrici.

The long round worms are seldom met with in these animals; but when they occur in the horse, they produce much uneasiness, and sometimes occasion colic and inflammation of the bowels. It is very difficult to expel these worms, as the only remedies by which this could be properly attempted, such as powdered tin and strong purgatives, cannot with propriety be often given to a horse, as, from the structure of his stomach, the former might produce considerable injury, and the latter are extremely debilitating.

413 Ascarides.

*Ascarides* are now and then found in the great guts of the horse, and sometimes prove troublesome, but are seldom or never dangerous. They are best removed by clysters of lime-water, followed by purgative clysters.

414 Tape-worm.

The tape-worm is seldom found but in dogs, where they are sometimes the cause of fatal diseases, especially to puppies. The symptoms of worms in dogs are, an itchiness of the nose and at the anus, both of which they are perpetually rubbing against every thing; swelling and hardness of the belly, leanness, running at the eyes and nose, and frequent purging of a slimy or stringy matter. There is also a peculiar staring appearance of the hair, which points the wrong way.

Mr Blaine says that the bowels of dogs are so irritable, that they will seldom bear strong physic, and that he knows of nothing that will certainly destroy the worms in their intestines. He has tried with variable success, tin, quicksilver, pewter, calomel, and savine, with other substances, but none of them appeared sufficiently certain to demand his confidence. When the worms are early detected, he thinks that purging doses of the compound powder of scammony with calomel, prove the most efficacious means. Mr Daniel recommends aloes, hartshorn, the juice of wormwood, with some flower of brimstone, mixed together into a ball, about the size of a hazel nut, which is to be wrapped up in butter, and given three or four times a-week, letting the dog fast for a few hours each time, which, he says, will destroy the worms. He also says that they may be destroyed by giving the dog as much finely powdered white glass as will lie on a sixpence, for three successive mornings, mixed up with butter; and if the worms are not voided in that time, the dose of the glass is to be increased, and it is to be repeated for three other mornings, by which time it will scarcely fail of producing the desired effect.

415 Concretions in the stomach.

There is a sort of concretion often met with in the stomachs of cattle, and sometimes in that of horses, which is partly composed of a chalky substance, and partly, or sometimes almost entirely, of hair evidently arising from the animals licking off their hair and swallowing it with their saliva. The mass thus received into the stomach, being wholly indigestible, collects there, and forms these globular concretions which sometimes grow to such a size as to prove fatal.

The growth of these concretions is thought to be encouraged by the long use of dry hard food, without the animal's being allowed to feed from time to time on fresh green herbage. It is even thought that the timely use of fresh grass may prove the means of dissolving these concretions. Van Swieten, in his commentaries on Boerhaave, when speaking of chalky matters found in the liver and other organs, remarks, that sometimes there are concretions of the like sort found in this organ, but of a more friable texture, and of a whiter appearance, like gypsum or plaster of Paris. Such incrustations were often observed by Glisson in the pori biliarii, and its larger branches dispersed through the livers of oxen that had been fed in stalls with hay and straw during the winter season and without exercise. But then these concretions are very friable, and they afterwards dissolve again, and pass out of the body when the cattle come to feed upon the fresh grass of the meadows; for in oxen that are slain in the spring or summer, they are very rarely to be found.

"In dissecting horses (says Mr Clark) I have frequently met with chalky concretions in their livers and in the lungs, especially in those that have been fed long on dry food, and likewise round balls in their stomachs, sometimes of an oval shape. The latter seem for the most part to be composed of the dust they lick from their own bodies mixed with the hair. Whether the fresh grass dissolves them is not so certain; but that it causes these concretions to pass through the intestines, I have had a full demonstration. In May 1786, a horse that had been long fed on dry food was turned out to grass; in about eight or ten days afterwards, he was seized with violent griping pains, which lasted for about 24 hours, when he died. As the horse was very fat, the man who had the charge of him wanted to make something of his grease. In searching for it, he observed a large space of the intestines of a very black colour; and on feeling it, found something hard and weighty within them. He immediately cut it open with his knife, and took out a large oval hard ball, which measured four inches in length, and three inches and a half in breadth, and which I have now in my possession. That this concretion was originally formed in the stomach, there can be no doubt, as they frequently upon dissection have been found there, and nothing but its great bulk had hindered it from passing through the intestines *."

The best means of obviating these concretions, is to allow the animal to feed occasionally on fresh green fodder; and, according to what has been said, this may sometimes remove them after they are formed.

416
Loss of appetite.

Horses and other domestic animals sometimes labour under a loss of appetite. Animals may eat less than usual, or they may refuse to eat at all, either from a want of that sensation in the stomach, which we call hunger, or from a dislike that the animal takes at the food that is set before him. Want of appetite is a symptom of several diseases, particularly of fevers and internal inflammations. When this happens, it would be absurd to force food on the animal's stomach, as it could not be digested, and would only aggravate the violence of the disease.

Want of appetite very often attends very great fatigue. It is also very frequently the effect of an improper use of cordial and strengthening medicines. It may, however, be the effect of weakness of the stomach, not brought on by those means. In such a case, cordials and tonics are very proper, and their use should be accompanied with gentle exercise.

This loss of appetite in the horse, is commonly called *chronic indigestion*, and is usually accompanied with a roughness and staring of the coat, the skin having the appearance which we have described in N° 328. under hide-bound.

An affection of a similar kind takes place in cattle, in whom it is called *loss of the cud*, from their not chewing the cud as usual. It is known by the animal's mourning, having no inclination to eat, or dropping his food, without swallowing it. It frequently arises from the stomach being loaded with hard food that is difficult of digestion, such as acorns, or coarse dry straw. It may also arise from a weakness of the stomach, which is not uncommon in hot weather, and may be brought on by confinement and want of fresh air. The treatment is much the same as in horses.

417
Foul feeding.

Horses are subject to an affection of the stomach, in which they sometimes eat voraciously, or greedily swallow substances that are indigestible. Horses labouring under this complaint are called *foul feeders*, as they eat clay, mortar, dirt, foul litter, or even the dung of other animals.

This is properly a symptom of indigestion, and seems to be owing to a peculiar acrimony of the gastric juice, and in most cases there is evidently an acid upon the stomach. The best remedies are bitters, and other strengthening medicines, combined with salt of tartar, or some other antacid. The receipts marked 61. and 62. are well adapted to these cases. These remedies should be assisted by pure air and regular exercise; and where costiveness is present, it should be obviated by the use of warm laxatives. Care should also be taken to keep the stable clean, and to have a quantity of clean straw below the manger, that the horse may not be tempted to eat other substances that are more injurious.

418
Surfeit in dogs.

A surfeit is sometimes occasioned by hounds eating putrid flesh, or that of horses that have died; or been killed, when violently affected with the farcy. Arising from the former cause, the fatality which attended the hounds of Mr Finch in Kent, is a curious instance. In drawing the covers, the hounds met with the carcase of a diseased bullock, with which they gorged themselves; the contamination was immediate through the pack; they were generally seized with staggering convulsive fits, operating to so violent a degree, that eight couple of hounds died in the field in less than two hours, and it was supposed the whole pack would have fallen victims, but for timely application of oil and other medicines. Mr Daniel, from feeding with the flesh of horses sent from a post stable, in which the farcy and the glanders had spread their ravages, had an opportunity of speaking to the latter; the hounds broke out all over in blotches, discharging a watery humour, similar to those occasioned by the farcy; they caused great stiffness, and were extremely painful. This inoculation took place, notwithstanding most of the horses were sent alive to the kennel, and were properly slaughtered, and none of the flesh was given raw to the hounds. Physic, and taking them frequently to the salt water, and well rubbing the sores by hand with it, at length recovered them. For checking a common surfeit, ox-gall and train-oil, equal quantities; the affected parts to be well rubbed, and some physic taken inwardly will quickly restore them *.

419
Rupture.

There are two diseases that affect the bowels, which we cannot consider more properly than at the end of this chapter. These are *rupture* and *falling of the fundament*. These may take place in any of the domestic animals, but they are more common in horses, as they are most frequently the effect of great exertion. *Burstenness*, or *rupture*, commonly proceeds from strains in labour, kicks on the belly, high and difficult leaps, especially when heavy laden. It may be produced by the gorging of oxen, by being staked, and by various other accidents. Gibson says that he has known it produced by too deep an incision being made in inserting a rowel.

The bowel may be ruptured either at the navel, or through the rings at the back part of the belly into the scrotum or cod. The tumour, when not too large, will return on being pressed, as if it were merely flatulent, and the rupture or chasm may be felt. It is easy to conceive that such a defect is incurable, excepting possibly in a very slight case, and a very young subject; the intention must be to palliate, to render the animal as useful as possible, and as comfortable to itself. In a recent case, bleed, and give emollient and oily clysters, boiled barley, malt mashes, nitrated water. Foment twice a day with camphorated spirits, and vinegar warm; and poultice with oatmeal, oil, and vinegar.

420
Falling of the fundament.

*Falling of the fundament* is sometimes occasioned by a long-continued looseness, and is most likely to be produced in such animals as are of a weak and delicate constitution, but is frequently brought on by hard riding or hard driving. Mr Lawrence says that he has frequently seen it in hard-driven pigs. According to Soleysel, it is in horses sometimes the consequence of docking.

When this complaint is first seen, it may in general be easily cured. The gut should be returned as soon as possible, by pushing it up with the ends of two or three fingers wrapt round with a piece of soft linen rag gently greased; but before returning the gut it should be bathed with some astringent lotion, as a solution

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* *Clark on Prevention*, p. 60.

* *Daniel's Rural Sports.*

of alum or white vitriol, or port wine and water; and a little of either of these should be frequently injected. If the gut should become inflamed, it must be anointed with some cooling liniment, such as receipt N° 28. Care must be taken to keep the animal's bowels open, by frequent bran mashes. If the complaint continues obstinate, nothing will effectually remove it, but cutting off a part of the protruded gut. This may be done with a common surgeon's knife, called a *scalpel*, but it is sometimes performed with a sharp red-hot cautery. The wound commonly soon heals, but the animal should not be worked for some time after; but should be allowed a long run at grass, or in a straw yard.

### Chap. IV. *Morbid Affections of Absorption.*

421 The absorbent vessels of the human body have been described in the article Anatomy; and the structure of these vessels, in the animals now under our consideration, is sufficiently similar to render a particular description of them here unnecessary. The function of absorption, and the derangements produced in it by disease, will be explained under those medical articles that have for their object *physiology* and *pathology*. It will be sufficient for us, in this place, to remark, that many of the disorders of the animal frame, are greatly influenced by the state of the absorbent system; and that some complaints seem chiefly to depend on the loss of the proper balance between the function of absorption, and that of circulation. Sometimes the absorbent vessels are too active, while the circulating system is proportionally languid; at others the absorbent system is languid, while that of the circulation is either unusually active, or continues in its natural state. The former seems to be the cause of leanness, costiveness, and some other morbid affections; to the latter may be referred the several species of dropsy. We shall here only consider two of these affections, leanness, and swelled legs, as most of our readers will expect costiveness treated of as a morbid affection of *excretion*, and most of the species of dropsy must be considered as general affections of the system; and therefore to be explained in the next section.

422 eanness. An unnatural degree of leanness may take place from many causes; as, 1st, From the want of a proper supply of food, whether from this being dispensed too sparingly in proportion to the labour of the animal, or from its not being sufficiently nourishing. Hence we see that such horses and dogs as are hard worked and ill fed, are extremely lean.

2d, In stallions leanness is often the effect of being suffered to cover too often, or too long at one season.

3d, It is a common attendant on several acute diseases, as fevers, some inflammations, especially dysentery, or what has been commonly called *molten grease*.

4th, Leanness is a common attendant on old age

This symptom requires little attention, as it is seldom dangerous, except when it comes on very rapidly, and is attended with great weakness, and manifest signs of decay, in stallions that are too *hard worked*. It commonly soon disappears after the cause that produced it, or the complaint, of which it is a symptom, is removed.

423 elled s. A swelling of the legs is very common to horses that are suffered to stand long in the stable, without being worked, or in some other cases that will presently be mentioned. There is a swelling of the legs that is the consequence of hard work, strains, or other causes that excite inflammation; but what we are now considering is a dropsical swelling, consisting in an accumulation of watery fluid below the skin, similar to the swelled legs of old people, and *chlorotic* girls. It may affect all the legs, but it is more commonly confined to the hinder extremities. The swelling generally takes place above the pastern and fetlocks; but if it continues long, it extends further up the legs, and the skin sometimes cracks, and there oozes out a watery fluid, or sometimes a purulent or greasy matter. In this last case it has degenerated into grease, which will be considered hereafter.

Swelled legs frequently take place in horses that are newly brought into the stable, or a straw yard; especially if they are not regularly worked, and their legs regularly rubbed down, at least twice a-day. It is more certainly produced, if the horse should be suffered to stand long on hot litter. It is also not uncommonly the effect of wading through snow or cold water, especially when the legs are heated. It evidently depends on a decreased action of the absorbent vessels and veins of the legs.

It may in general be prevented by regular exercise, and frequent rubbing: but if it should occur in a horse that is too full of blood, it may be necessary to bleed and physic. If the swelling should continue obstinate, it will be proper to apply a blister to the part, or to rub the legs frequently with some stimulating liniment, and if the complaint is of long standing, it may be proper to insert a rowel in each leg; and the dispersion of the swelling may be assisted by rolling hay bands around the legs, by way of bandage. One of the most effectual means of preventing a return, will be firing, making perpendicular lines with the cautery from the fetlock to the coronet. Regular exercise and friction must be persisted in; and if the complaint is accompanied with general weakness of the system, a nourishing diet, and strengthening remedies must be added.

### Chap. V. *Morbid Affections of Circulation.*

424 Pulse in various animals. The pulse in the inferior animals has been very little attended to by veterinary practitioners; indeed the common farriers and cattle doctors scarcely know whether their patients have a pulse, or where it may be most readily felt.

The strength and frequency of the pulse in its natural state, differs very much in the several species of the domestic animals. It is in general stronger according to the size of the animal; but its frequency diminishes in the same proportion, it being quicker in the smaller than in the larger animals, even of the same species. We cannot undertake to state exactly the average frequency of the pulse, in the several animals, and the accounts given by different authors vary considerably. Mr Clark says that the pulse of a horse in health, and no way terrified or alarmed, is from 36 to 40 beats in a minute. According to Mr Blaine, it ranges from 45 to 55, being generally from 45 to 50 in large horses, and from 50 to 55 in smaller horses. Dr Hales found that the pulse of an ox in health did not exceed 38 beats in a minute.

Mr Blaine, in his first volume, states the medium pulse of a dog at 80 or 90; but in his second volume, p. 149, he says, that a dog has usually from 90 to 100 or 110 contractions in a minute, so that we may probably take the average at from 90 to 100. Perhaps the pulse of a sheep is slower by about 10 beats than that of a dog.

425 **Feeling the pulse.**

The pulse in the inferior animals may be most conveniently felt in the temporal arteries, which, as we have said in N° 164. are situated a little backwards above the outer angle of the eye. It may be felt also at the corner of the lower jaw, on each side of the fetlock joint, on the inside of the hock, and at the heart.

As much is to be learned from the pulse, respecting the nature of many diseases, and the degree of danger which they indicate; we earnestly recommend to our practical readers, that they take every opportunity of examining the pulse of these animals, when in a state of disease. We cannot here enter with propriety into an explanation of the morbid varieties of the pulse, as it would be only to repeat what is given in the pathological part of our work, to which we refer our veterinary readers; as the observations there delivered can be easily applied to the particular cases of horses, cattle, sheep, and dogs, by keeping in view the natural state of the pulse, in each species, as above laid down.

426 There are two general states of the system, that may take place in all animals, and which are chiefly distinguished by the state of the circulation, as ascertained by the pulse. These are plethora, or fulness of habit; and debility, weakness, or inanition. The former is always attended with a fulness, and sometimes a hardness of the pulse; while in the latter, the pulse is weak and small, easily compressed or stopt by the finger, and is sometimes slower, but oftener much more frequent than natural.

427 **Plethora.**

When an animal has been kept for some time on a full nourishing diet, while he is at the same time confined within doors, and deprived of that regular exercise, which is necessary to carry off superfluities, he becomes fat, corpulent, and full of blood, or what we call *plethoric*. In this state the veins below the skin, from their being greatly distended with blood, are very prominent, excepting in those parts where they are bedded in fat; the pulse is, as we have said, full, and commonly strong, but in some cases it feels oppressed, as if the quantity of blood were too much for the cavity of the artery. The pulse in these cases is frequently slower than natural. The animal becomes dull and sluggish, averse to motion, and if he is obliged to exert himself, evidently does so with difficulty, pants, and labours, and becomes soon fatigued.

This plethoric state is extremely common in horses and dogs that are pampered with high living, and little or no work. A horse in this state, though he may look well, is far from being in good condition, and is by no means fit for active labour. In fact, if such a horse is put to hard work, before he is properly prepared for it, there is the greatest probability that he will be completely ruined. Instances occur every day of full fed idle horses knocking up, or even dying on the road, and a long list of violent diseases is the consequence of this plethoric state of body. It lays the foundation of broken wind, inflammation of the lungs, phrensy, and above all of staggers, or apoplexy. It is no uncommon thing to see a fat well-looking horse, fall down in convulsions, while drawing a heavy load, owing to the determination of blood to the head, from so great an exertion, while the vessels are too much distended. Most lap dogs and others who are parlour guests, commonly die of apoplexy. A lady of our acquaintance had a fine fat lapdog, who seldom quitted the cushion that formed his bed, beside his mistress's chair, where he was fed with the nicest bits from the dinner table. *Jack* had been unusually heavy for a day or two, and one morning was found lying dead on his cushion; *though* he had the night before eaten a *hearty supper*.

To prevent the ill consequences that must arise from this plethoric state, these animals should be regularly exercised, and not suffered to eat too much. Where the *plethora* has already taken place, and where no dangerous symptoms threaten the attack of some violent disorder, the best method of bringing the animal into good condition, is to lower his diet gradually, and as gradually increase his exercise or labour; but where the symptoms are such, as indicate approaching apoplexy, or some other dangerous disorders, it will be necessary immediately to bleed and purge, and to take care that the animal be not put to any violent exertion, till he be brought into good condition.

We must here remark, that frequent bleeding with a view to obviate *plethora*, is extremely improper, as it tends to produce the very state against which it is employed. Bleeding, therefore, ought not to be had recourse to, except in cases of imminent danger.

There is a complaint that sometimes appears among cattle, when they are suddenly put on high feeding, after having been long accustomed to a poor and sparing diet. It is called by the graziers, *Hawkes* or *Hocks*, and is probably of an inflammatory nature; but as it seems to depend entirely on a sudden distention of the blood vessels, and is speedily relieved by removing this distention, it may properly be considered in this place.

The complaint is said to begin with an uneasiness and swelling about the eyes, and about the glandular parts of the throat, which extends itself gradually over the whole body, to the legs and joints; and in cows to the barren and udder. The animal appears languid, dull, and heavy, and seems unwilling to stir from the place where he is; and when the disease has made some progress, he will not lie down till he is relieved. The legs become cold and numb, and as the swelling advances towards the hind parts, a copious secretion of saliva commonly takes place from the mouth, attended often with a swelling about the tongue. The disease is extremely rapid in its attack and progress, and if it be not speedily attended to, it will terminate in staggers, or some violent inflammatory disease.

The cure of this affection seems to depend entirely on bleeding, which should be performed as soon as possible, taking away a quart or two of blood at first, and repeating the operation some hours after, if the swelling is not diminished. It is recommended to rub the whole body well, both before and after bleeding, and if the mouth is much affected, it will be relieved by washing it frequently with salt and water. If there is any considerable heat, it may be proper to give a drench with nitre every four hours.

Inanition is a state of body directly the opposite of what we have described; and is produced by very different

ferent causes; from starvation, hard work, loss of blood, or violent or long-continued diseases.

An animal in this state is lank and lean; his pulse is small and weak, his eyes hollow, his skin dry and hide-bound, his excrements small in quantity, hard, dry, and discoloured, his urine thick and turbid; he takes every opportunity of grazing by the road side, pulling at the hedges, or eating whatever comes in his way; he becomes mangy; and if this state of debility continues long, he falls into what is called an atrophy, which commonly proves fatal.

The above description is chiefly applicable to those animals, who either from accident or neglect, are half starved. The state of inanition produced from this cause, is frequently seen in horses belonging to the lower class; and it is no uncommon thing to see dogs that have been turned out of doors, perishing in the streets in this condition. Sheep are also often found in a state of inanition at the end of a hard winter, after having been left for months to shift for themselves among the snow.

On opening the bodies of such as have died of hunger, we find the stomach and bowels much contracted, and sometimes in the former there will be a small quantity of food, scarcely masticated and indigested: Sometimes both stomach and bowels contain balls of earth or other indigestible matters; the large intestines are exceedingly diminished in size, and commonly contain a quantity of dry, hardened excrement; the caul and other membranes that surround the intestines are much shrunk, and for the most part appear completely divested of fat; the heart and large blood-vessels are flabby, and filled with a thin watery blood.

Though inanition is most frequently the effect of starving, it not unfrequently follows great loss of blood, or profuse discharges from the bladder and intestines. It also not uncommonly attends an obstruction in the gullet; in which case the animal can take little or nothing by the mouth, and the nourishment which he can receive by clysters is little more than sufficient to support his existence.

Inanition from the last cause is the most hopeless; for when it arises from starving, loss of blood, or profuse discharges, the animal may, in most cases, be brought back to good condition, by nourishing diet and strengthening remedies, with proper attention to pure air, gentle exercise when he is able to bear it, and proper shelter from the inclemencies of the weather.

430
Wounds of arteries.

It is not uncommon, either from injudiciousness or want of skill in bleeding, or from accident, for an artery to be wounded. If the wound be large, or the artery of any considerable size, so much blood may be poured out as to destroy the animal in a short time; but, if the artery be wounded by a small puncture, such as may be made by the point of a lancet passing through a vein, blood is gradually effused, and insinuates itself in the cellular membrane below the skin. In this way a swelling is formed with an evident pulsation like the beat of an artery; and, as this enlarges, the skin becomes discoloured and distended, so as sometimes to burst and occasion death by a sudden loss of blood. The swelling produced by the blood effused from a wounded artery has been commonly called a *false aneurism*, to distinguish it from what we are immediately to mention.

The artery that is most liable to be wounded in bleeding is the external carotid, which runs below the jugular vein, or sometimes a little to one side of it. This accident will, however, seldom happen, except when a ligature is used; but when this is employed, the jugular vein is pressed so closely on the artery, that the point of the fleam or lancet may easily penetrate through the vein into the artery. M. Huzard alleges, that in this way even the wind-pipe may be wounded, together with the artery, and that the animal may be choked by the effusion of the blood from the latter into the former.

When an accident of this kind has taken place, whether from bleeding, from wounds, or from the erosion of an artery by the acrid matter of a foul ulcer, it is necessary to take speedy means for preventing the ill consequences that may ensue; for, though the wounded artery be not very large, such an effusion of blood may take place from it, as may greatly weaken the animal, if it should not prove fatal. If the artery is very small, the bleeding is easily stopped, either by applying such a degree of pressure, as may be sufficient to obliterate the cavity of the wounded vessel, or, what is often more convenient, by completely dividing it; after which the divided ends will contract so much as to prevent the further effusion of blood. If the wounded artery be large, it can be secured with certainty only by means of ligature. For this purpose, pressure must be made on the artery, between the wounded part and the heart, while an incision is made through the skin and muscles down to the place where the artery has been wounded, so that this may easily be discovered. Then a pretty strong thread, doubled and waxed, is to be passed round the artery by means of a crooked needle, with a blunt point, and is then to be tied fast about an inch above the wounded part. A similar ligature is to be fixed upon the artery at about the same distance, on the other side of the orifice, and the artery is to be cut across between the two ligatures. Thus, the further effusion of blood is completely prevented, and the wound may be healed in the usual manner. The part that was supplied with blood by the wounded artery, will, if the vessel was pretty large, be colder and less sensible than usual, but it will in general be sufficiently supported by the small branches of other arteries that join with the wounded vessels beyond the ligatures; and these branches will gradually become so distended as to supply the place of the divided artery, and restore the part to its proper functions.

431
Aneurism.

It sometimes happens, that part of an artery becomes unusually dilated, forming what is called a *true aneurism*. This dilatation may take place in any of the arteries, but it is most common in the aorta or great artery within the body, and in the external carotid and popliteal arteries without. An aneurism of the external carotid is often seen in dogs, and sometimes in horses, especially such as are accustomed to draw heavy weights. An aneurism of an external artery is easily distinguished, by a considerable pulsation, which may be felt much more superficially than the ordinary beat of the artery, and is sometimes so remarkable, that it can be distinctly seen by the alternate heaving and sinking of the skin below which the swelling is situated. An aneurism of the aorta is not so easily distinguished in the inferior animals. The diagnostic marks by which it may be known

known in the human body, will be given in the article SURGERY.

Those aneurisms are attended with considerable danger, and those of internal arteries commonly soon prove fatal. Aneurisms of external arteries are attended with a wasting of the bones over which they lie, owing to the increased absorption of bony matter produced by the pulsation of the dilated artery; and these swellings commonly burst in no long time, especially if the animal be exposed to any great labour or exertion.

The treatment of these aneurisms is exactly similar to that of a wounded artery described above. It consists in securing the dilated artery, either by pressure on the sides of the aneurism next the heart, or by means of two ligatures, one on each side of the tumour.

432 Wounds of veins.

An effusion of blood into the cellular substance may take place from a vein, the orifice of which has not been properly closed after bleeding; or it may happen from the orifice in the vein not exactly corresponding to that in the skin, so that the skin gets over the orifice in the vein, and prevents the blood from flowing out. In this latter case there is said to be a *thrombus* of the vein.

When such an effusion of blood is observed, it is necessary to dilate the orifice in the skin, and to take away the clotted effused blood from below it. If the vein does not appear likely to bleed again, it will be unnecessary to pin it up; but if blood should still flow from it, it will be necessary to secure it by a pin. This, however, should not be suffered to remain too long, as it may produce inflammation and ulceration of the vein. Sometimes it is so long before the effusion of blood is observed, that the swelling is become considerable, and is attended with inflammation, or even suppuration. Where inflammation is present, but has not proceeded to suppuration, this latter may in general be prevented by keeping the part moist (after taking out the effused blood), with a solution of sugar of lead in vinegar and water. If matter is already formed, the swelling must be poulticed, or frequently fomented with warm liquors; and when the matter is let out, the sore must be treated as a common ulcer.

Sometimes the inside of a vein that has been opened in bleeding inflames, suppurates, and becomes a fistulous sore; and if this be neglected, the matter may extend to some important organ, as to the head, when the jugular vein has been opened, and produce death. When the vein is not very large, or the ulcerated part of it is inconsiderable, it may commonly be healed by means of the actual cautery, or firing, as described in N° 351.; but if the wound is very large, or the ulceration very extensive, it may be proper to secure the vein by means of ligatures applied on each side of the ulcerated part.

433 Varix or blood-spavin.

When the enlargement of any part of a vein takes place, without the vein having been wounded, the swelling is called by medical writers *varix*, or the vein is said to be *varicose*. This swelling seldom takes place in any of the domestic animals, except the horse, in whom sometimes the superficial vein that passes over the inside of the hock sometimes becomes varicose, and forms what farriers call a *blood-spavin*. The enlargement of this particular vein is always accompanied by *bog-spavin*, or an enlargement of the mucous capsules in the same part of the hock, and the former seems to be a consequence of the latter, being produced by the compression of the vein, by the swelling of the mucous capsule below it, whence an obstruction of the blood, and a consequent dilatation of the coats of the vein.

When the enlargement of the vein is not considerable, it requires no particular attention; but if it should increase so far as to be troublesome, methods must be taken for its removal. This may be effected, either by producing such a pressure on the vein as shall stop the circulation of the blood in it, or by tying up the vein with a ligature. In applying pressure, such a bandage should be adopted as may surround the whole hock, while the greatest pressure is made on the dilated vein. Mr Blaine recommends for this purpose a bandage including several of those elastic tubes, ladies glove braces or tops are made of, which would occasion permanent pressure, and yet permit motion. But, should it still be found to resist this, its removal must be attempted. For this purpose, an opening should be made above the enlargement, and then including the vein within a ligature, and an opening below likewise, including the vein also at that part; the enlarged part may then be punctured, to let out the distended blood, and the remainder suffered to slough away *.

## CHAP. VI. *Morbid Affections of Respiration.*

434

IN many complaints, especially fevers and inflammations of the internal organs, the breathing becomes hurried, and inspiration and expiration, but especially the former, are performed more quickly than in the healthy state of the body. This hurried respiration, in the inferior animals, is known by the rapid heaving of their flanks; and when it is attended with considerable heat and dryness of the skin, it denotes considerable danger. Any particular consideration of this symptom, will, however, be more proper, when we come to treat of the particular cases in which it occurs.

The principal affections of breathing which we shall here notice, are those in which respiration is rendered difficult, without being attended with fever or inflammation. Horses are more liable than other domestic animals to difficulty of breathing, and one particular modification of it, *broken wind*, is peculiar to this animal.

435 Snores, or snivels.

There sometimes takes place within the nostrils a gathering of thick clotted matter, which, when it comes to any considerable height, very much obstructs respiration, and produces a snivelling noise when the air passes through the nostrils. This affection is called the *snores*, or *snivels*, and is almost peculiar to cattle. It is sometimes mistaken for a disorder of the throat, where it is imagined there is some obstruction; but when this rattling noise is found to attend the breathing of cattle, it may generally be discovered whether or not it be the disease in question, by a careful inspection of the nostrils. The swelling thus produced in the nostrils generally goes on to suppuration, and when it breaks the animal is relieved. The object of our treatment must therefore be to hasten the suppuration by the application of warm stimulating fomentations or liniments. A very common application in these cases is the oil of bays injected up into the nostrils; but perhaps the steam of warm water would answer every good purpose, and might be easily applied, by putting a warm bran mash into a canvass bag, and tying it to the animal's head; and this may

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* *Blaine's Outlines*, vol. ii.

may be repeated till the imposthume breaks. The animal should in the mean time be kept in a well-sheltered house, and should be fed on nourishing diet.

436 Chronic cough.

Cough is almost a constant attendant on colds, consumptions, inflammation of the lungs, and other pulmonary complaints; and when it occurs as a symptom of these diseases, no particular attention is to be paid to it, as our principal object is the primary affection. It frequently happens, however, that after the inflammatory affection is removed, an obstinate cough remains; and if this is attended with no considerable difficulty of breathing, and if the horse eats well, and appears thriving, the cough alone requires our attention. This kind of chronic cough is generally more considerable in the mornings and evenings, and after eating, and is generally increased by any violent exertion.

Chronic coughs, though generally a consequence of previous inflammation, may arise from a peculiar irritable state of the top of the wind-pipe; and if this be the case, the use of some narcotic substance, as opium or hemlock, may be proper. A very obstinate cough is often the consequence of preceding inflammation, and is attended with a peculiar noise, as if the aperture through which the air came was diminished. This kind of noise is called *roaring*, and it is found on dissection that the wind-pipe is contracted by a quantity of coagulable lymph, that has been effused during the inflammation. Mr Blaine has seen a preparation where the diameter of the wind-pipe was reduced to one-third of its original dimensions, and it has often struck him as not improbable that the grasping the wind-pipe hard, as is sometimes done to try the wind, may bring on inflammation, and occasion this affection.

These chronic coughs, especially the *roarer*, scarcely admit of a complete cure; but they may in general be mitigated, by keeping the animal warm, and by avoiding violent exertion. The food should be such as is easy of digestion, and does not produce much distention of the stomach. Tar is much recommended in these cases, especially for the cough, or *hoose*, that sometimes occurs in cows. An ounce of tar, with the same quantity of vinegar of squills, and a little oil of aniseed, is to be given every morning, in a quart or chopin of warm ale.

437 Broken wind

One of the most common defects in a horse's breathing is that which is called *broken wind;* the nature of which complaint has been of late much elucidated by Mr Coleman. According to Mr Lawrence, broken wind is discovered by the quick and irregular heaving of the flanks, and a more than ordinary dilatation of the nostrils; sometimes also, by a consumptive appearance of the body. But the usual method of trying the soundness of a horse's wind, is to cough him; which is performed by pressing the upper part of the wind-pipe with the finger and thumb. The strong, clear, and full tone of the cough, prove his wind to be sound; if, on the contrary, the note be short, whistling, and husky, the horse is asthmatic and unsound. Horses labouring under the worst stage of this disease, are styled, in the language of the repository, *roarers;* from the noise they make in work, of very little of which they are capable. Broken-winded mares are generally barren, although we have heard of one which bred a whole team of horses after she became so. In confirmed broken wind there is sometimes observed a palpitation of the chest, with constant contraction and dilatation, and now and then a considerable cavity or depression may be perceived.

The old writers had many strange opinions with respect to the nature of this complaint. Gibson attributed it to an enlargement of the contents of the chest, and Dr Lower thought it proceeded from a rupture of the phrenic nerve. A friend of Bartlet supposed the disease to proceed from a morbid or obstructed state of the glands and membranes of the head and throat, the enlargement of which prevented a free passage to the wind. According to Mr Osmer certain glands, which are placed upon the air-pipe, at its entrance into the lungs, are become enlarged, and thereby the diameter of the tube is lessened; hence the received air cannot so readily make its escape, nor respiration be performed, with such facility as before; from which quantity of contained air the lobes of the lungs are always enlarged, as may be seen by examining the dead carcases of broken-winded horses.

It is now satisfactorily ascertained, that the immediate cause of broken-wind is a rupture of some of the air-cells of the lungs. The cause that most commonly produces such a rupture is over distention of the stomach, attended with hard and violent exertion. The horse being an animal that is always eating, will, when hungry, eat very voraciously, if he has an opportunity, and soon fills his stomach; and if, in this state, he is exercised violently, the circulation and respiration will be increased, but the lungs cannot expand sufficiently, because the diaphragm cannot descend from the pressure of the stomach. In this case, the circulation being hurried, the lungs do not undergo the necessary change, in consequence of their now being compressed. The animal then, endeavouring to take in more air, either actually occasions the cell to be ruptured, or something else to give way. If the cells are ruptured, the air escapes from them into the cellular membrane of the lungs, and there acts as foreign matter, or, at least, it cannot then produce the necessary change on the blood, when thus diffused; in consequence, difficulty of breathing arises from two causes: 1st, From the blood passing through the lungs before it has undergone its necessary alteration; and, 2dly, from the rupture of the air-vessels. The respiration is rendered slow, as is seen by the flanks being long in rising up, because there is no direct communication with the bronchia, as in the healthy state of the lungs; inspiration is, however, in a third of the time of expiration, which is seen by the sudden descent of the flank. The lungs, from containing more air, are specifically lighter than in the healthy state.

This local disease does not admit of a permanent cure, at least no medicine has yet had any such effect; but a temporary relief may be obtained, as we shall see hereafter. But we must not omit to mention here a most ridiculous practice which has sometimes been tried by common farriers, that of making an orifice above the rectum, and then introducing a machine similar to a musical instrument called a *flageolet*, with the idea of evacuating the superfluous air, or wind, which they suppose to have produced the disease.

Blistering the wind-pipe, rowelling the chest, and a small purgative of aloes and calomel now and then, have often produced a good effect.

A pound or two of shot has been strongly recommended to Mr Coleman, as a specific; but, upon trial, it has been

been found to have no obvious effect: it was thought that the shot would act by its specific gravity inclining the stomach further back into the cavity of the abdomen.

The treatment must be nearly confined to diet and exercise; the animal should have little hay, and water in particular must be administered with a very sparing hand. These substances which afford most nourishment in the least compass, as carrots, corn, split beans, &c. should be given; the horse should always be worked upon an empty stomach; and, upon the whole, his diet should be small in quantity, but nourishing. By observing this method, a broken-winded horse may do a great deal of work, and be useful to the owner *.

According to Mr Blaine, internal medicines have sometimes been found useful in this complaint. Lime-water has been employed with advantage; and the use of tar is much recommended. Mr Blaine prescribes a mixture composed of two gallons of lime-water, four pounds of tar, and an ounce of fresh bruised squills, or garlic, of which an English pint (or mutchkin) is to be administered every morning.

438
Thick wind.

A complaint similar to the foregoing often occurs in the horse, and is called *thick wind*. It proceeds from a very different cause, being always the cause of previous inflammation, during which coagulable lymph has been effused, as in the *roarer*. Thick wind may be distinguished from broken-wind, by the inspirations and expirations being equal in the former; while in the latter the respiration is not so frequent, and the principal difficulty consists in expiration, which is of course performed in longer time than inspiration.

Little can be done towards a cure of this complaint. We may prevent the disease by good management in the administration of the aliments, exercise, &c. Calomel has been employed to produce absorption, but without any great effect; a rowel under the jaw, and frequent applications of blisters on the wind-pipe, are the only methods capable of producing absorption of the lymph. Half a drachm of the digitalis, or fox-glove, in powder, twice a day, makes an admirable remedy in this, and local diseases of the lungs.

439 The breathing may be completely obstructed, either by the want of a regular supply of fresh air, or by the animals being obliged to breathe such kinds of air, as are unfit for respiration. The consequence of this impeded breathing, is a suspension of the vital powers, or, if the obstruction continues long, death will sometimes be produced. As suspended animation is always attended with more or less of an apoplectic state, we shall defer the consideration of those cases till we come to treat of comatous diseases.

## CHAP. VII. *Morbid Affections of Secretion and Excretion.*

440 THE fluids that are secreted or separated from the general mass of blood, by means of the organs called glands, are in some cases secreted in an unusual quantity; in others their secretion is lessened, or their excretion or passage out of the body is obstructed. Thus in colds of the head, as they are called, in glanders, and in some other affections, an unusual running takes place from the nose; in inflammation of the eyes the secretion of tears is generally increased, sometimes diminished, while it sometimes happens that their passage from the lachrymal gland out of the eye is obstructed. Again the secreted fluids may undergo various changes in their colour, fluidity, and composition. Thus the urine is sometimes yellow, at others red, or blackish; it is sometimes extremely watery, at others very thick and muddy, and in one particular disease, the *diabetes*, it seems to lose altogether the properties of urine, and appears like a solution of sugar, or honey.

In the present chapter, we shall consider the morbid affections of the bile, and of the urine. We shall also make some observations on costiveness and purging.

441
Jaundice or yellows.

The principal morbid affection of the biliary system that takes place in the inferior animals, is the obstruction to the passage of the bile, from the liver into the bowels, producing the disease called *jaundice* in the human body, and commonly known to farriers and cattle-doctors, by the name of the *yellows*.

This disease seldom takes place in the horse, for as it is almost always the consequence of biliary concretions, or gall-stones formed within the gall bladder, and as this animal has no gall bladder, the disease in question can seldom take place. It may however happen that an obstruction may take place in the common duct or pipe, that conveys the bile from the liver, either from concretions formed in the duct, from a spasmodic contraction of the duct, or from a schirrous or hardened state of the liver. The disease is however sufficiently common in cattle and sheep; and a description of the symptoms that mark the complaint in these animals will almost equally apply to the disease when it may take place in horses. According to Mr Denny, young horses are very subject to a variety of jaundice.

Its first visible sign is a yellowish tinge in the white part of the eyes, mouth, and tongue; the mucus and saliva, from the nostrils and mouth, are of a greenish hue, bordering a little upon the yellow. The beast is dull, and heavy, loathing all kinds of food, eating no more than a bare sufficiency for the support of nature; the skin is dry and itchy, especially behind the shoulders, where it can scarcely bear the touch. The beasts have an utter aversion to exercise, or stirring from the place where they are, and if removed with the least degree of precipitation, will break into a cold sweat. Their urine is of a deeper yellow than usual, which has sometimes led to believe it was red water, or bloody urine. The dung undergoes a very considerable alteration in all stages of the disease, and its general colour is blueish or brown, and much resembling burnt clay; but it varies in colour, according to the subject, or different circumstances and seasons. If the disease continues long, the beast gradually pines away, and at last dies of a decline.

It is said that horses have sometimes died of jaundice, in two or three days; and in these violent cases a black sanious discharge has taken place from the mouth and nostrils a little before death. This is called by farriers the black jaundice, and after death the liver is found totally decayed. Mr Lawrence says that he has repeatedly seen cases of this kind. Gibson speaks of an inflammatory species of jaundice, attended with delirium and madness; but this was probably a violent inflammation of the liver.

We have said that the immediate cause of this disease is an obstruction of the gall pipe, commonly owing to

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* Feron's Farriery.

to the formation of gall-stones. The formation of these concretions is most likely to take place, when the animals are deprived of their regular exercise, and are at the same time allowed too full a diet, or are given food of an improper quality. It is said to be very common in some of the cold provinces on the continent, where the cattle are stall-fed during the winter; after which the most of them are attacked with it in the spring. It may sometimes be brought on by hard labour and poor living; but then it probably depends on a diseased state of the liver.

In the treatment of jaundice, our chief reliance is to be placed on the use of purgative medicines; and of these rhubarb, calomel, and aloes, seem to be the most proper; and during their exhibition, gentle exercise should be employed. Mr Denny says that much relief is often afforded in the jaundice of young horses, by giving a ball composed of an ounce of aloes, half an ounce of Venetian soap, and a drachm of calomel; every second or third night, and giving on the intervening mornings a ball of half an ounce of nitre, with the same quantity of powdered rosin, and of common soap. Mashes and warm water are to be given plentifully, and the horse must be kept warm by clothing, and fully exercised.

In cattle, a vomit of emetic tartar may be tried at the first appearance of the disease, as the effort of vomiting may assist in promoting the passage of the gall-stone. If, however, the disease should arise in consequence of previous inflammation of the liver, vomits will be of no use, and the best remedies will be mercurial purgatives with soap. The food should consist of succulent and watery substances, especially of fresh grass; as it is found that when cattle affected with this disease are sent to pasture they commonly soon recover. Warm mashes of bran or malt should be given frequently, both to obviate costiveness, and as being good articles of diet. If the disease should continue obstinate, and the use of mercurial medicines should be found necessary, the animal must be confined within doors, during night and bad weather; and a horse should during the exhibition of the medicines be covered with a single cloth. It will be proper, whenever the weather and other circumstances permit, to give the animal regular exercise in the open air; but if necessity obliges us to keep him within doors, the whole body, but especially the belly, should be well rubbed for a considerable time, twice or thrice a-day. This friction will be proper, even though regular exercise can be taken in the open air.

442 Horses, and sometimes cattle, are subject to a profuse discharge of urine; but as the complaint of which this is a principal symptom, seems not to be seated in the urinary organs, we shall not consider it here, but shall treat of it among the general and more important diseases.

443
iconti-
ence of
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It often happens that there is an inability in these animals to retain their urine for any length of time; they are either obliged to void it very frequently, and in small quantities, or, what is more frequent, it drops away imperceptibly and involuntarily, forming the complaint called *incontinence of urine*. This complaint differs from diabetes, or profuse staling, in the urine coming away by drops, or in very small quantities at a time, whereas in diabetes it passes off in a full and copious stream.

Incontinence of urine is extremely common to dogs, and often arises in these animals from excessive venery, or from the violent efforts which they are sometimes, by the brutality of bystanders, obliged to make to separate themselves from the females. It is also not uncommonly owing to the presence of a stone in the bladder. M. Barruel, professor of the veterinary school of Alfort, had a little Spanish bitch, not above five inches high, and about seven years old, who was troubled with an incontinence of urine, unaccompanied by any other symptom; she was sprightly and well, and was in good condition. Not knowing to what to attribute the complaint, M. Barruel tried a number of remedies, such as warm bathing and clysters of various kinds, but without effect; at last he killed the bitch, and found in her bladder a stone that weighed an ounce and 40 grains, a very considerable bulk, if we advert to the small size of the animal.

This complaint is less common in the horse, but it may arise in any of these animals from a paralytic affection of the sphincter muscle at the neck of the bladder; which is sometimes the consequence of the bladder's being unusually distended with urine. When there is reason to suppose that it is owing to this cause, the best remedy is a blister applied above the pubis, or the frequent application of stimulating liniments to the same part.

444
Suppression of urine.

A difficulty of making water, or even an entire suppression of urine, is a very common disease among horses, and frequently occurs in sheep. The symptoms accompanying this affection, differ somewhat according to the causes which have produced it; we shall therefore consider it under several heads.

445
Cause from over distention of the bladder.

1. One of the most common causes of a suppression of urine, is suffering the animal to travel for a long time without stopping him to allow him to stale; a circumstance which is often neglected by thoughtless people, while on a journey. From the urine being so long retained, the bladder becomes excessively distended; considerable irritation takes place, and when the distention has proceeded to a great height, the animal, though constantly stimulated to relieve nature, is not able to effect his purpose, owing to a paralytic affection that has taken place in the muscular coat of the body of the bladder, attended probably with a spasmodic contraction of the sphincter. If the animal be not soon relieved, a considerable swelling appears above the pubis, accompanied with great uneasiness; the urine becomes absorbed, and is carried through the circulation to various parts of the body, producing an itching of the skin, and generally, in no long time, apoplexy and death.

Sometimes, however, before any considerable absorption can take place, the bladder either becomes inflammed, or bursts, and discharges its contents into the belly, producing there inflammation and mortification.

446
Watery braxy.

This complaint is, as we have said, very common among sheep, constituting an affection which in Scotland is called the *watery braxy*. It is said that young and vigorous sheep are most liable to it; and according to the writers of the ingenious appendix to Mr Findlater's Survey, the immediate cause of the disease, is feeding too freely on succulent diuretic food, and resting too long

long in their laires in the morning. It has been frequently observed, that this species of braxy is most apt to make its attacks upon Sundays, because shepherds generally sleep longer on Sunday mornings than other days of the week, and, of course, allow the sheep to remain too long in their laires. This disease may be prevented by avoiding too free a use of succulent diuretic food, and by moving the animals from their laires early in the morning, making them walk about for some time, in order to encourage them to pass their urine and purl.

In attempting to effect a cure, it may be known whether the bladder is affected, by a great fulness in the lower part of the belly, immediately above the pubis. The seat of the distemper being ascertained, a female silver catheter, or one of elastic gum, ought instantly to be passed through the urethra into the bladder of females. This will draw off the urine, and give immediate relief. But this will be attended with greater difficulty in males; and if attempted, must be done with a long and properly bent catheter or bougie. In either case, when this cannot be accomplished, a puncture may be made into the bladder with a trocar, directly above the pubis; taking care not to wound the intestines. By either of these methods, the urine may be discharged, and the animal relieved. In other respects, with a view to allay or prevent inflammation, evacuations should be procured by clysters and warm injections into the great gut.

447 From inflammation. 2. In the case which we have been considering, the urine, though secreted as usual, could not be discharged; but a suppression of urine sometimes takes place from the secretion not going on as usual, owing to some affection of the kidneys, commonly an inflammation of those organs. We can scarcely with propriety consider this case here, but shall treat of it among the other inflammations in the second chapter of the next section.

448 Stone. 3. Another cause that may produce a suppression of urine, or a difficulty in staling, is a stone in the bladder, or gravelly concretions passing from the kidneys through the ureters or urinary pipes. We have just seen that a stone is sometimes found in the bladder of dogs; but doubts have arisen, whether this could take place in the horse. Examples of it are no doubt very rare, but we have sufficient proof that it may take place. Mr Clark of Edinburgh mentions that he has several stones taken out of different horses; and it is said that Dr Mead had in his cabinet one that weighed 11 ounces. M. Huzard gives an account of a dissection that he made of a horse that died of a suppression of urine, in whom the following appearances were observed. The bladder contained a considerable quantity of red and bloody urine. Its internal membrane was thickened, especially at its lower part; and it was also inflamed and gangrenous in several points. The ureter contained at about its middle, a fragment of a stone that entirely blocked up the passage of the urine, and had no doubt been the cause of this suppression. The stone was imbedded in a cavernous body like the kernel of a fruit. *Within the bladder there was also a stone about the size of a large pullet's egg, broken into two portions.*

If we consider that symptoms of gravel are by no means uncommon in the horse, that gravel is often found in his urine, and that calculous concretions have been frequently observed in his kidneys, we shall easily see that these cases are not so extraordinary as some may imagine. There is no doubt, however, that cases of a stone in the bladder cannot so frequently happen in quadrupeds, from their horizontal position, which prevents the stone from passing from the kidney into the bladder so readily as in the human subject. Hence the kidneys have often been found to contain stones of a considerable size, without the horse having been during life affected with symptoms of calculus.

When concretions form in the kidneys, they generally produce a great degree of irritation, and consequent inflammation; but if a horse is affected with a suppression of urine, there is reason to suppose that a stone is lodged in the bladder. The certainty of this having taken place may be very readily ascertained, by introducing the hand within the rectum, as the stone will, for the most part, be felt below the finger.

It is not probable that internal remedies can have any effect in cases of calculus in the horse. In the beginning of the complaint, when the symptoms are very slight, diuretic medicines may be tried, and will perhaps bring away the small sandy particles; but if a stone of any considerable size be lodged in the kidneys, the case is incurable. If the stone has got into the bladder, it may be extracted by making a cut into the bladder above the pubis, and taking out the stone by means of forceps, such as are employed by surgeons in the operation for the stone. In the mean time the animal may be relieved, by drawing off the urine from time to time by means of a catheter, which is easily used in the mare, and by preventing costiveness. Too much labour or over exertion should also be avoided, and the animal should live chiefly on succulent food.

4. A suppression of urine may arise from an obstruction in or about the neck of the bladder. A curious case of this kind occurred to M. Huzard, and he has related the appearances on dissection, which were as follows. 449 Obstruction at the neck of the bladder.

There was at the base of the spermatic arteries, on the right side, a glandulous body about the bigness of one's fist, through which oozed a lymphatic fluid, that was whitish and thick, in some places appearing like pus. The bladder was enormously distended with urine, and extended into the belly beyond its usual limits; it was inflamed and thickened; the urine was nearly in its natural state. The neck of the bladder was filled with varicose excrescences, that completely obstructed the passage. These excrescences were red, and so hard as to resist the knife; they contained each a small particle of hardened blood, in which two parts were distinguishable. The bottom of the bladder was very black, and its surface of a reddish yellow; the whole of the urethra was red and inflamed.

It will be pretty evident, that, should a case like this occur, it is incurable. It sometimes happens that the urine appears unusually red, as if bloody. This affection may take place in any of these animals, and it is called *bloody urine*, *pissing of blood*, or *red water*. It is most common among cattle. It may arise from falls or bruises, from overstraining at hard work, as in horses from a hard-run heat in racing, or after any violent exertion, such as a desperate leap; or it may proceed from inflammation of the kidneys. 450 Bloody urine, or red water.

When it takes place in cattle, the animals are affected with an almost incessant desire to stale; sometimes they

they make but little water at once; sometimes the urine comes away in its usual quantity. In this latter case, if the urine be deeply tinged, it is considered as a very dangerous symptom, and when it happens, the beasts leave the herd, and appear to feel considerable pain; they hold up their tail, and sometimes hold their back higher than common. In fact, these symptoms, which do not seem well understood by the cattle doctors, indicate an inflammation of the kidneys.

When this disease is occasioned by strains, bruises, or any violent exertion, there is reason to fear that inflammation may take place. This must therefore be guarded against by bleeding, cooling drinks, and succulent food; by avoiding exercise and every thing that can heat or irritate. It is a common custom to give nitre and other saline substances in these cases; but when there is any inflammatory affection in the kidneys, these salts are improper, as they tend to increase the irritation of these organs. The best drinks in such cases will therefore be thin gruel, linseed-tea, or bran-water.

Cattle are said to be most subject to the red water in the spring, or summer, while at grass; and it is supposed to be produced sometimes by sudden changes of the weather, by want of water, or the use of such as is unwholesome. Young cattle are more subject to it than those of more advanced age; hence particular attention should be paid to these young animals; as when the affection has once taken place, it is considered as highly dangerous. These are the opinions of cattle doctors, and we suppose they refer chiefly to inflammation of the kidneys, of which bloody urine is, as we have said, a prevalent symptom. This formidable disease will be considered more at large hereafter.

It appears that when cattle are sent from Europe to the West Indies, the bulls, when first put on shore, are extremely liable to this complaint, which often proves fatal. It is attributed to the eager desire which these animals, after having been so long confined to a dry diet on board, have for green succulent food, in which they will of course indulge to excess the first opportunity. The remedies found most effectual are bleeding, and the administering of nitre and purging salts; but it might probably be prevented by housing the cattle immediately after they are brought on shore, and accustoming them gradually to their change of diet.

451 Black water.

Sometimes the colour of the urine in sheep and cattle is nearly black, and they are then said to labour under the black water. This affection is not well understood, but it is probably a variety of the last. It is said to be produced by feeding on cold, wet land, and that simple removal of the cattle to a more favourable situation will often effect a cure. Mr Lawrence considers the black water as a symptom of incipient mortification of the kidneys, and commends bleeding, (unless in a cow), cordials and tonics, such as iron filings, with bark, opium, nitre, in strong beer, if the progress of mortification be apprehended. We may remark, that, if mortification of the kidneys has taken place, which may in general be known by the stinking smell of the urine; all these remedies could produce no effect; and it would be much better to kill the animal at once, than be at the expence of time, labour, and medicines, in attempting to effect a hopless cure.

452 Scouring or purging in horses.

A scouring or purging is a very common disease in all our domestic animals; and in some of them it is very dangerous, and very difficult to cure. The complaint is somewhat different in the several species, so as to require a particular description in each. Some horses are liable to be affected with a purging from the slightest causes, and on every exertion. These horses are called by grooms *washy horses*, and they are said to have narrower chests and lanker bellies than others; and it is to this unusual deformity that the purging is generally attributed. Some horses are said to labour under a nervous diarrhœa; those that are chiefly subject to it are young, and of a weak and irritable habit. The complaint generally appears on them only when at work; and when they are suffered to remain idle, their bowels are sufficiently healthy. Mr Lawrence had a favourite young horse that was subject to this nervous scouring, and on whom he tried a variety of medicines to no purpose, as it was found that nothing but idleness could arrest the complaint. To use Mr Lawrence's words, "the nag whilst at play, was always fat as bacon, and very firm in body; but a week's work reduced his flesh, and caused him to dung like a cow." Horses of this delicate constitution require great care and attention, or they will not be of much use to the owner. They should have strong nourishment, but it should be given in small quantities at a time. Mr Lawrence recommends good old beans mixed with their oats, lucerne, or strong upland hay, with rice mashes, carrots, and occasional runs of grass.

A purging may be brought on in horses by a sudden change of diet, as from hay to grass, or from grass to hay. Hence, in such horses as are liable to disorders of the bowels, these changes should always be made very gradually. It is very commonly the effect of exposure to cold while the body is heated, and is one of the least dangerous affections arising from that cause. A purging may also be owing to irritating substances, such as crude, unwholesome, or undigested food remaining in the bowels; and in these cases it is often attended with pain, from the formation of an acid in the bowels.

A purging in horses is seldom dangerous, except when it arises to a great height, or continues very long, so as to produce a great waste of flesh, or very considerable weakness.

In general it is sufficient, in order to carry off a purging in horses, to avoid the causes which have produced it, where these can be ascertained; to wash away irritating substances from the bowels, by giving plentifully of diluting liquors, such as water gruel and linseed tea, or gradually to change the diet, if the purging seems to have arisen from improper feeding. If, however, the disease should continue obstinate, or be attended with unpleasant symptoms, means must be taken for checking or removing it. Some caution is requisite as to the plan of treatment to be adopted; as, if the complaint be checked too suddenly, some other dangerous affection might be produced. Veterinary writers differ considerably with respect to the treatment of diarrhœa in horses; some recommending gentle laxatives, as rhubarb, which Mr Lawrence considers as the sheet anchor in these cases; whilst others as strenuously advise against the use of purgatives, and recommend opium and astringents. Probably in most cases there is little need of laxatives, and after plentiful diluting, one of the best remedies will be clysters of starch or water gruel, with a small quantity of laudanum. If there is acidity in the stomach and bowels, prepared chalk or lime water may be given with advantage; and if there is considerable weakness, the strengthening astringent medicines may, in the latter stages, be used without hesitation. We agree with Mr Blaine, that these are less proper at the commencement of the disease.

453
In cattle.

In cattle this complaint is sometimes very serious, and farmers not unfrequently lose several of these animals by it in a season. This has induced them to call it the *scouring rot*. When the purging has continued long, it produces in these animals a general weakness and loss of flesh. Their skin sometimes hangs loose about the body; in other cases they appear hide-bound; their hair turns sandy, or of a grayish colour; their eyes grow pale; the pulse becomes weak and irregular; their excrements thin and slimy, and frequently change colour, especially in the early stages of the disease; but when the complaint is pretty far advanced, the dung appears like half-chewed food; and in fact, in these cases the food appears to pass through the bowels without undergoing the digestive process. It is said that when the animals have been long affected with this scouring rot, they feel a great degree of distress and pain, when grasped on each side of the back-bone, just behind the shoulders; and this is considered as a sure mark that the beast has become tainted or unsound, from the scouring rot.

This complaint in cattle may arise from most of the causes that have been stated to produce it in the horse; but it is considered as being most commonly owing to their being overheated in driving, and to want of sufficient nourishment, either with respect to quantity or quality. It may be produced in cows, by their being constantly and too frequently milked, while they are deprived of proper nourishment; and it is not uncommonly produced by lodging on wet ground in autumn, and feeding on a coarse, unwholesome fog.

In the treatment of this complaint in cattle, a number of strange remedies have been employed, such as hogs dung, turpentine and butter-milk; dock root boiled in salt and water, and nettle root boiled in forge water. Among the most sensible receipts that we have seen, is one in Rowlin's Cow-doctor, composed of three ounces of bole armoniac, with two ounces of bay berries, and the same quantity of alum, of shavings of ivory, and powdered comfrey root, boiled in two quarts of skimmed milk, adding while boiling a handful of starch. This is to be given for a dose, for which, however, it is perhaps rather too strong. Mr Lawrence recommends that, on the first appearance of the scouring, the cattle should be taken to the home fold, and put on dry food, which will generally supersede the necessity of medicine. The remedy which Mr Blaine seems chiefly to rely on, is a decoction of an ounce of ipecacuanha, a drachm and a half of nux vomica, half an ounce of galls, two drachms of alum, and 20 grains of white vitriol, in a quart of water boiled to a pint. Perhaps this decoction is rather too complex, and some of its ingredients may be spared. The receipt, N° 30. is well suited to these cases. It may be supposed that where the scouring has continued for any considerable time, the bowels are become extremely sore and tender. In this case, mucilaginous or oily substances would be of advantage, and they should be given frequently, both by the mouth and by way of clyster. Mr Lawrence recommends a pound of fresh mutton suet boiled in 3 quarts of milk until the suet is dissolved, to form a drink to be given warm. This, we doubt not, will answer extremely well. If the disease should go to an alarming height, starch clysters with laudanum may be given as a last resource. Mr Blaine remarks, that in these cases, he should be disposed to try animal food altogether; giving broth to drink, or the blood of other animals, with meat balls forced down the throat; as he thinks it not improbable that thus a change might be effected in the constitution, which might pave the way to a cure.

Dr Dickson thinks that much advantage may be derived in these cases, from a strong decoction of hartshorn shavings and cassia, with powdered chalk, in the proportion of half a pound of chalk, four ounces of shavings, and an ounce of cassia, to be boiled together in two quarts (chopins) of water to three pints, (mutchkins) adding the cassia towards the close of the boiling. A hornful of this mixture is to be given several times in the day, shaking it well every time.

454
In calves.

Calves, when first weaned, are subject to a species of purging which sometimes proves extremely obstinate; and it is said that the principal reason of the calf-feeders giving them chalk to lick, is to prevent this purging. It appears that this disease will take place in calves, when they are fed on the milk of some particular cows; and that when the milk is changed the complaint goes off. The purging may in general be checked by boiling starch and bean flour in their milk: and if it still continues obstinate, a little ginger and laudanum may be added.

455
Pinning in lambs.

This disease is extremely incident to young lambs, and it is called by the shepherds *pinning*, because when the purging has continued for any time, there flows from the fundament a glutinous matter that fastens or pins down the tail to the hips, and prevents any farther evacuation. When this is observed by the shepherds, they commonly seize the lamb, and after washing away the glutinous matter from the tail, so as to disengage it from the hips, they rub the parts with fine earth, or other fine powdery matter, to prevent their sticking in future. Something of this kind is very proper, but hogs lard, or any other greasy substance, would answer the purpose much better. The disease is said to be produced by wet and cold in spring, together with the ewes eating too greedily of soft moist grass. It may be prevented or cured, by removing the flock to heathy or poorer pastures, that abound with astringent or aromatic plants.

Mr Findlater remarks, that among lambs fed with their dams, upon the rich improved pasture of Lothian parks, *pinning* never occurs; whence it is probable that it originates from milk concocted from poorer pasture, which gives more curd than cream to the milk, rendering the excrements of the lamb more viscid. When the mothers have little milk, the lambs are very rarely *pinned*. *Pinning* is therefore considered as a favourable symptom of the lamb's being well nursed. It is not considered as a disease in Tweeddale; though, if not redressed, it would be productive of disease. It is considered as an accident to be guarded against, and which, like other accidents to which sheep are liable, requires the shepherd to be constantly walking through his flock. No Tweeddale farmer would, on this account, remove his ewes and lambs to poorer pasture, where the lambs would be worse nursed; as he knows, that if the pinned lamb is timeously noticed, and relieved by pulling up the tail, all danger is removed.

456 In dogs. Dogs are also very subject to this complaint, and it may be brought on in these animals by any of the causes which we have mentioned as producing it in the other species. In young dogs it is often the effect of worms, and in this case the stools are slimy, greenish, and sometimes bloody. Common looseness in dogs may be removed by much the same remedies as in other animals, as by ipecacuanha, opium, with starch, or arrow root clysters, and prepared chalk, if there is any acidity in the bowels; but where it proceeds from worms, it cannot be effectually removed till they are expelled.

Purging must be carefully distinguished from dysentery, or what is called bloody-flux in the human species, and *brake-shaw* in sheep, as in this latter there are symptoms of inflammation, and commonly more or less of fever. The distinguishing marks of this disease will be considered hereafter, as we cannot properly treat of it in this place.

457 Costiveness. Costiveness, or binding of the belly, occurs occasionally in all these animals; but it chiefly calls for attention in the horse, as in him it is more frequent and more dangerous. It arises for the most part from want of exercise, when the horse is kept upon hard dry food, as oats or beans. It is a constant symptom of colic and of inflammation in the bowels, and the continuance of it always aggravates these complaints, and seldoms fails to produce them where they were not before present.

It is best prevented by occasional change of diet; by giving the horse barley boiled, or green food now and then, where he cannot be frequently sent to pasture; and every night or two allowing him a mash of bran, or, if he is of a very costive habit, of malt. Regular exercise and good dressing, especially friction on the belly some time after feeding, are also good preventives. If it should arise to any considerable height, the bowels must be emptied by back-raking, and the administration of softening, laxative clysters, which may be repeated every three or four hours till the bowels become sufficiently regular. Purges given by the mouth, though they may, after some hours, remove the costiveness, seldom fail to do more harm than good; especially if the complaint has continued long, and there is considerable heat of the body, fulness of the pulse, pain in the bowels, or great irritation. In these cases, while the bowels are opened by clysters, it may be proper to take away a little blood.

Suckling calves are sometimes subject to costiveness. When this happens, the chalk should be taken away, and half an ounce or an ounce of magnesia be given them in a pint of warm gruel; or if the costiveness continue, a little rhubarb may be added.

## Chap. VIII. *Morbid Affections of Generation.*

458 It has been wisely ordained by nature, that the inferior animals shall feel the passion of desire only at certain seasons; and these periods are generally so adapted, that delivery shall take place at such a time of the year as will be best suited to the rearing and feeding of the young animal. It is probable that in a state of nature these animals, whether male or female, do not experience inordinate desire, except at the proper periods; and when domesticated, the females are scarcely ever salacious, except at these times. The males of these animals, however, in the domestic state, especially dogs, are occasionally subject to excessive lust, and all of them, during the periods assigned by nature, become sometimes very unruly, if not permitted to indulge their natural appetite. Should circumstances render it necessary to prevent them from indulging this propensity, they must be kept on a lower diet than usual, or have such food as contains least nourishment in the same quantity: and must be made to use more exercise than common. They must also be kept extremely cool, and horses should at these times have less litter to sleep on than usual.

459 Indifference. It is of considerable consequence to those who make breeding an object, that the animals who are to copulate should not be indifferent to the act in which they are to engage. It sometimes happens that either the male or the female betrays a coolness or indifference, which may defeat the object of the breeder. When it appears that a stallion or a bull regards the mare or cow presented to him with tranquil air, or turns from her when he ought to do his duty, it is clear that something is wrong, and that the issue of such a forced connection would scarcely be worth the trouble of rearing. It is said that Spanish stallions are more subject to this indifference than others.

If an indifference of this kind should take place in an animal that is generally keen and vigorous, it would be wrong to employ any incitement to stimulate him to an action for which he has perhaps been unfitted by too much exertion of the same kind during the season; but where the animal is naturally thus cool, and has otherwise the requisite qualities of a good stallion or bull, it may not be amiss to employ some stimulating means before leading him to the female. He should be kept on a generous diet, and when particularly required, he may have a cordial ball given him, with a quart of good ale after it. This will generally answer the purpose, or if it does not, the animal is unfit for his office, and should be discarded. It is a common practice among some grooms to insert a slice of ginger into the fundament of an indifferent horse, and this is said to have the effect of rousing his latent powers.

Indifference for coition is more likely to take place in the females of these animals, and it is no uncommon thing for a mare or cow to refuse the male. In general this is owing to a poorness of diet; and these females should, like the males, before being taken to be covered, be put on a generous diet with moderate exercise. Probably all strong, stimulating remedies, such as cantharides, which are sometimes given, do more harm than good, as they may produce inflammation of some internal organ, without producing completely the desired effect. The cordial ball and strong ale are the most innocent remedies in these cases, and where nature is tolerably sufficient, they will be the most efficacious.

The parts of generation in these animals are subject to certain accidents or diseases, and it is necessary that we should notice the more common of these.

460 Falling of the penis. The horse is subject to what is called a falling of the penis. This consists in a relaxation, and total weakness of the parts destined to sustain and support it in its natural

ral state, and is in fact a kind of paralysis of the erector and accelerator muscles, or a total atony of the suspensory ligament.

It may be produced by various causes, as by too great exertion in labour; hence it is common to draught horses that are hard worked. It may also depend on a violent spasm of the muscles of these parts, as this is always succeeded by a proportionate relaxation and atony. It is not unfrequently produced when a stallion is made to cover too many mares in one season.

When the case is slight, after returning the penis within the sheath, which should always be done, a pail or two of cold water, or of salt and water, may be thrown over it several times in the day, and the muscles may be anointed with some stimulating liniment. It has been advised to make superficial punctures about the yard with a sharp needle, and then to wash it with distilled vinegar; but we do not know whether this plan has been attended with the desired success. If the complaint continues obstinate, the penis must be bolstered up, and a charge applied over the back part of the sheath so as to leave sufficient room for the horse to make water. If the complaint is attended with a general weakness, tonics and cordial remedies must be applied.

461 Falling of the womb.

When a cow has been delivered with more than usual difficulty, or has been very long in labour before procuring assistance, it not unfrequently happens that the womb is inverted, or, as it is commonly expressed, the calf-bed comes down. This accident is more likely to happen to some cows than to others, and is more especially incident to those of a weak habit of body, and such as are unusually wide between the thighs. In such cows it would be proper to pay more than usual attention about the time when labour is expected to take place, and the stall in which they are left should be made very commodious, that they may frequently lie down, as the great weight of their burden will have most effect while they are standing. When the calf-bed is come down, it should be returned as soon as possible, by the operator clenching his fist after greasing it and putting it to the middle part of the womb, which he is thus to push gently into its place, and when it is up, he must take care not to withdraw his hand too suddenly; but it would be better to keep it within the womb for a little, as it will stimulate the adjacent muscles to preserve the parts in the proper situation. After withdrawing the hand gently, the external parts should be bathed with camphorated spirits, and the beast must be watched, to prevent the same accident from taking place again. It is the practice with some to lead the cow down a hill after returning the womb, as it is supposed that this is greatly advantageous to the parts recovering their proper position. If proper assistance cannot soon be procured, the inverted womb should be laid on a clean soft linen sheet, and carefully covered from the air, the irritation of which might produce an inflammation. If the relaxation of the parts is so great that the womb still comes down, recourse must be had to a stay, to put behind, to prevent the womb from falling down; and some have recommended stitching it to the adjacent parts with a wax thread. Probably this operation would be attended with more danger than benefit.

462 Abortion.

Cows and mares sometimes suffer abortion, or, as it is called, slip their calf or foal, before the usual time of labour. This accident may be brought on by violent exercise, especially by leaping hedges and ditches; by sudden frights, knocks, or bruises; and it is also said that it may arise from bad smells, and ardent desire in the mare or cow; but these latter causes are probably imaginary. It is advised by some to keep cows who have slipt their calves as free from having any communication with the rest of the cattle as possible, under the idea that the accident may become infectious; and it is declared that experience has shown, that without great care and management it may go through the whole stock, and even return the next season, if the same cattle are kept. We cannot vouch for the truth of these assertions, but if true, the circumstance is very remarkable.

When a cow or mare has slipt her young, unless this accident has been occasioned by great exertion, it is a proof that the animal is extremely weak, and she must be put on a more nourishing diet, and have strengthening remedies; but in general little is required after such an accident, but rest, and perhaps a warm bran mash. This latter may be frequently given to mares or cows during pregnancy, as costiveness may be a great means of producing abortion.

## SECT. II. OF COMPLICATED DISEASES.

Many of the diseases, that have been treated of in the last section, are very important, and several of them highly dangerous; but those which we are now to consider, have a superior claim to our attention, either from their fatality, the rapidity of their progress, or their intimate connection with some of the most important or destructive maladies that affect the human race. They will, therefore, require a somewhat fuller discussion than we have thought it necessary to give to the diseases described in the last section. 463

We shall class them under the several heads of Fevers and Febrile Eruptions; Inflammations; Lethargic diseases; Spasmodic diseases; Dropsies; and Anomalous diseases; which will form the titles of as many chapters, the last comprehending those affections, of which the nature or causes have not been fully ascertained, with those that could not properly be reduced under any of the former heads.

For the general doctrine of fevers, inflammations, comata, spasms, and dropsy, we must refer to the medical articles of this work.

### Chap. I. *Of Fevers and Febrile Eruptions.*

464 Inflammatory fever.

All the domestic animals may be affected with primary fever; and this may be either of an inflammatory or putrid kind.

#### 1. Inflammatory Fever. Synocha.

Inflammatory fever is, we believe, seldom seen in a primary or idiopathic complaint, except in the horse; and to the consideration of this fever, in that animal, we shall here confine ourselves. The symptoms are thus described by Mr Blaine:

" It is not easy to say what is the first symptom of fever in the horse; but from the effects that we see arise in some cases, it may be presumed that it is a cold fit. It is usual however first to observe this complaint, by by the loss of appetite, and dull heavy appearance of the animal; the extremities are cold, and the trunk hot, or the body is cold, and ears are hot. If a horse is attacked with common fever, while he is at grass, he is found restless, roving about the field, with an unsteady staggering air, and his head held low; if in the stable, frequently shifting his position, and is evidently restless and uneasy. His pulse is generally full, frequent, and hard, the two latter states of it are almost always present, but the former may vary. If the mouth is examined, it will be found hot and dry, and frequently smells strong; the breath is particularly hot, and there is often an increased redness of the inner membrane of the nose, even though there should be no primary affection of the lungs. The eyes are dull, heavy, and sometimes inflamed, and the horse starts, and is at times drowsy, but has no regular sleep. In this fever the secretions are generally diminished, therefore the dung is hard, and in small quantities; the urine sparingly made and high coloured, and the excretions from the skin equally confined, giving it a dry harsh feel. The respiration is quickened, which is shewn by the heaving at the flanks, and which must be distinguished from that difficulty accompanying inflammation of the lungs; in which case the air appears drawn through a part too small for it, as though we were to breathe through a quill; but in fever it is usually only simply accelerated.

"This forms the first stage of the complaint, and sometimes immediately succeeding to this, is an attack on some one particular organ, as the brain, lungs, bowels, or kidneys; in which case it ceases its primary affection, and becomes secondary and symptomatic; but when it remains purely of the febrile type, as the disease advances the symptoms become more irregular, seldom appearing the same in any two objects, arising from particular states in the individual bodies, varieties in the treatment, or from some peculiarities in the disease itself. The pulse in this second stage continues hard, but loses some of its fulness, and increases in frequency; the skin becomes moister, the urine is secreted in rather larger quantities, and sometimes to these succeeds a purging; the watchfulness increases, and the horse is often observed in these cases to chew a lock of hay, and let it fall from his mouth again, as though insensible of its escape.

"This disease seldom remains very long in this state; but there either succeeds a gradual abatement in the hardness and frequency of the pulse, the countenance becomes more lively, the muscular weakness increases, but the irritability lessens; the animal appears more tranquil; the secretions gradually return to their natural state; the mouth becomes moist, and the beat regular and equable; and thus is formed a resolution of the fever. This kind of fever, I believe, seldom terminates in a crisis, nor often by sweating; perhaps it may sometimes by purging.

"But when to the foregoing symptoms, instead of their latter appearances, there succeeds great restlessness, or sometimes contant drowsiness, the pulse becoming very quick, as from 70 to 80 pulsations in a minute, preserving some of its hardness, and accompanied with profuse staling, though at others the urine remains high coloured, and small in quantity, and the thirst unabated; when to these are added great prostration of strength, a fatal termination may be expected *."

We have said that simple fever is not common in sheep or cattle; but when it occurs in these animals, the symptoms differ little from those above described.

It must be remarked, that though the foregoing description will apply to most cases in horses, all the symptoms here laid down will not often be found in the same case; but they will vary according to the constitution of the animal and other circumstances. Sometimes the fever will have less of the inflammatory type, and will approach to what is called a low or nervous fever. Cases of low nervous fever are, however, very uncommon among horses. Mr Blaine says that he has met with no instance of this kind, but that he was assured by a Mr Bloxham, a veterinary practitioner of considerable observation, that he had met with a well-marked case of typhus fever. In cases that approach this low type, the heat of the body is more irregular than in the pure inflammatory fever, and the mouth often continues moist though drink be refused; and the secretions and excretions are usually not so much affected. Sometimes there takes place a discharge of glutinous matter from the nose, and the eyes are watery. The pulse in these cases usually ceases to be full after the first 24 or 36 hours; and though it still continues hard, it is more frequent than before, and becomes small and irregular as the disease advances. This low variety of fever, is more dangerous than the true inflammatory fever, and requires more particular attention.

Inflammatory fever may be produced by any cause that violently agitates the body, and unusually accelerates the motion of the blood. It may be produced by excessive exertion and fatigue, or by an exposure to cold while the body is overheated. It is said to have been sometimes brought on by a sudden fright. A very common cause in hot climates, is long exposure to the direct rays of the sun. Pure inflammatory fever is certainly not contagious.

In the cure of inflammatory fever it is necessary to draw blood as soon as possible; and the quantity of blood taken away should be in proportion to the violence of the inflammatory symptoms. We are disposed, however, to think, that a less quantity than is usually recommended, perhaps not more than two quarts at once, will be sufficient, as the weakness that comes on in the latter stages of all fevers, will be greatly increased by too much loss of blood. The blood should be preserved in a proper vessel, as directed in N° 162. that it may be ascertained how far it will be proper to repeat the operation. When blood has been drawn, the horse should be back-raked, or a hand passed up the rectum, and the dung drawn carefully away, after which a clyster should be thrown up, such as N° 17. of the receipts. It should be blood-warm, and should be passed up carefully and gently. If there is much determination to the head, a blister may be applied to the neck, or a seton inserted as near the head as may be. Cooling medicines may be administered, such as the drenches, N° 22. and N° 26. All heating or cordial medicines, and stimulating food should in the early stage of the fever, be carefully avoided. The diet should consist of light food that is easily digested, such as sweet hay, or, if that can be procured, lucerne or sainfoin; bran mashes, and, by way of drink, thin gruel.

The rational mode of treating fevers, lately introduced

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* *Blaine's* *lines*, ii.

ced into human medicine, will probably not soon be transferred to the stable. Grooms and farriers will not easily believe that it is necessary to keep a feverish horse cool, and allow him to breathe a free, pure air. The practice usually followed in these cases is to shut up the stable as closely as possible, and even to stop every cranny in the door and windows. This practice is not only sufficient to increase the disorder of the feverish horse, but even to excite fever in such horses as happen to be in the same stable. It is, besides, customary to cover up the horse with a load of body-clothes, in order that he may sweat off the fever; aud probably these clothes are girded tight round his body by means of rollers.

Instead of this absurd method of treatment, a feverish horse should, if possible, be put into a stable where there is not more than one horse. As these animals naturally love society, it is better that he should not be quite solitary, otherwise he might be put in a stable by himself. The stable should be roomy and airy, and should be regularly cleaned. The horse may have a light cloth thrown over him, but this should not be fastened more than is sufficient to keep it from falling off his body.

When the inflammatory symptoms have subsided, and signs of debility begin to make their appearance, as they never fail to do in the course of a few days, a different plan of treatment will be required, as far as respects the administration of internal remedies. A horse labouring under fever must be carefully watched, in order to mark the time at which the inflammatory symptoms begin to give way to those of lowness and debility; and as the change is often very sudden, the horse should be visited at least twice a-day, or oftener if possible, as were the groom or other attendant to continue the debilitating treatment after the symptoms of debility come on, such a degree of weakness may be produced as will not easily be recovered. The change will be discovered chiefly by the alteration of the pulse, which, from being hard and full, becomes softer and in general weaker. This is the time to exhibit strengthening medicines; but these at first should be of the gentler kind, such as Peruvian bark, or willow bark, which may be given at first in moderate doses; and if the debility continues, the dose must be increased, and the medicine administered more frequently. During the whole treatment, care must be taken that the horse be not suffered to remain costive, and his bowels may be kept moderately open, by giving him a warm mash every night. If the weakness becomes very great, and there appears much restlessness or heaviness, while the pulse continues low, it will be proper to administer some of the more powerful stimulant medicines, as camphor and opium, ammonia, or snake-root, as directed in the receipts N° 35. and 38. As the horse becomes convalescent, the stronger tonics, as oak bark, with ginger, may be administered twice or thrice a-day; and as his appetite returns, he may be indulged with his usual food, with gentle exercise. It will be proper, however, to avoid any considerable exertion for a long time after the animal has become convalescent, as a considerable period must elapse before the body can recover its usual strength and vigour.

Inflammatory fever precedes or accompanies most violent inflammations, especially those of the brain and other viscera, and it generally ushers in several of the eruptive diseases. In some of these complaints the fever demands particular attention; but in most of them it is merely a secondary symptom, and yields to the general treatment of the disease.

### 2. EPIDEMIC PUTRID FEVER. Typhus. *Murrain, Pestle, Garble.* Epizootée, Fr.

Putrid fever does not commonly attack horses, though it has occasionally raged epidemically among these animals. Lancisi, an Italian physician, has described an epidemic fever that raged among horses in Italy about the year 1712, and Mr Osmer mentions an epidemic of a similar kind, attended with critical abscesses. He calls it the distemper, and says that it had raged at different periods for more than 50 years.

The most serious epidemic fevers that have ever appeared among domestic animals, are those which, from their violence and fatality, have been called *murrains* or *pests*, and which have raged occasionally from the earliest historical accounts.

Columella mentions a contagious disease, which he calls *cruditas*, that scarcely differs in its symptoms from the murrains that we are presently to describe. The following is his description. "Crebri ructus, ac ventris sonitus, fastidia cibi, nervorum intensio, hebetes oculi, propter quæ bos neque ruminat, neque lingua se deterget." He advises bleeding in the tail, and back-raking, and clysters; and if it appears that the disease is contagious, he recommends the infected cattle to be separated from the rest of the herd.

A similar disease is also described by Vegetius, who recommends a similar treatment, with the additional advice: "Mortua cadavera ultra fines villæ projicienda sunt, et altissimè obruenda sub terris;". To carry the carcases to a distance from the farm, and bury them deep in the earth.

Marius, a Burgundian ecclesiastic, who wrote in the 6th century, mentions a disease, which he considers as the smallpox, that destroyed great numbers of cattle. "Hoc anno (570) morbus vàlidus, cum profluvio ventris et *variola*, Italiam, Galliamque valdè affiixit, et animalia bubula per loca superscripta maxima interierunt *."

The first accounts that we have of any disorder of this kind, since the beginning of the present century, are related by Ramazini and Lancisi, two physicians then living in Italy, where this disorder first broke out, in the year 1711, in the territories of the republic of Venice, in the country round Padua; and was said to have been brought from Dalmatia, a province of Turkey, by some merchants importing living cattle, according to their annual custom, from that and the neighbouring parts. The disease soon spread itself through most parts of Italy beyond the river Po, and appeared two years after in the duchy of Ferrara, where it so ravaged the country, in the years 1713 and 1714, that Lannonius, a celebrated physician of that time, informs us, it was a prevalent opinion, that the whole species would quickly become extinct. From Italy it travelled through the Tyrolese into France. Shortly after Germany suffered, as well as the Low Countries; and from these parts it was supposed to have been transported into Great Britain and Ireland. But there is no record of a new infection in this country since the year 1714, till the middle of last century, when we probably received the infection from Holland, where this disorder then reigned, having received the infection from some of the neighbouring parts of Germany and Flanders.

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About the year 1744, it was reported to have been brought by some traders into Essex, who had purchased calves in Holland, or some other of the provinces of the low countries, which had the infection, and spread through several counties, till it became a matter of importance to the state; and on the 13th of February 1745 gave occasion to the passing of an act of parliament, commanding that every probable, or even possible, means should be employed, by officers appointed for that purpose, to prevent the farther spreading of it. Premiums were given to those who killed their cattle as soon as the infection made its appearance; and fines were imposed upon every one who acted in opposition to the established laws, respecting driving, exposing, or selling cattle, supposed or found to have caught the disorder. Every precaution, however, which could be suggested at that time, proved ineffectual; and fresh orders were issued by his majesty in council, which for some time were also found to produce very little effect. It became so alarming to the country, that many eminent medical characters in different parts of England, closely applied themselves to the study of remedies for this calamitous distemper. They differed in opinion, whether it was a disease of an infectious nature, or proceeded from a malignancy in the state of the atmosphere, or some peculiarity in the nature of their food. The contradictory opinions which prevailed among them, nearly prevented some of the ablest professional men from appearing in behalf of the public; especially Mr Barker, who wrote an ingenious pamphlet on the subject, and whose mode of treatment proved more successful than that of many others, whose pretensions were given to the public in a more confident manner, and more strenuously supported.

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From the several histories that have been given of the disorder, it appears to have differed in its symptoms and effects, according to the countries in which it appeared, the various seasons in which it commenced its ravages, and some other circumstances not fully ascertained. There seems to have been no doubt that the disease was infectious, or at least that it was easily propagated among the species of animals which it attacked; but it does not appear to have been capable of spreading to other species; as men, horses, sheep, and dogs, that lived in the neighbourhood of the infected cattle, shewed no marks of having received the contagion.

In the historical sketch of the writers on veterinary medicine, we mentioned several works on the subject of the murrains that prevailed over Europe in the last century; and of these it will have appeared that the greater part were the production of foreigners. The most celebrated of these foreign publications were those of Sauvages, Goëlicke, and Camper. The work of the latter upon this subject is extremely valuable; and as it was written for the instruction of people in general, having been delivered in the form of lectures before a crowded audience, it is preferable to many others that have appeared on the subject. It is given in the third volume of Camper's works on natural history, physiology, and comparative anatomy, lately published at Paris. Camper delivered four lectures; in the first of which he explains to his hearers the structure and direction of the principal blood-vessels of the neck and extremities in cattle, and the natural position and appearance of the entrails of these animals. In the second he describes the natural structure of the four stomachs, the liver, and the spleen, and of the heart and lungs. In the third he explains the function of rumination, or chewing the cud, in all ruminating animals, but especially in cattle. In the fourth lecture he gives an account of the several writings that had appeared on the subject of *epizootic diseases;* among which he particularly recommends a German work by Dr Krunetz, that of Goëlicke, and those of our countrymen Brocklesby and Layard. In the same lecture he gives a very accurate detail of the symptoms of the disease as it appeared in the province of Groningen in the year 1768, with the appearances on dissection; his own opinion with respect to the nature of the malady, and an account of the most approved method of treating it. We regret that this work came into our hands too late for us to make any considerable use of it in this article.

The medical practitioners in England, to whom we are most indebted for an accurate account of the symptoms of this disorder, and a rational mode of treating it, are Dr Brocklesby and Dr Layard. As the account given by these gentlemen differs in several particulars, though there can be no doubt that both describe the appearances which fell under their own observations, we shall extract a few particulars from both their publications. The following is Dr Brocklesby's account of the disease.

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Brocklesby's description of the murrain.

For ten days or a fortnight the cattle were troubled with a dry cough, which is indeed not an uncommon symptom among cattle, at that time of the year, and therefore Dr Brocklesby did not consider it belonging to the present disease; the hair was rougher on the skin than ordinary; their eyes looked heavy, and, when the principal disorder appeared, they refused fodder, but had an insatiable thirst for a time: The milch cows decreased in their milk, which remained to a certain quantity, sometimes for two days, before it changed colour, but at length often dried up. Upon ceasing to chew the cud, a shivering seized them all over, and a high fever immediately came on; the milk, if any remained to that time, curdled over the fire, but did not in the first of the disorder. At first the belly was costive, but for the most part a looseness succeeded within forty-eight hours after the shivering fit. The stools were first green and watery, and of a stinking smell; their consistence, however, altered afterwards to a viscid, slimy matter, the purging accompanied till about the seventh day, and about that time the excrements became thicker, in such as recovered; and these soon chewed their cud again, and tasted of fodder, which they had before absolutely refused through the whole disease. All that had not the looseness before the third day died. The urine was very high coloured, and in smaller quantities. The degree of fever was observed very high; upon the third day the pulse beat near a hundred times in a minute, whereas the ingenious Dr Hales found a sound ox's artery not to exceed 38 pulses, in the same time. At different intervals, after the attack, they all laboured under a prodigious difficulty and panting for breath; some suffered these after the first day, others not before the third. But this disorder suffered remissions, and seemed to be augmented towards evening, and at night. Several beasts discharged, towards the fourth or fifth day, when ill, a very great quantity of a frothy matter from the mouth and eyes; others ran actually purulent matter from the nostrils. As the disorder advanced, the eyes sunk more in their orbits, and some were observed to be quite blind. Towards the conclusion, the fore parts of the body, and particularly the glands about the head, were prodigiously swelled, and several beasts had a universal emphysema, or crackling of air beneath their skin; these that were not blooded, equally with such as were. Frequently one might observe pustules break out on the fifth or sixth days, all over the neck and fore parts. Some cattle were raging mad on the first day; such were necessarily killed: some dropped down suddenly; others died on the third, most on the sixth or seventh, very few alive to the fourteenth day; before death the horns and dugs grew remarkably cold.

470 Appearances on dissection.

The appearances in the dead bodies of eight different cows were as follow: The flesh was of a sound colour, and everywhere lined with fat, the cellular membrane between the skin and flesh was distended with air to above the thickness of three inches. The paunch was prodigiously distended with food, in all of them, but it contained not any thing preternatural; nor indeed in the *reticulum* or second stomach, were there any morbid appearances; but, upon incision of the *omasus*, or third stomach, in which the food is naturally without much juice, a most offensive stench rushed out, with a large quantity of thin greenish water.

The blood-vessels on the inner surface of the ventricle were very full. The abomasus and part of the intestines discovered the like morbid phenomena. The liver, spleen, and kidneys, were as usual; but the gall-bladder seemed to be in the greater number fuller than ordinary; the consistence of some was thicker than the rest, and the gall tasted disagreeably sweetish. Dr Brocklesby did not observe any purulent matter investing the inner surface of the intestines, though other gentlemen discovered such, in some cattle, if he was rightly informed; but there appeared in some a slimy mucus, all along the intestinal canal.

The lungs universally shewed the strongest signs of a preceding high inflammation; most of them were turgid with red blood, while the smallest vesicles of the bronchia, or air-vessels, were very much inflated. Some few arterious vessels were replete with a gelatinous, glairy mucus, and all the lungs appeared larger than they do in common. The whole inner surface of the trachea, or wind-pipe, was covered with a frothy mucus; but he never found any ulcers with purulent matter either at the root of the tongue, or in the lungs. Upon opening two or three heads, he found large quantities of extravasated serum; and the blood retained fluidity in the larger vessels long after death.

471 His mode of treatment.

The method of treating the cattle recommended by Dr Brocklesby is as follows: Before the cattle are seized, he advises two setons, or pegs, to be put deep into the dewlap, and into the under part of the neck; and immediately upon refusing fodder, the beasts should have three quarts of blood taken away; and, after twelve hours, two quarts more; after the next twelve hours about three pints may be let out; and after the following twelve hours, diminish a pint of blood from the quantity taken away at the preceding blood-letting; lastly, about a single pint should be taken away in less than twelve hours after the former bleeding; so that when the beast has been blooded five times, in the manner here proposed, the worst symptoms will, it is hoped, abate; but if the difficulty and panting for breath continue very great, he sees no reason against repeating bleeding, or at least against taking away the fifth time, instead of a single pound, twice that quantity.

In the mean time the setons or pegs should be daily promoted to suppuration by moving the cord; and the cattle should have as much bran-water as they choose to drink luke-warm. This should be made a little tart or sourish, either with common vinegar or spirit of vitriol; and immediately after the first bleeding they should have a drench composed of a drachm and a half of camphor, well rubbed with two ounces of honey, adding an ounce and a half of nitre, and about a quart of water-gruel.

It is extraordinary that this treatment, with a little variation in the internal medicine, is recommended by Mr Feron as the result of his own experience, in what he calls the general inflammation of cattle. It is a curious coincidence; as we suppose that Mr Feron, from his not noticing Dr Brocklesby's pamphlet, has never seen it.

The doctor recommends keeping the cattle very warm, and guarding against the admission of any cool air, a practice in which he will scarcely be followed at the present day.

472 Layard's account of the murrain.

The symptoms of this distemper as described by Dr Layard are, on the first appearance of the infection, a decrease of appetite; a poking out of the neck, implying some difficulty in deglutition, a shaking of the head, as if the ears were tickled; a hanging down of the ears, and deafness; dimness of the eyes; and a moving to and fro in a constant uneasiness. All these signs, except the last, increase till the fourth day. Then a stupidity and unwillingness to move, great debility, total loss of appetite, a running at the eyes and the nose, sometimes sickness and throwing up of bile, a husky cough and shivering. The head, horns, and breath are very hot, while the body and limbs are cold. The fever, which was continued the three first days, now rises and increases towards evening; the pulse is all along quick, contracted, and irregular. A constant diarrhœa, or scouring of fœtid green fæces, a stinking breath, and nauseous steams from the skin, infect the air they are placed in. The blood is very florid, hot, and frothy. The urine, or stale, is highly coloured; the roofs of their mouths, and their barbs, are ulcerated. Tumours, or boils, are to be felt under the panniculus carnosus, or fleshy membrane of the skin; and eruptions appear all along their limbs, and about their dugs. If a new milch-cow be thus ill, her milk dries up gradually, her purging is more violent, and on the fourth day she is commonly dry. There is such acrimony or sharpness in their dung, that a visible irritation is to be observed during some time in ano. They groan much, are worse in the evening, and mostly lying down. These symptoms continue increasing till the seventh day from the invasion, on which generally, though sometimes protracted till the ninth, the crisis or turn takes place.

If after the seventh day from the invasion (at which time a crisis may be expected), the eruptions, boils, or abscesses are decreased in bulk, or totally disappear, without having broken or discharged outwardly, or an aggravation of the symptoms already mentioned, with no intermission; it may be assuredly pronounced, that the beast will die.

As to the cure, immediately upon the first appearance of the distemper, the beast should be put into some place where it may be kept clean, warm, and as free as possible from infectious steams of other beasts in the same condition. The beast must be bled in proportion to its strength, washed with warm water and vinegar, to clear the hair from filth and insects, and rubbed every morning and evening, for a quarter of an hour, with a dry linen or woollen cloth, or straw, to promote perspiration. A rowel also is to be made in the dewlap, which is to be dressed twice every day, which rowel is also to be kept in a month at least after the recovery of the beast.

Should the beast be hot, hang down his head, breathe with difficulty after the bleeding, dung hard, and the skin feel tight and thick; then it will be very proper to give a gentle, cooling purge in this first stage. When the beast has voided the hardened dung, or if it should not have wanted purging, the following drench is to be given. Take of madder-root, three ounces; of turmeric and horse-radish-root, each one ounce; of fenugreek-seeds, bruised, two ounces; of chamomile-flowers, dried leaves of feverfew, rue, and sage, of each one handful. Boil them half an hour in a gallon of small ale, well hopped, to three quarts; then strain the liquor, and give the beast three pints in the morning, and the remainder in the evening. No dry or solid fodder is to be offered till the beast chews the cud again. Between these drenches a quart or two of distilled vinegar-whey must be given frequently in the day, to dilute the hard fodder, and strengthen the coats of the stomach; and hay-water may be also given. Great care must be taken, twice or thrice a-day, to cleanse the mouth, barbs, and nostrils of the distempered cattle, with some absterging acidulated liquor. On the fourth day, if the beast be heavy, dull, shivering, no pimples or knots arise, and a purging be coming on, the following drench must be given at about eight in the evening, and repeated three or four nights, as occasion requires.

Take of Virginian snake-root, contrayerva root, chamomile flowers powdered, of each half an ounce; Venice treacle, six drachms: Mix all these in three pints of vinegar-whey, and give the drench lukewarm. Let a person sit up all night with the beast, and give it frequently a quart of vinegar whey. Venice treacle may also be serviceable; and if there be any signs of mortification from the dark and relaxed appearance of the mouth, the coldness of the skin, the black fetid dung, insensibility, &c. the Peruvian bark must be instantly given every four or six hours, as occasion may require, taking the usual medicines in the intervals. In the last stage, let the swellings that puff up the skin be opened and digested; and after the crisis takes place, if a scouring should ensue, it is not to be hastily stopped, though diligently watched and restrained, lest it weaken the beast too much; and to cleanse the stomach and bowels, let a purge of rhubarb, senna, &c. be given. Dr Layard advises to let the beast drink water-gruel lukewarm, and keep it on dry meat, though sparingly; and at night to give an ounce of electuary of diascordium, in a quart or three pints of small ale, warm. But if after the crisis the beast is costive, and the skin dry, harsh, and tight on the flesh; dunging may be procured by giving in the evening a mash of bran, with a handful of beans bruised, and an ounce of Epsom salt. He recommends, however, the greatest exactness in observing when the crisis is over; for the least laxative medicine, or opening food, at the height of the disease, and consequently in the former stages of expulsion and maturation, will certainly bring on a scouring, attended with fatal consequences, or at least very difficult to be removed. In winter time, the cattle, upon recovery, should not be turned out at once to the pasture grounds, let these be ever so dry; but towards the middle of the day, in fair weather, turning them out two hours, and then bringing them in again, will gradually use them to the open air. In summer, morning and evening will be the most suitable times; for the heat of the sun, or cold, may bring on other disorders.

"A farmer, (says Dr Layard), lost ten head of cattle, and two more were dying, and seven others ill, when I took upon me the direction of the seven which were last fallen ill. By the preceding treatment five of these recovered. One cow, very near her time of calving, died; and the seventh was certainly lost for want of observing the due time of the crisis, and purging too soon."

Such are the accounts given by Brocklesby and Layard, of the symptoms and treatment of this destructive malady; and it will be seen that their accounts differ no more than what may be expected from two different persons describing a similar disease that occured at two different periods; for the murrain described by Dr Brocklesby appeared in the years 1744 and 1745, while that of which Dr Layard has given an account occurred between 1750 and 1760.

473 The causes and nature of this disease have not been exactly ascertained. Some have supposed it connected with a peculiar state of the atmosphere, and that it did not originate in contagion. Many considered the principal causes of the disease to be previous hard winters, obstructed perspiration, worms in the liver, and corrupted food.

Hard winters have been considered as a cause of this disease, because it was in 1710, after the hard winter in 1709 that the great mortality among the cattle was observed; and because the hard winter in 1740 was followed by the contagion in 1741, which spread over the most part of Europe. Not to mention many others, the murrain in 1768, followed immediately after a pretty hard winter in 1767. On the other hand Camper remarks, that the hard winter in 1727 was not followed by the contagion; from which it would appear that the epidemic does not necessarily depend on the severity or mildness of the preceding winter.

It was attributed by many to obstructed perspiration; and to prevent its attack, it was proposed to cover the cattle during the nights of autumn, and to make them sleep within doors during the spring nights.

It may, however, be observed, that if this reasoning were true, the disease ought to have been less prevalent, or ought not to have appeared at all, in those provinces where, for the sake of saving the dung, they house the cattle at night, even in the summer as well as in the spring and autumn. Besides it appears that the contagion was not known at Bern, though the cattle in that district lay all night in the field whenever the weather would permit.

Camper justly ridicules the idea of the disease originating from worms.

"If (says Camper), you demand of me to what I attribute the first of the distemper, I shall answer, as it were to be wished that all naturalists would do in similar cases, that I do not know; that the subject is above my comprehension, and doubtless above that of every man *."

There seems no doubt, however, that the complaint was infectious, and that, provided proper means were taken to prevent infection, the distemper would not spread. The means proposed by Dr Layard and some other medical practitioners, to destroy the contagion, was to bury the carcases of the infected animals, and to slaughter all that appeared to have received the infection. Inoculation was proposed by some, as a means of diminishing the ravages of the murrain; and is said to have been practised in Denmark with considerable success: but if this be true, it is probable that the epizootic disease that raged in Denmark was of a different nature from that which appeared in Britain, and on some parts of the continent; as inoculation seems to have been tried in these places without effect. What probably led to the proposal of inoculation was, that the disease was considered by some as exactly similar to the smallpox in the human body. This opinion was adopted by Dr Layard, and seems to have arisen from the boils or suppurating tumours which appeared on the bodies of most of the affected cattle; but these tumours do not appear to be similar to the eruption that takes place in smallpox, but rather resemble the boils or buboes that take place in the plague and some other highly infectious fevers. On the whole, it seems to us pretty evident, that the disease is of the nature of putrid fever, and we have therefore ranked it under this head.

It appears from Camper's works, that inoculation was attended with so much success in many cases on the continent, that a great number of cattle was saved by it, who probably could not have been recovered from the natural disease. The advantages attending inoculation according to Camper are,

1st, That we can expose to the danger of contagion such calves and heifers only as are of a moderate price.

2d, That the heifers pass through the disease before they take the bull, and consequently before they are pregnant. This is attended with more advantages than may appear at first sight; for when the contagion attacks a whole herd, all at once, oxen, calves, heifers, and cows are seized without distinction. Such cows as are pregnant generally slip their calf, and even if they should perfectly recover, their womb is so disordered that it will never afterwards be capable of retaining the calf; besides, that afterwards it is a long time before they come in heat, so that the proprietor is obliged to keep them for a whole year without deriving from them any benefit, except he fatten them for the butcher.

If the success of inoculation, as well as the certainty of the cattle being incapable of a second infection, were fully ascertained, the plan of inoculation would be extremely proper. If these points were fully established, would they not, however, considerably militate against the opinion that is entertained by the best writers on the subject, even by Camper himself, that this disease is an idiopathic putrid fever, and not an eruptive complaint like the smallpox?

474 Means of checking the contagion.

Considering the disease as one that is highly contagious, every method should be taken to check the progress of the infection. For this purpose the houses where the cattle are stabled, should be kept perfectly clean, and well ventilated. It would also be proper to fumigate these places twice a day with the vapours of some mineral acid, such as the nitrous or muriatic acids, as has been recommended by Dr Johnstone, Guyton Morveau, and Dr Carmichael Smith. This fumigation may be easily effected by placing pipkins of warm sand in various parts of the cattle-houses, and particularly at the doors, and placing on the sand a cup containing common salt or pounded nitre, on which is to be poured a sufficient quantity of sulphuric acid or oil of vitriol, stirring the mass now and then with a glass rod, to promote the escape of the acid vapours.

475 We shall conclude this subject with a series of queries that were circulated among medical men on the continent by the Society of Medicine at Paris, for the purpose of gaining every necessary information respecting this alarming pestilence, as they may tend to direct the inquiries of those who shall in future have an opportunity of observing the distemper.

1. What is the situation of the country in which the epidemic appears, and what is the nature of the soil?

2. Of what quality are the waters which the cattle usually drink, and of what dimensions are the reservoirs that contain them?

3. What is the quality of the pasturage, and what are the plants which most constantly grow in the pastures?

4. Of what nature is the fodder and the grain that are given to the cattle within doors?

5. Have there been any abundant rains or inundations; has the water continued for a long time on the ground, and what are the effects it has produced on the fodder?

6. Or has there on the contrary been any great drought, and how long has it continued?

7. What has been the season for getting in the hay, and for harvest; and what effect does the season seem to have had on the hay and other fodder?

8. What circumstances seem to have rendered it necessary for the cattle to work?

9. Has the distemper been announced by any previous symptoms; and what were they?

10. Did the disease come on with shivering, with coldness of the horns and ears, and with the loss of appetite?

11. Did the heat come on soon after the cold fit, or was it not preceded by a cold fit?

12. Do the animals continue lying, without being able to raise themselves on their legs?

13. When

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* Oeuvres de Camper, tom. iii. p. 120.

13. When they are lying, is their head low, or how do they hold it?

14. Are their eyes red, watery, and hot?

15. Are their nostrils dry, or does there ooze from them a mucous matter?

16. Is their tongue in the natural state, or is it very red, or is it covered with a yellow or brown mucus; is it moist or dry, or are there on it any tubercles?

17. Is their throat inflamed, or are there on it any aphthous crusts?

18. Is the animal fatigued with a cough, and is this cough very frequent?

19. Does the flanks heave or not?

20. Do the animal seem to feel any great pain when he is touched in the flanks, or the belly, on the spine, or on the rump?

21. Are there any pustules or tumours on the surface of the body?

22. Is the hair smooth or staring, or does it easily come off when the skin is curried, or even when the body is rubbed with a wisp of straw?

23. Does the animal seem much disordered, or does he refuse every sort of drink?

24. Does he chew the cud?

25. Has he a frequent discharge of urine, and what is the colour and consistence of it?

26. Has he a discharge by stool more frequently or less than usual, and are the excrements natural, or very dry, or very liquid; what is their colour and odour, and is their discharge preceded or accompanied with a frequent explosion of wind?

27. Are there to be observed any little convulsions below the skin, especially about the neck?

28. Is the belly in its natural state, or is it swelled; is it soft, or hard and tense?

29. At what periods do these several circumstances take place?

30. How does the distemper terminate; what are the symptoms that announce a healthy termination, and what are those which precede death?

31. In what state after death are found the stomachs, the bowels, the liver, the spleen, the lungs, the heart, and the brain?

32. What remedies have been administered to the diseased beast?

33. What sensible effects have these remedies produced?

34. Lastly, what regimen has been observed in the convalescent state?

476 Eruptive diseases.

The eruptive diseases incident to dometic animals are but few, when compared with the *exanthemata* that take place in the human body. Many such diseases are, however, described by veterinary writers, especially on the continent, where they seem to be much more prevalent than among us. In particular, it appears, that in the southern parts of Europe the sheep are frequently affected with an eruptive disease that nearly resembles the smallpox; and, like this disease in the human subject, there are two varieties of this affection, a *distinct* and a *confluent*. A very particular account of this disease, as it occurred at Cauterets in the department of the Lower Pyrenees in France, was drawn up by M. Tenon, and communicated by him to the agricultural society at Paris; and a translation of it has been published in the Farmer's Magazine for May 1804, from which we have taken it.

477 Sheep-pox.

### 3. SHEEP-POX. Claveau, Fr.

This distemper, which at Cauterets is called the smallpox, is contagious; and indiscriminately attacks wedders, ewes, lambs, and goats, more especially when, shut up during winter in confined cots, the animals are kept very hot. It is a very singular circumstance, that this distemper should only appear at Cauterets, after intervals of twelve, fifteen, or twenty years; while in Guienne, and the Higher Languedoc, it rages every year. Besides, that in the former mountainous tracts, the weather is colder than in the plains of the latter districts, the sheep of the Pyrenees are kept more apart from each other than in the low countries, and the different flocks are much less liable to meet together, or to pass through the same roads, by which they are not nearly so much exposed to the danger of infection.

When seized with this distemper, the sheep become dull and weak, and they loathe their food; the head, eyes, ears, and gums, are swelled; and hard white tumours appear in the groins and under the joint of the shoulder. Three or four days after the appearance of these tumours, pimples break out in different parts of the body. At first, these are situated on the naked skin between the thighs, and on the places where the wool is short and scanty; afterwards, they break out about the head, and successively over the whole body, even on the eye-lids, ears, and throat. In this stage of the disease the animal swallows with pain, being obliged to hold back the head, and to stretch out the neck for the purpose, and it breathes with great difficulty. As the disease goes on, the pimples enlarge, and become inflamed, particularly at their bases; they suppurate and burst; the matter which runs out mixes with the wool, and mats along with it into hard lumps, and afterwards dries and falls to powder; the wool falls off in locks; and even the scarf skin peels off in large pieces, which are full of holes. When the distemper begins to abate, the sheep rub themselves on the posts of the racks, or any other hard substance which comes in their way; and by this means the wool, along with the loose skin and dried pus, are rubbed off. If proper precautions were not employed, this would infallibly spread the contagion by infecting any other sheep that might be brought into the same cots: but, on purpose to destroy the infection, new cribs are either substituted for the old ones, which are pulled down and burnt, or else the infected cribs are washed with cream of lime, and the cots are thoroughly fumigated with burning juniper and other aromatic plants.

There are several varieties of this disorder. In some of these the eruption of pustules is by no means complete as above described; sometimes the pimples grow black, and dry up without coming to suppuration; at other times the disease is of a complicated nature. But as the disorder only appears at distant periods among the sheep at Cauterets, we are not to expect very full information concerning its various degrees from the shepherds of that district; neither have they any decided experience of the effects of sulphur, or setons, or

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of blisters, in the cure of this distemper. Blisters are said to have scarcely any effect upon the skins of sheep.

It is certain, that the flesh of such sheep, as have died of this disorder, is very unwholesome, has a very bad taste, and is even dangerous to eat; and they add, that when dogs happen to feed on it, they catch the disease, and spread it by infection. Three cats, by eating this food, had their heads affected with an eruption of pustules, by which they were first blinded, and afterwards lost their lives. Hence the necessity of the precaution which is taken at Cauterets to bury deeply the carcases of sheep which die of this disease.

I had an opportunity, says M. Tenon, at a butcher's in Paris, to examine some sheep which had died of this disorder. The skins were covered with suppurated pustules, which penetrated as far as the cellular membrane, and the fat in their neighbourhood was affected for a considerable distance all round, being browner and firmer than the ordinary fat; and this alteration penetrated even to the flesh.

The inhabitants of Cauterets affirm, that these pustules are found on the liver and other internal parts of the body.

M. Tenon made every possible inquiry to learn whether this disease was ever communicated from the sheep to mankind, but he could learn no instances of such infection: it is believed, however, in Languedoc, that it is communicated from sheep to rabbits. He could not learn whether the sheep were ever affected a second time with the same disorder; but we cannot expect information at Cauterets on this part of the subject, since the disease only appears there for a single season, after intervals of twelve, fifteen, or twenty years, while the sheep live but eight, or at most, ten years; so that any of them, which have once been diseased, cannot be alive when the next period of contagion comes round.

Whenever the disorder appears in the flock, the infected animals are separated from the rest, and shut up in warm cots, having plenty of wheat or barley straw given them for litter; they are fed with hay and aftermath which have been made on a dry field, with a little salt, and are allowed lukewarm water for drink.

In the flat country at Tarbes, which is ten leagues distant from Cauterets, and considerably warmer than in the Pyrenees, and where this distemper is much more frequent, a different method of treatment is followed. At the beginning of the disease blood is drawn by cutting the ear; the cots are fumigated for five or six successive days, by burning aromatic and strong smelling herbs, preferring the dried stems of garlic for this purpose; these are burnt on a large stone in the middle of the cot, while all the vent holes are carefully stopped, to prevent, as much as possible, the smoke from escaping. The shepherds of Tarbes have great confidence in the beneficial effects of fumigating with garlic steams, which occasions a great discharge from the nostrils, especially in such cases of the disease as are complicated with catarrhal disorders, and with the staggers or vertigo.

At Bellegarde, near Auch, they give to each beast a double handful of white mulberry leaves, which they allege is a most effectual cure, and serves excellently for preventing the attacks of the disease.

When, at Cauterets, the disorder begins to abate, whatever be the season of the year, the animals are clipt, on purpose to assist the drying of the pustules, and to favour the growth of a new fleece. After this the sheep fatten very quickly; and it is worth while to remark, that the fleece which immediately succeeds this disease is finer and more silky than any former or future fleece on the same beasts.

Formerly this disease made great ravages among the sheep at Carcassone, till a method was fallen on to inoculate the disease. M. Tenon learned this fact in 1762 from Dr French, an Irish physician, who lived in Languedoc for several years; but it was not till 1763 that he received particular information on this curious subject from M. Berra, mayor of Carcassone, to whom he had written for information, and who procured him a memoir on the diseases of sheep in that part of the country. From this memoir the following account of inoculating the sheep-pox is extracted.

"The seigneur of Maux, in the diocese of Narbonne is the first, and almost the only person who has practised inoculating the smallpox on his flocks; and having been successful during ten years experience of the practice, his widow has ever since continued to follow his example.

"In the month of September, when the heat of summer is past, and before there is any danger of very cold weather; while the pastures are still in good order, and the lambs, which are now six or seven months old, are strong enough for withstanding the force of the disease, this season is chosen as the fittest for communicating the smallpox to the sheep. For this purpose the fresh skin of a sheep, either ewe, wedder, or lamb, which has died of the disease, or, instead of that, one taken from a sheep which has been killed while affected by it, is placed on the floor of the cot. Into this cot all the young sheep of the year are driven, and they voluntarily rub and roll themselves on the diseased skin. Very soon afterwards the symptoms of the disease begin to appear; they have a dull and heavy appearance, hold down their heads, are somewhat fevered, and loathe their food. On purpose to aid the eruption of the pustules, bread dipt in wine is given to the sheep; they are anxiously preserved from being exposed to great heat or great cold, and particularly from rain. By these precautions they speedily recover, and it very rarely happens that even one dies out of a flock of three hundred.

Although the disorder has often spread over the districts in the neighbourhood of the estate where this practice prevails, there has been no instance of a single sheep, after undergoing the above described operation, having been infected a second time. It ought to have been noticed, that the inoculated flock is carefully prevented from mixing with any other sheep, by keeping it in a separate cot, and on a particular pasture, the other shepherds being forbidden to use either for the flocks under their charge. By these precautions, the disease is prevented from spreading, and such proprietors as do not wish to have their sheep artificially infected, have themselves to blame if they do not avoid the place where the diseased sheep are kept. Since this practice has been followed, it has been observed that the disorder has not returned so frequently, but that it has not proved in the least degree destructive to the flocks which have not been inoculated.

M. Berra adds, that the lambs never lose their wool under the instance of the inoculated disorder, and that their fleeces are equally good in every respect with those of the uninfected, so that no difference can be perceived[*].

This disease was once pretty common in Britain, but is now scarcely known among us. It is, however, justly apprehended, that importation of sheep from the continent may again introduce it; and Sir Joseph Banks has taken much pains to caution the public against the danger of such an introduction.

### 4. Cow-pox, or *Kine-pox*. Vaccina.

478 Cow-pox. A greater blessing was never procured to mankind than what has been already derived, and will, we trust, be ultimately derived, from the invaluable discovery of the inoculated cow-pox, in preventing the person who has received it from being afterwards liable to variolous contagion. For this blessing we are certainly indebted to the labours and experiments of Dr Edward Jenner. There is no doubt that the disease was known many years ago in some of our principal dairy districts; but Dr Jenner has all the merit of having extensively circulated the discovery, and of having first applied it to those valuable purposes to which an almost universal experience has shown it to be well adapted.

The symptoms and origin of this disease amongst cows, have been briefly described by Dr Jenner in his publications on the subject. The first of these appeared in 1798, while Dr Jenner was practising in Berkely in Gloucestershire, where he had an opportunity of frequently seeing the disease.

"In this dairy country, (says Dr Jenner) a great number of cows are kept, and the office of milking is performed indiscriminately by men and maid servants. One of the former having been appointed to apply dressings to the heels of a horse affected with the grease; and not paying due attention to cleanliness, incautiously bears his part in milking the cows with some particles of the infectious matter adhering to his fingers. When this is the case, it commonly happens that a disease is communicated to the cows, and from the cows to the dairy maids, which spreads through the farm, until most of the cattle and domestics feel its unpleasant consequences. This disease has obtained the name of the *cow-pox*. It appears on the nipples of the cows in the form of irregular pustules. At their first appearance they are commonly of a palish blue, or rather of a colour somewhat approaching to livid, and are surrounded by an erysipelatous inflammation. These pustules, unless a timely remedy be applied, frequently degenerate into phagedenic ulcers, which prove extremely troublesome. The animals become indisposed, and the secretion of milk is much lessened[†]."

There sometimes appears another kind of eruption on the udder of the cow, which on a superficial view may be mistaken for cow-pox. It consists of a number of white blisters on the nipples, and these blisters are filled with a whitish serous fluid. They are to be distinguished from the pustules that take place in the cow-pox, by their not having the bluish colour of the latter, and by their never eating into the fleshy parts, being confined to the skin, and ending in scabs. This eruption also appears to be infectious, but not nearly in so great a degree as the true cow-pox.

Dr Jenner considers this spurious eruption as being chiefly produced by the transition which is made by the cow, in the spring, from a poor diet to one that is more nourishing, by which the udder at this season becomes more than usually vascular for the supply of milk. There is, however, another sort of inflammation and pustules, which appears to be not uncommon in all the dairy counties in the west of England. A cow intended to be exposed for sale, and having naturally a small udder, is for a day or two previously neither milked by the milker, nor is her calf suffered to have access to her; thus the milk is preternaturally accumulated, and the udder and nipple become greatly distended. The consequences frequently are inflammation and pustular eruption.

As the eruption of the cow-pox disappears in a few days, little more is required than to keep the teats clean, and handle them as carefully as possible during milking.

479 Originates in grease. The fact of cow-pox originating from the matter of *grease*, or of the latter being capable of producing the former, was, we believe, first discovered by Dr Jenner; but the opinion was for some time considered as fallacious. Many unsuccessful attempts were made by Dr Woodville and by Mr Coleman to produce cow-pox by inoculating the udders of cows with matter from greasy heels. Some experiments made by Mr Simmons tended still farther to disprove Dr Jenner's opinion. But about five years ago, Dr John Loy published a small pamphlet, in which he has related some experiments made by himself, with a view to determine this controverted point. He was led to make these experiments from some cases that fell under his observation, of a disease very similar to the cow-pox appearing on persons who must certainly have derived it from the matter of grease. Dr Loy's experiments fully confirmed the opinion of Dr Jenner, and proved that the matter of grease would, by inoculation, produce in the human body a disease exactly resembling cow-pox, and like it capable of protecting the inoculated person from an invasion of the smallpox. Dr Loy also proved, that in some cases, the cow-pox might be produced in cows by the immediate application of the matter of grease, but that this experiment did not succeed unless the horse had also a general affection of the system. This led Dr Loy to suppose that there exist two species of grease, the one merely a local affection, the other a general affection of the system[*].

The reasons that induced Dr Jenner to suppose that cow-pox originates in grease are thus stated by himself, in his second publication on the subject of cow-pox.

First, He conceived grease to be the source of cow-pox, from observing that where the cow-pox had appeared among the dairies in Gloucestershire (unless it could be traced to the introduction of an infected cow or servant), it had been preceded at the farm by a horse labouring under grease, which horse had been attended by some of the milkers.

Secondly, From its being a popular opinion through that dairy country, and from its being insisted on by those who there attend sick cattle.

Thirdly, From the total absence of the disease in Scotland and Ireland (as the doctor was informed from the best authority), where the men servants are not employed in the dairies.

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[*] *Farm. Mag.* vol. v. p. 175.

[†] *Jenner's Enquiry*, p. 3.

[*] *Loy's account of Experiments on the Origin of Cow-pox.*

Fourthly, From having observed that morbid matter generated by the horse, frequently communicates in a casual way, a disease to the human subject so like the cow-pox, that in many cases it would be difficult to mark the distinction between the one and the other. The truth of this observation is well illustrated by the above experiments of Dr Loy.

Fifthly, From his being induced to believe from experiments, that some of those who had been thus infected by the horse, resisted the smallpox.

Sixthly, From the progress and general appearance of a pustule on the arm of a boy whom he inoculated with matter taken from the hand of a man that had been infected by a horse, and from the similarity to the cow-pox, of the general constitutional symptoms which followed *.

### 5. Le Louvet.

480 Le Louvet. Continental writers describe a variety of eruptions under the general name of *charbon*, or *carbuncle*, which affect various parts of the body, and have received different names according to the part which they attack. We shall here only notice one of these which raged epidemically about the middle of the last century in Switzerland, where it is called *le Louvet*.

It affected both cattle and horses, but seems to have been attended with different symptoms in each. According to M. Reynier, a physician at Lausanne, who published an account of the distemper, when an ox is seized with it, he suddenly loses his strength, trembles, seems desirous of lying constantly on the ground, whence he seldom moves except to refresh himself; he carries his head low, and his ears slouching; he is sad, and moans; his eyes red, his skin very hot and dry, and his breathing frequent and difficult. When the disease has made some progress, expiration is always followed with a considerable depression of the flanks; there is a frequent cough; the breath is very fetid; the heart and arteries beat violently; the tongue and palate are dry and become blackish; the animal loses his appetite and ceases to chew the cud; there is considerable thirst; the urine is scanty, reddish, and the excrement hard and blackish towards the beginning of the disease, and sometimes limpid and bloody. Cows lose their milk. On most of the animals inflammatory tumours are produced, which appear sometimes on the chest, sometimes on the vertebræ of the neck, and on the belly; at others on the udder, and the parts of generation. At other times they entirely cover the skin in pimples, like those of the mange or scab.

All these symptoms do not often appear on the same subject; but in proportion as more of them occur, the disease is the more fatal. In general, death takes place on the fourth day, when the symptoms are violent; if they pass the fourth day, and are not worse on the seventh, their recovery is pretty certain, though they are often not convalescent before the fifteenth day.

When the urine is turbid, and deposits a whitish sediment; when the excrements are more abundant than in the natural state, moist and not very offensive; when the skin is black and relaxed, the pimples filled with whitish matter, the thirst alleviated; when the appetite and rumination return, and when the pustules begin to dry up, a perfect recovery may be expected: but on the contrary, when there is much swelling of the belly, when the animals moan much, when there appear great debility, trembling, convulsions, retention of urine, diarrhœa or dysentery, a fatal termination may be looked for.

On opening the bodies of such animals as die of this disease, there appear on the skin numerous black tumours, full of yellow serous fluid that effervesces with acids; the muscles are livid, soft and flaccid; the lungs wasted, full of tubercles and little ulcers, especially on those animals which died on the fourth day. The stomach and bowels are beset with red tumours, full of a tenacious clammy fluid.

M. Reynier considers the predisposing causes of this disease to be the bad quality of the water which the beasts drank, the corrupted state of their food, excessive fatigue, low and ill-aired stables, deficiency of herbage, and tempestuous weather. Like many other medical men of his time, he held the immediate cause of the disease to consist in an alkalescent state of the blood. The method of cure consisted in giving drenches of emollient decoctions, clysters of the same substances, with nitre and vinegar mixed with honey; and towards the latter stage of the disease, the Peruvian bark and camphor were administered. This was a very *innocent* and *gentle* treatment, and it is no wonder that so many of the cattle died.

### 6. Strangles.

481 Strangles. The disease called *strangles* in horses, is considered by Mr Blaine as a specific fever, accompanied with a disposition to inflammation in the glands of the head and throat. It most commonly attacks horses betwixt four and six years of age, though it may occur at any period before six; but rarely appears after that age. Young horses are most subject to it when first brought to labour, and put on the nourishing diet of the stable, though Mr Lawrence has seen it in unbroken colts in the field. It seems that few horses escape having it once in their life.

It commences with a considerable degree of fever; the breath is hot, the eyes are heavy and languid, the horse thrusts out his nose, has a hoarse cough, and labours under some difficulty in swallowing. There soon appears a swelling between the jaws, or on the inside of the lower jaw, which usually extends to the parotid glands. These swellings, if left to themselves, go on to suppuration; and about the fifth or sixth day they break and discharge a considerable quantity of matter; but sometimes the heat, hardness, and swelling of the glands continue for a long time. These symptoms are usually attended with a running at the nose, which is considered as a favourable sign.

This complaint is seldom dangerous, though now and then there is some risk of suffocation, and sometimes it degenerates into glanders. Of this Mr Lawrence has seen several instances. It appears to be contagious, and may be propagated by inoculation, which has induced us to consider it among the febrile eruptions.

The writers on farriery have strangely differed with respect to the nature of this affection. The elder Lafosse considered it as analogous to the smallpox; Bracken, as a species of *cynanche*, or *quinsey*; and it certainly nearly resembles the *cynanche parotidea*, or *mumps*. Others have supposed it to be like the chickenpox, or measles.

It is not agreed on whether it is better to check the

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* *Jenner's further Observations*, p. 21.

inflammation of the glands, or to encourage their suppuration. Mr Blaine recommends the former plan, which is best effected by bleeding, purging, and the use of diuretics; while a solution of sugar of lead is applied to the swelling externally; but if the swellings continue hard and hot, it will be proper to encourage suppuration by the frequent application of warm poultices. If there is much soreness and swelling of the throat, a large blister should be applied to it. If there is much fever, nitre or emetic tartar may be added to the horse's water; for it would be wrong to give him medicine in the form of a ball or drench. He may have frequent warm mashes; and to encourage the running at the nose, there should be hung to it a bag containing a warm mash, which should be frequently renewed. The horse's head should be kept warm, and currents of cold air should be avoided. When the tumours break, the discharge should be assisted by enlarging the opening and applying warm poultices, and the ulcers may be dressed with the common digestive ointment. If the discharge proceeds by the mouth, the parts should be frequently washed with vinegar and water sweetened with honey.

482 Grease.

GREASE. Eaux aux Jambes, Fr. *Greasy heels.*

In the fourth chapter of the last section, N° 423. we made a few observations on swelling of the legs, and we remarked that this complaint often terminated in grease.

Grease is a complaint that is extremely common among horses, to whom it is peculiar, not being known to affect any other species of animals, or at least there is no other animal in whom that peculiar secretion which constitutes the matter of grease in horses is found to take place. There appears to be two varieties of grease; the one a mere local affection, the other a more general affection of the system attended with fever.

The complaint first appears by a slight swelling about the coronet and pastern, sometimes accompanied with pain or itching, so that the horse rubs his feet against each other, or stamps and shifts himself from side to side. On feeling the swelled part, it is commonly found much hotter than usual, and is evidently red and inflamed. Very soon there may be perceived an oozing through the skin, of a yellowish fluid that is very offensive, and of an unctuous greasy feel. This swelling gradually extends up the canon towards the knee, and when the horse is taken out to work, he appears stiff and lame till he becomes heated; and when he returns from work, the leg appears hot and inflamed. The swelling and oozing of fetid greasy fluid gradually increase till cracks begin to make their appearance in the skin about the heels, the hairs about these parts fall off, and the skin below appears puffy, of a whitish or livid colour; and on it are generally seen little bladders, from which a matter of the same kind as what we have described oozes out. These vesicles soon become ulcers, and the matter they contain assumes the appearance of pus, which irritates and inflames the neighbouring parts, fretting and excoriating the skin. Generally a number of red granulations or excrescences appear within the ulcers, and from their form are commonly called *grapes;* and if the complaint continues long, the hoof becomes fungous, or there is a luxuriant growth of soft spongy horn. If the complaint be neglected, the ulceration of the part increases, and extends even to the bones, which become soft, spongy, and at last carious.

In what is called the confirmed state of grease, the affected parts are exquisitely sensible, and they bleed on the slightest touch, and there are commonly produced a number of horny excrescences about the fetlock. The hair stands erect, and the horse becomes lean, weak, and excessively irritable.

Such are the general appearances and progress of grease; but there are often some little varieties in both. Sometimes the cracks appear very early in the disease, and sometimes there is considerable fever; but whether this precedes the appearance of the vesicles, or is occasioned only by the pain and irritation that accompany the complaint, we are uncertain. It should seem, from the observations of Dr Loy and others, that a fever, such as accompanies eruptive diseases, frequently attends grease; and in this case, as we have said, it is to be considered as a general affection. It is described as such by Huzard, and other continental writers; and they even speak of the appearances that have been found on dissection of horses that have died when affected with this complaint, of the repercussion of the eruption from cold, &c. On the other hand, there is no doubt that fever may be excited by the irritation of the parts, especially if the horse is obliged to work. It may take place in any of the legs, but is more common in the hind legs.

Such horses as have round fleshy legs, such as have white hair upon their legs, and in general, such horses as are weak and phlegmatic, are more subject than others to grease.

It may be brought on by various causes. It is very commonly produced by allowing horses to stand long idle in the stable. In this way the circulation, which is naturally more languid in the legs, especially in the hinder legs, than in other parts of the body, becomes so languid in the heels, that the veins cannot readily propel forward their contents, and consequently an accumulation takes place in the minute capillary branches; whence swelling and inflammation. This accumulation is assisted by the perpendicular situation of the legs, by which a column of blood, that for want of the action of the muscles is moved with difficulty, continually presses on the lower parts. Hence we find, that when horses are not allowed to stretch themselves at their ease, they are extremely subject to swelled legs and grease. The languid circulation is still greater in horses that are naturally of a weak constitution, or who have been debilitated by disease. So great is the effect of diminished exercise in producing swelled legs in grease, that some horses are always affected with this complaint when brought into the stable, and can be preserved from it, only by being regularly turned out into the field after work. It is very commonly observed, that when horses first come up from pasture, or from a straw yard, they are all more or less affected with swelled legs; and if these are not diligently attended to, they soon have greasy heels. It is certain that horses in their natural state, or while kept constantly at pasture, are never affected with grease.

Sudden changes from heat to cold, or *vice versa,* frequently produce this complaint; but, according to Mr Feron, it is more commonly produced by sudden changes from cold to heat. "If (says he) a colt is taken from grass, and immediately kept in a warm stable, after having been used to the severity of the atmosphere, he then gets the disorder. When old horses are troubled with the grease, we shall find that their feet have been exposed first to cold, and afterwards to heat, as when they have been in cold water or snow for a long time, and on coming into the stable have a large bed of straw, or perhaps hot dung, to stand upon. This sudden transition from cold to heat, produces a weakness in the legs, particularly in the skin; when inflammation and cracks, similar to chilblains in the human subject, take place, and are called the grease in horses."

Nothing contributes more to the production of grease than negligence, with respect to keeping the legs clean, and rubbing them often. It is a disputed point, whether the hair that grows about the fetlock is prejudicial or not to horses that are subject to grease. It is contended by Mr Richard Lawrence, that grease is a very common consequence of removing the hair; and considering that the hair is a good preservative against sudden transitions from heat to cold, we are disposed to think its removal improper, where the heels are not already ulcerated. On the other hand, Mr Blaine remarks, that whenever accidental wet occurs, this hair must retain a large quantity of it, and hence be long in drying, occasioning a copious evaporation, and thus producing much cold, and that the hair renders it difficult to keep the legs so clean, as they might be preserved without it. Even supposing these arguments to be just, they only show the necessity of greater care and attention in rubbing the heels dry and keeping the hair free from dirt.

Grease may also be produced by too much hard work, after which the legs swell, and if the swelling be neglected the heels may become greasy. This, however, is probably not a very common cause.

Grease is said to be most common in spring and autumn, when horses are moulting or casting their coats.

On the whole, it appears that this complaint may take place in two different states of the body; a state of general weakness, the effect of constitution or disease; and a state of plethora, attended with proportional languid circulation in the vessels of the legs or feet.

In the treatment of grease, we must consider whether it be merely a local affection, or be connected with some general morbid affection of the body; and we must also attend to the state of the affection, as the nature of the local applications will depend much on the progress that the disease has made.

In the early stage of the complaint, when the inflammation is slight, and the skin is not yet broken, if it has been owing to want of exercise and plethora, it may be proper to draw blood from the veins of the thighs, and a diuretic ball, such as N° 12. or 13. should be given, and repeated every two or three days. The hair must be cut close, and the heels well washed with warm soap and water, after which they must be gently rubbed till they are perfectly dry, and bathed with some stimulating liniment. This plan, with gentle exercise and a cooling diet, especially bran mashes, with an ounce of nitre in each, every night, will probably prevent the complaint from going any farther. If the inflammation be very considerable, and the horse is plethoric, he must be bled pretty largely from the jugular vein, and have a mild purge. Cloths, dipped in vinegar and water, or in a solution of sugar of lead, should be applied to the heels after washing, and kept constantly moist with the same liquor. More than walking exercise here will be improper; but if it is dry weather, a run for a few hours a-day in a field will greatly contribute to removing the swelling. Mr Feron, who is a great advocate for warm fomentations in inflammatory affections of the feet and legs, recommends the legs to be kept the whole day in warm water; and when they are taken from the bath, to be well wrapt up in a warm poultice of bran and water. If by these means the inflammation subsides, the legs may be washed with a solution of alum.

If cracks appear, great attention must be paid to keep them clean from dirt, and they should be frequently washed with a solution of blue vitriol. If grapes appear, they may be touched with blue vitriol, or burnt alum; or if they become large, they must be cut away with a sharp knife, and afterwards seared with a hot iron. If the ulcers are foul, one of the best applications will be a solution of verdigrise, or the ointment commonly called *Egyptiacum*, of which verdigrise forms one of the principal ingredients.

The strictest attention to diet, regimen, and cleanliness, must be observed during the whole treatment, and gentle exercise must be persisted in. The best diet on these occasions will be cut grass, lucerne, fresh clover, carrots, or good sweet hay, and an occasional feed of corn. The horse should not be tied up in the stall, but should stand loose while he is in the stable, and should be allowed no litter, except at night. The stable should be kept perfectly clean and well aired, and not too warm.

Sometimes, even though the complaint should not at first have originated in debility, there will, if the disease is of long standing, be produced a considerable degree of weakness. In these cases the cure will be greatly assisted by giving strengthening remedies, such as bark, horse-chesnut bark, &c. And as in this weak state of the body the discharge from the ulcerated surface is commonly thin and ichorous, the sore must be dressed with stimulating ointment; and if there appear a tendency to mortification, as sometimes happens, a powder of equal parts of Peruvian bark and opium should be sprinkled on the sores, before applying the plaster. If the discharge is very offensive, a fermenting poultice, such as N° 64. may be applied over the dressings.

It will readily appear, that the best means of preventing grease, will be to give the horse regular exercise, to dress him well, and especially to keep his legs dry and clean, and to avoid the extremes of heat and cold.

Grease might perhaps have been considered under the head of specific inflammation; but as it is sometimes attended with a general affection of the body, and is ultimately connected with one of the most interesting eruptive diseases, we thought it best to treat of it in this place.

## Chap. II. *Of Inflammatory Diseases.*

### 1. Inflammation of the Brain. Phrenitis. *Mad Staggers*, *Phrenzy*, *Megrim*, or *Sough*. Mal de feu ou d'Espagne, Fr.

483 nflammaion of the rain.

This is one of the most serious and fatal inflammations which affect the animal system. It attacks occasionally all the domestic animals, but horses and cattle are the most subject to it. In the former it is generally called the *mad staggers*, to distinguish it from apoplexy or sleepy staggers; when it occurs in cattle, it usually takes one of the other names which we have given as synonyms.

Inflammation of the brain is sometimes preceded by giddiness and partial blindness; the animal holds his head low, or rests it against the manger; he appears dull, heavy, and sleepy; gradually, however, these symptoms go off, and are succeeded by others of a very different nature. His eyes appear red, fiery, and sparkling; he now holds his head higher, and appears for some time to look constantly at any object before him: soon he becomes very restless, till by degrees he is quite unmanageable. He sometimes lies down, and tumbles about, and then remains quiet for a while; but he soon gets up again, and is as ungovernable as before, rendering it dangerous for any person to approach him. The pulse in this disease is full and hard, and there is considerable throbbing of the temporal arteries. The pulse is not always the same in every case, being in general less frequent than in health, but sometimes more so. There is always a considerable degree of fever, and the head seems peculiarly affected. The secretions and excretions are generally diminished, but it is said that they are sometimes increased.

Such are the symptoms as they generally appear in the horse; those which take place in cattle, as they are described in the best books on the subject of cattle medicine, differ in a few particulars.

The animal is described as looking frightfully, being unusually watchful, starting often, groaning vehemently, as if affected with sudden and violent pain; his respiration slow, but he sometimes makes very long inspirations, and appears for a time as if his breathing was entirely suspended. Suddenly the beast will rise, turn about, and instantly lie down again, showing marks of great restlessness and delirium. When the frenzy is high, the eyes look red and furious; at other times they border on languor and stupefaction; but the beast always appears to labour under considerable fear, and dreads the approach of every thing; he is often quite ungovernable, and scarcely ever inclines to rest, except in the latter stage of the disease, when, if it has been neglected, or has not yielded to the usual remedies, a lethargy takes place, and the animal sinks. Sometimes the urine is hot and high-coloured; but it is said that before a fit of phrenzy takes place, the urine is often of a pale colour, and thinner than natural.

When the symptoms of fury or irritation suddenly cease, and a lethargy takes place, while the pulse becomes feeble, and the strength diminishes, the case is pretty certainly hopless; but if the fever, redness, and flashing of the eyes gradually subside, without the pulse sinking, or great debility coming on, the beast may generally be pronounced recovering.

On opening the head of such animals as have died of this complaint, very evident marks of inflammation appear about the membranes of the brain, and very frequently in the substance of the brain itself. All the vessels are turgid with blood; and on cutting into the brain, innumerable little red points are to be seen, which do not appear in the natural state. Very commonly an effusion of blood, or of purulent matter, is found to have taken place in the cavities of the brain, or in some part near its surface.

The causes of inflammation of the brain are generally the same that produce inflammatory fever, applied in a greater degree; as great heat, excessive exercise, a sudden change from a poor to a rich diet.

The cure of this complaint requires the most prompt and decisive measures. Blood must be taken in large quantities from the jugular vein or temporal artery. Not less than three quarts should be taken from an ordinary horse, ox, or cow; and if the animal is very large, four may be taken; and the bleeding must be repeated a few hours after, if the symptoms do not abate. When the beast is very furious, it is often dangerous to bleed in a very deliberate way; but as his recovery will almost certainly depend on a sufficient loss of blood in the early part of the disease, it will not be amiss to bleed him in the manner described by Mr Blaine, as having been practised by an eminent veterinary surgeon, who being called to a horse affected with staggers, and in such a state of delirium that none of the ordinary precautions for securing him could be adopted, plunged a lancet into each jugular, and permitted the animal to bleed till he fainted, by which means, though the disease was far advanced, he saved the horse. After bleeding, a stimulant blister should be applied to the top of the head, and the sides of the neck should be well rubbed with a mixture of powdered cantharides and oil of turpentine, and other means used to promote external inflammation, for the purpose of determining the blood from the head. Mr Coleman is said to recommend in these cases the pouring of boiling water on the pasterns, by which means blistering will speedily be produced in these parts. In desperate cases the determination of blood to the head may be most effectually stopped, by tying a ligature about one of the external carotid arteries; but in doing this great care must be taken not to include within the ligature the nerves that run near the artery, as these nerves are the principal branches that supply the stomach; and if they be included in the ligature, the functions of that organ will be in a great measure destroyed. In addition to these means costiveness must be carefully guarded against. After back-raking, a stimulating purging clyster should be injected as soon as possible, and if an interval of quiet will permit, a purging ball, such as N° 15. may be given by the mouth. If the above means are adopted in proper time, the animal will generally be saved; but if some days have elapsed before vigorous steps are taken, there can be little hopes of a cure.

Mr Downing, in his work on cattle-doctoring, mentioned in N° 87. advises a method of treating inflammation of the brain in cattle, that is extremely contradictory and inconsistent. He at first very properly advises bleeding; but he directs this to be followed by giving diapente, a very powerful cordial medicine, the administration of which completely counteracts the effects of the bleeding. *Dr* Downing describes a fever of the brain

brain as distinct from inflammation; and he then treats of a sleepy fever. These are evidently symptomatic affections, and should have been given as such, as well as giddiness, or swimming in the head, which is described by *Dr* Downing "as a distemper belonging to the cavities of the eyes and optic nerves. It gives a wavering motion to the body. For if the optic nerve, or its expansion on the bottom of the eye called *retina*, be agitated by any preternatural heat or other emotion, objects will change their situation; therefore this disease is a fever affecting the cavities of the eyes, or the optic nerves."

### 2. INFLAMMATION of the EYE. Ophthalmia Membranarum. *Moon-blindness.*

484 Inflammation of the eye.

Though in the human subject there are several species of ophthalmia, in the horse there is but one, which is in a great measure synonymous to what has been called *ophthalmia membranarum* by medical writers. This disease in the horse is of considerable importance, as it is not merely a local disease, but appears to be connected with some constitutional affection. Before we describe the symptoms and treatment of this complaint, it will be proper to remark, that in the eye of the horse there is a firm cartilaginous substance, situated at the inner corner of the eye, the greater part of which is hidden by the eyelids, but a small portion projects beyond them, and may be distinguished by its black colour. This is commonly called the *haw*, and by anatomists the *membrana nictitans*, and is supposed to be a production of the retractor muscle. Our reason for mentioning this part will appear immediately.

Inflammation of the eye sometimes makes its appearance very suddenly; at others it is gradual in its attack. In general, one of the earliest symptoms of it is a swelling of the eyelids, especially of the upper, which is with difficulty held open; the eyes water considerably, and drops of tears may be seen at the extremity of the lachrymal duct, which do not appear in the healthy state of the eye. The external transparent parts of the eye become discoloured and obscured, appearing of a blackish glassy hue; sometimes of a dull white, at others brown or bluish. Red vessels may be seen running over the white of the eye, especially at the corners, and sometimes reaching to the centre of the eye. The cornea is said to be most obscured on its upper part; but this is probably owing to the situation of the person who looks at the eye, who being below it, sees directly through the lower part of the cornea, and but obliquely through the upper. When the eyes are in this state, the horse is very impatient of light, and holds his head down to guard against it. The eyelids and ball of the eye are evidently much hotter than usual, and sometimes there may be seen through the cornea, a small quantity of thickish matter called *pus*, in the lower part of the anterior chamber of the eye. The cartilaginous membrane or *haw* is now much more visible, and projects forward considerably outward from the corner of the eye.

It not unfrequently happens, when the disease has not proceeded farther than we have described, that it gradually, sometimes pretty suddenly, disappears, and is seen again in the course of a few weeks, although sometimes it comes back in the course of a few days. The disappearance of inflammation in the eye of the horse is sometimes so sudden, that the eye, which one day is considerably inflamed, will appear the next perfectly clear and healthy. Sometimes it seems to appear and disappear periodically; and it has been supposed by ignorant people, that in these periods it follows the changes of the moon, whence it has received the name of *lunatic blindness*. If the disease does not thus disappear, or if it appears again, and reaches the height before described, the inflammation goes on, and the cornea becomes more obscure; or, what very frequently happens, the cornea recovers its transparency, and the crystalline humour becomes opaque, forming the disease already spoken of in N° 325.

In the horse, one eye frequently only is affected, whereas in man, both eyes are generally inflamed at the same time. This disease more frequently occurs in young horses of five or six years old, than in those of a more advanced period. It is said that horses are never affected with inflammation of the eyes till they are broken, or taken up from the pasture where they have remained from their birth.

A plethoric state of the body seems very much to predispose to inflammation of the eye, and this seems to account for its occurring so frequently in horses of five or six years old, as at that age they generally cease to grow, and are, of course, more disposed than at other times to fulness of blood. Sudden changes of temperature form a very common exciting cause of this disease, and the heat and foul air of a close stable frequently produce it. Such horses as are kept in dark stables are also more subject to it, from the effect of sudden exposure to broad day-light. Want of exercise, or extremes of idleness and hard work, may also assist in producing it. Mr Coleman considers this disease in the horse as an inflammation of a specific nature, very different from any that occurs in other animals. The principal reasons for supposing that the constitution is affected are, that a horse affected with an inflammation of the eye either does not perspire, or sweats profusely, indicating a slow fever. If the animal is bled or purged, the eye speedily becomes clear; and if the same causes are applied, the same eye, or more commonly the other, becomes inflamed, and sometimes the disease appears alternately in each eye.

Provided the proper means be taken in the early stage of the disease, the inflammation is commonly soon removed; but when the crystalline humour becomes opaque, no means hither employed have, as we shall presently see, produced any benefit.

In the treatment of this affection, it must be remembered, that the constitution is deranged, and that our remedies must therefore not be confined to local applications to the eye. General blood-letting will almost always be required; but, unless the horse is very fat or plethoric, this need not be repeated. It will be proper also to apply a blister or two to the head, as near the eye as possible, and the veins at the corners of the eye should be opened, to draw blood from that part. The horse must be put on lower diet, and should use only very moderate exercise; the stable should be kept well aired and cool; and if the horses eyes are very sensible, and the stable happen to have windows, these should be darkened. It will generally be advisable to give a purgative medicine; and the horse may drink frequently of some cooling liquor, especially of water, with nitre dissolved in it. Rowels have been sometimes recommended; and it is said that considerable benefit

has

has followed the insertion of setons as near the eye as possible. They have sometimes been passed through the white of the eye, just below the transparent cornea; but to this we should object, as being liable to produce specks that may extend to the cornea. As there is generally considerable dryness of the skin in this complaint, it may be useful in some cases to administer a gentle sudorific, such as a solution of two drachms of emetic tartar, or N° 22. of the receipts may be given.

With respect to the applications to the eye itself, those which appear the most likely to be of advantage, are stimulating substances, such as tincture of opium, solution of blue vitriol, red precipitate, in the form of a soft ointment, such as N° 40. Sometimes, however, these stimulating applications do harm; and it is found that a weak solution of sugar of lead, or acetate of zinc, as prescribed in N° 31. are most useful. We must here take notice of an absurd practice that is in use among common farriers, of cutting away the *haw*, which they consider as a very principal part of the complaint. There is no doubt, however, that relief may have been procured by this operation, as it will generally be attended with a pretty copious effusion of blood, that will relieve the distended vessels; but as this effusion can be more easily produced by scarifying the red vessels of the white of the eye; and, by opening the angular veins, there is no occasion to take away a part, which is certainly of considerable use to the animal.

Sheep are sometimes affected with inflammation of the eye; but in them, as in most other animals, it is merely a local disease, and is generally relieved by topical bleeding. In the corrected agricultural report of Perth, it is stated, that the common practice in that district for relieving inflammation in the eyes of sheep is, to open the veins in the corner of the eye; and hold down the animal's head, so as to allow the blood to get within the eye. There is no doubt that this bleeding does good; and the introduction of the blood within the eye may, we believe, also be of service; not, however, in the way supposed by the reporter, but because it acts as a gentle stimulus.

We have already, in N° 324. made some observations on cataract, and noticed the inefficacy of all the usual methods of treatment. It may not be improper here to add the result of Mr Coleman's experimental attempts to relieve this complaint, as stated by Mr Feron.

"The professor has begun with bleeding from the jugular or angular veins, and, at the same time, employing purgatives frequently repeated, as well as diuretics administered one after another. After which he has tried all the medicines of Messrs Phipps and Wathen, but without any degree of permanent success. The local and surgical treatment has been as follows, viz.

"1st, He has ordered scarifications, and to pass a seton through the membrana conjunctiva; but without effect.

"2dly, We have removed some of the larger vessels going to the cornea, and divided them with the actual cautery, but with no success.

"3dly, We have applied leeches to the conjunctiva, but without effect.

"Lastly, We have taken up both carotid arteries, which was of no avail, from the anastomoses which the vertebral arteries form with them.

"Therefore, the treatment is confined entirely to bleeding, purging, and diuretics; fomentations of warm water, in order to diminish the irritation from the tears that run over the cheek; and plenty of moderate and continual exercise, so as to increase the perspiration."

### 3. CATARRH. Catarrhus. *Mor Foundering*, or Common Cold.

485 Catarrh, or cold.

Catarrh has been placed by Dr Cullen among the *profluvia*, or fluxes attended with fever; we have ventured, with some modern authors, to rank it as an inflammation, because the increased secretion of mucus, which might entitle it to be called a *profluvium*, though sometimes pretty considerable, is not a constant, or often a very remarkable symptom of the disease; and in all cases appears to be the effect of an inflammatory state of the pituitary membrane. There are generally reckoned two species of catarrh, simple cold, and epidemic catarrh, or *influenza*. Though in the latter of these the catarrh is probably only symptomatic, we shall, in compliance with the usual custom, consider it immediately after common catarrh.

This disease attacks all the domestic animals; but horses and dogs are most liable to it, and in them the symptoms are most severe. It usually commences by a general dulness and heaviness, a dryness and increased redness of the inside of the nostrils, from which there soon proceeds an unusual secretion of mucus; a dryness of the eyes, or sometimes an increased effusion of tears. In a short time there is generally added some degree of cough and difficulty of breathing; and sometimes there is with these symptoms a considerable degree of heat and dryness of the skin; increased thirst, and not unfrequently a loss of appetite. At first the cough is dry, and sometimes continues so; but more frequently, when the complaint has remained for some time, a frothy whitish mucus is coughed up. The pulse is not always much affected in this disease; but in general it is fuller and harder than natural. The first symptom of the disease is not unfrequently a chilliness and trembling.

The principal causes of catarrh in domestic animals, as well as in man, are sudden changes of temperature. especially cold applied when the body is in a state of perspiration, or entering a warm apartment after having been long exposed to a cold air. Drinking cold water, when sweating, is also a common cause; and these causes are the more likely to produce their effect when the animal is in a plethoric state.

If neglected, catarrh may go on to inflammation of the lungs; in the horse it may produce thick wind, or even broken wind; in cattle it may end in chronic cough; and in sheep it may lay the foundation of consumption or pulmonic rot. It is also not unfrequently followed by the complaint called *glanders*, which we are presently to describe. An improper mode of treatment, especially giving cordials and other hot medicines, will hasten on these terminations of the disease. If attended to in time, and if the proper mode of treatment be adopted, the symptoms are, in general, soon removed.

If the complaint is slight, and there is little fever, it will often be sufficient to take the animal within doors into a warm stable, give him a warm mash, and put a cloth over him, when he will perspire through the night,

night, and be nearly well next morning. This plan will also answer, if it be adopted immediately, on perceiving the chilliness, or shivering. If, however, considerable fever has taken place, and the animal's pulse is hard, it will be proper to draw blood, according to the urgency of the symptoms, before giving any internal remedy, or using warm clothing. After bleeding, a drench, composed of warm ale, with a drachm or two of salt of hartshorn, or half an ounce of spirit of hartshorn sweetened with molasses, will prove an excellent remedy; after taking which, the animal should be well rubbed down, and clothed as before. If the animal is costive, back-raking, followed by clysters, will be advisable; and throughout the treatment costiveness must be avoided. If there is considerable fever, the drench, N° 22. or 26. where costiveness is to be obviated, should be given every six hours. Some practitioners advise balls in these cases, as in most others; but as there is often some swelling of the throat, and always considerable irritation about the *fauces*, it is better to give the remedies in the form of drenches. The cough seldom needs particular attention during the inflammatory state of the disease, as it will generally go off when the inflammation is removed; if it should continue obstinate, it becomes a chronic cough, and must be treated as directed under N° 436.

### 4. *Influenza, or Epidemic Catarrh.*

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Influenza.

The epidemic catarrh also affects all these animals, and has sometimes been known to attack a whole yard of oxen, horses, and cows, in one night. It differs from common catarrh in the degree of fever, which, in this complaint, is always very considerable, and is one of the first symptoms. There is a smart shivering, followed by considerable heat and dryness of the skin, and the fever is commonly attended with great heaviness and pain of the head, and affection of the eyes. In this complaint there is also a great degree of weakness, which comes on pretty early in the disease, and this weakness not unfrequently brings on a fatal termination of the disease. Sometimes there is a considerable discharge from the nostrils; at others this discharge is either trifling, or the nostrils are dry, in which cases the fever is most considerable.

The epidemic catarrh appears to depend on some peculiar state of the atmosphere; but there is no doubt that it is capable of being propagated by contagion. It is more prevalent in the spring, especially when this has been preceded by a mild winter. It is said, that when cattle are at these times exposed to currents of air from the north-east, they are most likely to be affected with it.

In the commencement of this disease, it will be proper to house the animals; but too much warmth must be avoided, as it would tend to increase the weakness that forms a principal part of the disease. It may sometimes be necessary, when the fever runs very high, to draw blood once; and, at any rate, it will be proper to apply a blister to the head, or on each side the neck. Though warmth must be avoided, great care should be taken not to expose the animals to a draught of air. Warm mashes may be given as in common catarrh, but when the fever has subsided, cordials and strengthening remedies will be required; and if the appetite is tolerably good, the diet may be more nourishing than usual. The animals should on no account be hard worked, but be allowed to rest from the time the disease is first noticed, except taking gentle exercise when their strength will admit of it.

What is commonly called the distemper in dogs is now pretty generally considered as a sort of epidemic or contagious catarrh. We shall therefore treat of it in this place.

### 5. *Of the* Distemper *in Dogs.*

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Distemper in dogs.

No disorder is more general among dogs than that which is generally known by the name of the *distemper*; and none is so destructive. It is asserted that, except the plague, no disease is so fatal to the animal which it attacks.

It appears that this disorder has not been known in Britain till within the last 50 years, but, during that time, it is astonishing what numbers of dogs have fallen victims to it. For these last fifteen or twenty years, however, the distemper has been less frequent, and has assumed a milder form.

The symptoms of the distemper are not alike in every case. The following are, according to Mr Blaine, its usual appearances. It generally begins with a dry husky cough, attended with dullness and want of appetite, a running from the eyes and nose, and loss of flesh. As the disease advances, the dog appears much emaciated, and grows excessively weak, particularly in the loins and hind legs. Convulsive twitchings of different parts, especially of the head, come on, attended with dimness of sight; and, as the disease proceeds, and puts on a more virulent form, these twitchings degenerate into strong convulsive fits, which continue for a long time, and repeatedly return. In these fits the dog foams at the mouth, runs round, and appears to be in great pain, and to have a constant desire to dung. This is sometimes attended with obstinate costiveness, at others with violent purging. The stomach is extremely irritable; every thing that the animal takes being immediately thrown up. When the disease has reached this state, the animal seldom recovers, and is usually carried off in one of the convulsive fits.

In every part of this disease there prevails a want of energy, and a particular paralytic affection of the nerves. This latter symptom, in some instances, remains long after the disease has been otherwise removed; but, in general, the strength returns almost immediately on the removal of the other symptoms.

The distemper in its worst form is often mistaken for canine madness; but they may in general be distinguished, by attending to the following points.

1st, The distemper seldom occurs except in puppies, its most common period being from six to twelve months. Madness may occur at any age, but seldom attacks puppies.

2d, In the distemper dogs drink freely; in madness, though they often attempt to drink, it does not appear that they are capable of swallowing the water.

3d, In the distemper the animal does not attempt to bite; but, in madness, the propensity to biting seems to be incessant.

4th, In madness there appears to be a loss of reason at all times, though, as is said, they are so sensible, as to know their master; but in the distemper, though there is sometimes a loss of reason, it lasts no longer

longer than during the continuance of the convulsive fits.

If, therefore, a young dog will drink, as soon as the effect of the convulsion is removed, but more particularly when his weakness is excessive, and strongly apparent in the intervals between the fits, it may be pretty safely concluded, that he is affected with the distemper, and not with madness. These circumstances, says Mr Blaine, should be carefully remarked, as they are unerring, and may save many a valuable animal from destruction, and many a timid mind from the most dreadful apprehensions.

The cause of the distemper is difficult to explain; nor do the most careful dissections, in every stage of the complaint, ascertain more than that there is a general inflammation of the mucous membrane; but whether the true seat of the disease is confined to that membrane, and all the other symptoms are the consequences of it, or are real affections of other parts, is an undecided point, although it is certain that its first appearance is by an inflammation of the pituitary membrane, and which is one of the most lasting, as well as constant symptoms. That this inflammation is given from the membrane of the nose, to the upper part of the gullet and wind-pipe, is evident by the swelling of the glands of the throat, the tenderness and dry cough; and that this inflammation extends from thence to the same membrane of the stomach and intestines, is equally so, producing vomiting, costiveness, or purging. It has generally, as we have said, been considered as a species of *catarrh;* but it has been suggested to us, by an ingenious friend, that, from several symptoms, as well as from its attacking dogs only once in their lives, it is more analogous to *pertussis*, or chincough, in the human subject.

With respect to the cure of the distemper, Mr Blaine's directions and remedies appear to have been tolerably successful. With the nature of his remedy we are unacquainted, but believe it to be a preparation of mercury. This medicine has been made known by extensively advertising it, and although certificates of its utility are numerous, they make no part of the advertisement, but are to be seen at Mr Boofey's, in Old Bond Street, London, the wholesale agent; the form is a powder. Explicit instructions accompany it; and the price, considered with its asserted efficacy, bears no proportion, as no sportsman would think five times the sum too much for the preservation of a valuable animal. Although so efficacious, it is nevertheless innocent enough for a child to take; nor must those who are advocates for strong remedies imagine, that, because the effects of this shake not the whole constitution, that the disease will not be eradicated by it. When the disorder is strong, after it is given, there is for the most part a gradual decrease of the symptoms, and nothing but a small moisture at the nose remains, which speedily disappears the next day. If the attack is slight, no more is seen of it, and the animal is at once well.

From the varieties in the size, and consequent strength of dogs, a difference in the quantity of the medicine is necessary; the packets are therefore marked 1, 2, and 3. For a mastiff, pointer, setter, or dog of a large size, N° 1. should be procured. Hounds, spaniels, and those of a middling size, require No 2.; and all the lesser dogs, N° 3.

It has been already observed, that in the severity of the disorder, there is frequently so great an irritability of the stomach, that every thing taken into it is instantly thrown up; in such cases, the powder should be carefully mixed with a small piece of butter, at the same time adding to it thirty, forty, or fifty drops of laudanum, according to the age, size, and strength of the dog; who is to be watched, whether the medicine is retained, and kept as still as possible; but should it be thrown, up, notwithstanding this addition, in two hours after the same quantity of laudanum should be given with the powder, in a little broth or milk, and half an hour afterwards the powder mixed into a paste with treacle, honey, or flour, and thus the vomiting will be prevented. Should there be at the same time obstinate costiveness, it is probable that sickness may be the consequence of it, and must be removed before it will cease; twenty grains of jalap, or, in preference, fifteen grains of calomel, with four or five drops of laudanum, may be given in a small ball; or two table-spoonfuls of castor oil, may, if more convenient, be used. Should these not stay on the stomach, a clyster with milk, salt and oil seldom fails to remove the costiveness, after which the powder should be given, if there has been great sickness, with the laudanum; if not, without it.

When, likewise, extensive purging accompanies the complaint, the laudanum should not be omitted; as by running off rapidly by stool, the effect of the medicine is equally lost, as if it were vomited up. In such csaes it will be proper to give before the powder thirty or forty drops of laudanum, with two ounces of olive oil. We should always attempt to remove the sickness and purging, or costiveness, before administering the powder, as the effect of this will be then more certain. In the milder form of the disease, however, nothing is requisite but to give the powder in such a way, as that the dog may take the whole of it; for which purpose the powder should be well mixed with a small quantity of any thing that the dog will eat, or, if he is averse to eating, it should be made up into a small ball with honey, treacle, or butter, and forced down his throat. It must not be mixed with any liquid, as it is so heavy that it would fall to the bottom, and thus will probably be lost. Care should be taken to give the medicine on an empty stomach, as the effect will otherwise be lessened or destroyed; and the dog should be carefully watched to see if the medicine be thrown up, as, if this is the case, or if there is reason to suppose that the whole dose is not given, a second should be administered. Mr Blaine concludes with observing, that the symptoms remove without any particular appearance; yet so quickly, as that there is seldom any remains of the disease two hours after the medicines have been administered.

Mr Daniel has witnessed the extraordinary effects in the distemper, from Dr James's powder, given in the following manner. When the symptoms of the distemper are apparent, a third part of one of the parcels inclosed in the half-crown packets is to be given, mixed with a little butter, and the dog is to have plenty of warm broth, or milk and water, and, if possible, he is to be near a fire, or at least kept very warm. Two hours afterwards another third part is to be administered; and should neither of these operate by vomiting or purging, at the end of four hours, give the remaining third. Should the two first portions have the effect, the remaining third should not be given until four or six hours (according to the evacuations) after the expiration of the four hours; in the interim the dog is to be encouraged to lap, and if he refuses, be forced to take plentifully of warm broth, or milk and water. Very seldom, even when the case is inveterate, but the evacuations are brought on by the taking of one packet, generally by the second dose; but should it so happen that there is no such proof of the powder's effect, the second parcel should be divided into similar proportions, and applied in the same manner, until the stomach is emptied. Warmth and warm liquids will quickly perfect the recovery. As soon as the dog's appetite returns, let him be fed (at first rather sparingly) with animal food *.

Dr Darwin advises, that the dog be permitted to go about freely in the open air, and have constant access to fresh water. The use of being as much as may be in the air is evident, because all the air which we breathe passes twice over the putrid sloughs of the mortified parts of the membrane which lines the nostrils, and the maxillary and frontal cavities; that is, both during inspiration and expiration, and must therefore be loaded with contagious particles. Fresh new milk and fresh broth should be given them very frequently, and they should be suffered to go among the grass, which they sometimes eat for the purpose of an emetic, and, if possible, should have access to a running stream of water, as the contagious mucus of the nostrils, both of these animals and horses, generally drops into the water when they attempt to drink. Bits of raw flesh, if the dog will eat them, are preferred to cooked meat; and from five to ten drops of opium may be given with advantage, when symptoms of debility are evident, according to the size of the dog, every six hours. If sloughs can be seen in the nostrils, they should be moistened twice a-day with a solution of sugar of lead, or of alum, by means of a sponge fixed on a bit of whalebone, or by a syringe. The lotion may be made by dissolving half an ounce of sugar of lead in a pint of water †.

### 6. RHEUMATISM.

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Rheumatism.

There seems no doubt that horses, and perhaps cattle, are affected with rheumatism; but it is sometimes difficult to ascertain the presence of the complaint, or to distinguish it from other causes that produce lameness. It may take place in any of the limbs, but it is more frequently observed to affect the hip-joint and the adjacent membranes; and when seated here, it is called the *sciatica*, and sometimes the *hip-gout*. It will require considerable judgment to distinguish this complaint; but it may generally be known by attentively examining the limb in which the lameness is seated, from the hip down to the foot, and by attending to the causes that seem likely to have produced the lameness. In rheumatism, the skin will be found dry, and the affected part swelled, and the lameness attendant on it will be more readily removed by exercise than that which has its cause seated in the foot, or which arises from bony excrescences. Rheumatism in the horse, as in the human subject, may be either acute or chronic, and the latter is the more obstinate.

Rheumatism, like catarrh, is produced by sudden changes of temperature, and by exposure to a cold moist atmosphere. It is no otherwise dangerous than as it renders the animal lame.

The cure of rheumatism differs according to its state. In the acute one bleeding may be proper; after which a warm mash, with two drachms of emetic tartar dissolved in the water, should be given, and the horse treated as directed under CATARRH. If a sweat is produced, and kept up for some hours, the complaint will probably disappear, and its return may be prevented by frequent friction of the affected part, regular exercise, a nourishing diet, and attention to avoid changes of temperature. In the chronic rheumatism, bleeding will be improper; and the most likely means of relief will be, to rub the affected parts several times a-day with some stimulating liniment, or, if convenient, to use the warm bath for a considerable time together, or to foment the affected limb for an hour or two every night, after which the limb must be rubbed perfectly dry. Pretty constant exercise will also contribute greatly to the cure, and costiveness must be avoided. A blister applied over the affected part will sometimes do good. According to Mr Lawrence, the only cure to be depended on is a month's run of salt marshes in the spring, and being continued abroad in some shady place till autumn, afterwards mercurial physic, and the best stable care.

### 7. INFLAMMATION of the LUNGS. Pleuritis. Peripneumonia. *Pleurisy. Peripneumony. Rising of the Lights. Rot.*

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Inflammation of the lungs.

The lungs are frequently inflamed in the domestic animals; and, as in man, the inflammation may be seated either in the membrane covering the lungs and lining the chest, or the *pleura*, or in the substance of the lungs, constituting the two varieties, *pleurisy* and *peripneumony*. The disease has been called by common farriers, *rising of the lights*, from an idea that the lungs protruded against the throat, and caused that difficulty of breathing which is one of the principal symptoms of this complaint. The other vulgar appellation of *rot* seems to owe its origin to the appearance which the lungs sometimes present on dissection, being found in a state of mortification, and partial decomposition, as if they were rotten. It is of little consequence to distinguish the two varieties of the disease, as the treatment is the same in both.

According to Mr Feron, the symptoms of inflammation of the lungs in the horse are invariably as follow. The respiration is quick, the breath hot, the extremities cold, the tongue dry and hot, the flanks heaving, the patient never lying down, which forms a very characteristic symptom; and sometimes he hangs down his head. If nothing has been done, it is hardly possible to save his life, after three days have elapsed; and, after death, the right side of the heart is found to have been inflamed, and, on some occasions, so much distended with blood as actually to burst, and the lungs are found to resemble putrid liver, the cells filled with blood, from the great distension of the pulmonary arteries, and perhaps sometimes effusions take place; the pulse is oppressed, from the great distention occasioned by the blood in the right side of the heart, while the left side of that organ is weak from want of sufficient blood.

To Mr Feron's account it may be added, that the pulse,

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* Daniel's Rural Sports, vol. i.

† Darwin's Zoonomia, vol. ii. 4to.

pulse, at the commencement of the disease, is generally more full, harder, and more frequent than natural; but, as soon as the disease reaches the stage at which it is usually first observed, the pulse has become small and oppressed, and but little increased in frequency; the veins of the neck are swelled and prominent, and the eyes are generally red and starting. There is sometimes cough, at others none; but the difficulty of breathing is always great, and the horse stands extended, panting for breath, with heaving flanks and open nostrils, till, no longer able to support himself, he drops down and dies. This fatal termination sometimes takes place in a very short period; in 48, 36, or even 24 hours.

The only disease with which this can easily be confounded, is colic; and the discriminating marks will be mentioned when we treat of this disease. At present it will be sufficient to remark, that when a horse appears dull, holds his head very low, breathes with difficulty, especially during inspiration, stands constantly, has a quick heaving of the flanks, a fulness of the eyes, and redness of the inside of the nostrils, and when the pulse is small and oppressed, he may almost certainly be declared affected with inflammation of the lungs.

It may not be improper to give a brief explanation of the symptoms which we have enumerated; and they are chiefly to be explained from the difficulty with which the blood passes through the lungs, on account of the unusual accumulation in the pulmonary vessels. Hence the difficulty of breathing, and the aversion that the horse expresses to lie down; for it is evident, that he will breathe more easily in a standing posture than if he were lying; because, as was remarked in the table of the extremities of the muscles, some of these act on the chest when the fore legs are fixed, and thus assist in carrying forward the ribs, and thus increasing the cavity of the chest. The impeded passage of the blood through the lungs also explains why the pulse is weak and oppressed; and hence, when this obstruction is relieved by lessening the quantity of blood, the pulse never fails to become stronger and fuller.

The causes of inflammation of the lungs are doubtless sudden changes of temperature, especially when the animal is plethoric; it is probable that the most common cause is a sudden change from heat to cold and moisture. It is at present, however, more fashionable to consider the reverse of this as the general cause of pulmonary complaints; and we understand that Mr Coleman goes so far as to say, that horses are never attacked with inflammation of the lungs from exposure to simple cold, for, that the turning of horses to grass without preparation, though it may render them emaciated, seldom produces the complaint in question. Mr Feron also, who may be considered as a pupil of the veterinary college, is of opinion, that inflammation of the internal viscera proceeds from a sudden transition from a cold to a hot temperature, but seldom or never from a hot to a cold one. We are aware that these gentlemen have borrowed their theory from Dr Beddoes, and it is of little consequence to our present purpose, whether it be correct or not.

The judgment to be formed with respect to the termination of this disease, which is always highly dangerous, will depend on the urgency of the symptoms, and on the changes that take place after the exhibition of the usual remedies. If the pulse becomes fuller and stronger after bleeding; if the breathing becomes less difficult; if the parts where blisters have been laid inflame soon, and the blisters rise well; and, in particular, if the horse lies down, and seems less distressed, we may hope that the danger is lessened; and if these favourable signs continue for 24 hours, we may consider a cure as pretty certain: but, if the pulse still continues small and oppressed, more especially, if it becomes quick and irregular; if the difficulty of breathing continues or increases; if there is a rattling in the throat, with partial cold sweats and extreme dejection; a fatal termination must be looked for, which will speedily take place, if the breath becomes cold or fetid. It is considered as a very unfavourable symptom when the horse appears insensible to external stimuli; as when blisters do not rise well, nor rowels easily suppurate.

In the cure of inflammation of the lungs, every thing will depend on the speedy adoption of the most vigorous measures, and the first and principal remedy is bleeding. This should be performed as soon as possible, and to a greater extent than in most inflammatory diseases. It will scarcely be proper to take less than five or perhaps six quarts at first, and the bleeding must be repeated, though less copiously, some hours after, if a considerable remission of the symptoms does not take place. It must not be expected that the pulse will rise much after a second or third bleeding; but, if it is not considerably weakened, and if the oppressed feel of it is removed, we may be sure that the bleeding has not been carried too far. Another principal means of checking the internal inflammation is, to excite an inflammation externally near the seat of the complaint, by every means in our power. A large blister should be applied on each side of the chest, and to the inside of the fore legs; a rowel should be inserted below the chest, and if the symptoms are very urgent, another near the belly. Mr Coleman recommends inflating the cellular membrane below the skin with air, so as to bring on an inflammation between the skin and muscles; and if this does not succeed, he advises that some stimulating fluid, such as oil of turpentine, be injected. We should suppose this carrying inflammation rather too near the lungs; but from some trials that Mr Coleman has made, and some others of Mr Feron, this method seems to have been attended with considerable advantage. In addition to these means, the fore legs should be well rubbed two or three times a day with oil of turpentine, or the liniment in No 42. of the receipts. These are the external means that are chiefly to be relied on; and if these be followed up speedily, and with proper attention, there will be seldom any occasion for internal remedies. If these be given, they must be such as are calculated to cool the body, and to check inflammation, such as the drenches N° 22. and 26. especially the latter, as it is necessary to keep the bowels open. Perhaps foxglove might here be given with advantage, as directed under that article, at 290. Mr Feron recommends diuretics, and a ball composed of *an ounce and a half* of emetic tartar, a drachm of opium, and 15 or 20 grains of calomel. We do not know whether this is the practice of the veterinary college, but it appears to us to be inconsistent with the bleeding and other evacuants which are generally found most successful. As costiveness would tend to increase the inflammatory symptoms, back-raking and the occasional use of mild clysters,

clysters, will be requisite. In general, warm water, or this with a little Glauber salt dissolved in it, will be sufficient, as all heating purgatives would do harm. The horse should be kept rather warm, should be clothed, and should drink frequently of warm gruel. Food will not be requisite, and, if set before him, he would probably not touch it. Exercise of every kind must be avoided, at least so long as the inflammatory symptoms continue.

The most favourable termination of this complaint is by resolution, when the inflammatory symptoms go off without producing suppuration or ulceration of the lungs; but sometimes this state is unavoidable, an ulcer is produced, and, if the matter is not thrown off, it may either produce suffocation, or bring on hectic fever and consumption. When it is found that a cough remains after the inflammation has subsided, and a quantity of mucus is thrown off, the evacuation of this should be promoted by gentle expectorants, and the horse must still be kept warm. Though the matter may be completely expectorated, there will generally remain a difficulty of breathing, or thick wind, when inflammation of the lungs terminates by suppuration. Sometimes there is left an anasarcous or dropsical state of the lungs, and in these cases it is said that blue vitriol and turpentine, to the amount of two drachms of each, mixed into a ball, with a proper quantity of linseed powder, and given every morning, have been beneficial. It may also be proper to apply a blister over the wind-pipe.

Inflammation of the lungs in cattle differs little in symptoms, and nothing in the treatment, from that which we have been describing in the horse.

490 Pulmonia rot in sheep.

The lungs of sheep are very frequently affected with inflammation, which forms one of the diseases that has been confounded under the name of *rot*. It most frequently attacks young sheep, especially those of the more delicate breeds; and it is most prevalent in damp pastures, and during unfavourable seasons. The symptoms of this disease in sheep have not been well described, but they probably differ from those in horses and cattle, only in degree. It does not appear to be so speedily fatal, although the animals seldom or never recover from it. Towards the latter stage of the disease there is considerable weakness; and at this time there appears below the jaw an œdematous swelling, containing a quantity of fluid, which is easily evacuated by piercing the tumour. This tumour is called the *pock* in Scotland. On opening the bodies of sheep that have died of this species of rot, the lungs are found full of knots or tubercles, similar to those which appear in human subjects that have died of pulmonary consumption, and sometimes the lungs appear mortified or rotten. The liver, however, in these cases, is sound, which distinguishes this variety from the other diseases called *rot*.

We do not know that this disease admits of a cure in sheep, though it might probably be prevented by housing them, or affording them shelter, at those seasons when it is most likely to occur.

491 Pleurisy in dogs.

Inflammation of the lungs occurs sometimes in dogs, but it does not seem to be very frequent in these animals. It requires pretty much the same treatment as in the horse, except that here emetic tartar may be given in such a quantity as to excite considerable sickness, without vomiting. This would be improper in the horse, as it would be difficult to regulate the dose of the medicine, so as not to produce such an irritation of the stomach as might considerably increase the animal's distress, and augment the difficulty of breathing.

### 8. Inflammation of the Liver. Hepatitis.

492 Inflammation of the liver.

We have no doubt that inflammation of the liver takes place occasionally in most of our domestic animals; and it is probably a more frequent disease than is generally supposed. Both species of it, viz. the acute and chronic, may appear in these animals, and it will appear presently, that the latter is a very common disease among sheep. Though dissection has clearly shewn, that the liver in cows, horses, and sheep, has been affected with inflammation during the life of the animal, yet any account of the symptoms of this disease that is given us by the veterinary writers, is so obscure, that we cannot pretend to give any thing like a perspicuous history.

According to Mr Blaine, this disease, considered as a distinct affection, is seldom met with in the horse, though, when great abdominal inflammation exists, the liver often partakes of the general disease. In the description of the symptoms, this author states that it is usually accompanied with costiveness, for the gland ceases to secrete the bile from its being in an inflamed state; and that bile which was secreted, is not poured into the intestines, but becomes deposited in the skin, producing jaundice, which is known by the yellowness of the eyes and the tongue. The pulse is generally full, hard, and frequent, but the pain not very intense. It would be difficult to detect it, unless by the symptoms of fever, accompanied with yellowness of the mouth and eyes. There would *possibly* be pain in the shoulder as in the human, in which case the horse might on trial be found lame.

It is easy to see, that this description is a fanciful picture of the disease, drawn from the analogy that the author supposes to exist between inflammation of the liver in man and the same disease in horses; and it is probably not to be depended upon.

The writers on cattle medicine describe the symptoms of the disease in cattle to be a difficulty of breathing, evident marks of fever, yellowness of urine, a swelling about the short ribs, and an unusual distention about the barren or womb. Here the symptoms of an acute and chronic distemper seem to be confounded.

493 Hepatitis in sheep.

As for the symptoms of the disease in sheep, in whom it forms one of the varieties of *rot*, we have seen no account of them any further than as they are confounded with those of the other varieties of rot, and, as such, they will be noticed when we come to treat of the rot in general. If this disease could be detected in its acute state, the cure would probably not be difficult; but when it appears in the chronic form, it is, we believe, seldom removed.

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When the bodies of such animals as have died of inflammation of the liver are opened, the liver has been found in various states of disease; sometimes it is harder and firmer than usual, and very frequently there are parts of it that are scirrhous and discoloured, resisting the knife when we attempt to cut through them. Sometimes the biliary ducts are almost bony, and there is commonly found in them, and sometimes in other parts of the liver, a species of worm called *fluke*; the *fasciola hepatica*.

*hepatica* of naturalists. Sometimes there are ulcers or abscesses formed in the liver, and frequently, especially in sheep, this organ is mortified or decayed.

495 The causes of this disease are very obscure; in horses and cattle it is said to be most common in hot seasons and warm climates, and that such of these animals as are fat are more exposed to its attacks. It may also be brought on by blows or bruises on the short ribs, by which the liver may have received some injury. In sheep it is said to be more common in dry weather, especially when the animals have but a scanty supply of food, and when they are of a costive habit. It is supposed by many, that this species of rot owes its origin to the flukes that we have described, as found in the liver after death; but, as these flukes have been found in the livers of sheep that had never been apparently affected with the rot, and, as they are frequently found in the livers of old sheep, this cause is probably rather fanciful; though when these animals are very numerous, or when they are situated in a very sensible part of the liver, they may excite a degree of irritation, and consequent inflammation, just as a great quantity of bots in the stomach of horses have been found to bring on inflammation of that organ.

In attempting the cure of this disease, when it is ascertained to be present, we must consider whether it is acute or chronic. When it occurs from injuries, it will probably be of the former kind, but in most other cases it will be chronic. Acute inflammation will require bleeding, purging, blisters, and low diet, as in all other cases of internal inflammation; but, in chronic hepatitis, the most likely remedy is mercury, which may be administered either internally, in the form of calomel or corrosive sublimate, or externally rubbed into the skin on some parts of the animal's body. This mercurial friction may be performed with tolerable ease on the sheep, by pulling off the wool from the inside of the thighs, and rubbing a drachm or two of the strongest mercurial ointment upon these parts every night, till the general system becomes affected, which may be known by the swelling of the gums, offensiveness of the breath, and increased flow of saliva from the mouth. This, however, would be an expensive and tedious cure; and if many of the flock appear affected, it would be better to kill them as fast as possible, before the disease has made such a progress as to render the animals lean. If a mercurial course should be attempted, the animals should be housed during the course, and should be kept on good nourishing food. Costiveness must be avoided in all these cases, by the administration of gentle clysters, or occasional doses of opening physic. A very good medicine, in all cases of liver complaints, is a ball composed of calomel and soap, as directed under jaundice, N° 441.

### 9. INFLAMMATION of the STOMACH. Gastritis.

496 mma- of the ach. The stomach may be inflamed, both in horses and cattle, from various causes; but this is a disease, the existence of which is not easily detected. Here also Mr Blaine has supplied the want of observed symptoms by analogy, and has supposed that there would *probably* be unsuccessful efforts to vomit; and, as the stomach is so essential an organ, the pulse would *probably* be affected even more than in inflammation of the bowels; that the animal would perhaps point to the left side about the tenth or eleventh rib; that there would be great distress evident in the countenance and manner, and that the loss of strength would be very great.

In cattle there are generally reckoned two species of inflammation of the stomach, one affecting the first stomach or paunch, and the other the third stomach or the manyplies. This latter is commonly denominated *lake-burn*. The symptoms of the disease in these animals are also very obscure, but they are probably similar to what have been described above.

If the reader looks back to N° 409. he will see detailed, a case that occurred to Mr Clark, in which inflammation of the stomach was observed, and detected after death; and though the symptoms there described are few, they are *probably* more characteristic of the disease in question, than any imaginary description which we can copy from writers who have never seen the complaint.

This disease is extremely dangerous, and will not admit of a cure, unless effectual means are taken at its commencement.

Inflammation of the stomach is commonly produced by some acrid irritating substance which the animal has swallowed, and this is the effect produced by most poisons. A large quantity of cold water drunk while the animal is in a violent perspiration, will also produce it. It not unfrequently accompanies inflammation of the bowels, which we are immediately to describe. It is said to be sometimes produced in cattle by the giving of too strong a dose of astringent medicines to cure the red water or bloody urine; and as we have seen in N° 409. it may sometimes be occasioned by bots.

The disease can only be cured by very copious bleeding, frequently repeated; by giving mucilaginous drinks, such as water gruel or linseed tea, applying a large blister just behind the short ribs, and the frequent administration of relaxing clysters. If poison has been swallowed, we must proceed as recommended under N° 407. though in most cases of inflammation of the stomach, it will be the most humane plan to effect a radical cure by shooting the animal through the head, or cutting his throat.

### 10. INFLAMMATION of the BOWELS. Enteritis. *Red Colic. Inflammatory Colic. Dry Braxy in Sheep.* Tranchée Inflammatoire ou Rouge, Fr.

This is a disease, to which all the domestic animals are subject, but it is attended with somewhat different symptoms, in the several species. 497 Inflammation of the bowels.

It is generally preceded by more or less fever. In horses, the first remarkable symptoms that appear, are a great degree of restlessness, with loss of appetite, thirst, with considerable heat, and dryness of the mouth. The animal evidently labours under violent pain, and is perpetually lying down and getting up again, scraping and stamping with his feet, with which he sometimes strikes his belly. When the belly is touched with the hand, the horse betrays extreme sensibility, and shrinks from the touch. The pulse is always increased in frequency, and is hard, giving the sensation of a cord below the finger. The skin feels unusually hot, all over the body, except at the ears, which are said to be cold. The tongue is commonly covered with a white fur. Costiveness is almost a constant symptom of this disease, and till the inflammation is subdued, this continues very obstinate, or, if the animal dungs, it is in very small quantity, and the excrement is very hard. The urine is voided in very small quantities, and with great pain, especially towards the latter period of the disease. The symptoms go on with more or less rapidity, till the inflammation is subdued by the proper remedies, or till it terminate in the death of the horse.

Returning health may be expected when the heat of the body gradually lessens, while the pulse becomes full, regular, and of the natural frequency, when the horse dungs freely, and returns to his usual appetite, and cheerfulness. But when there appears a sudden relief from pain, with a soft, feeble, or irregular pulse, and a purging of offensive black matter comes on, mortification of the bowels has taken place, and the horse will expire in a few hours.

On opening the body, evident marks of high inflammation appear in many parts of the bowels, the outer or membranous and muscular coats of which will be found red, and in some parts black. The inflammation is frequently found to have extended to other parts, as the stomach, liver, or bladder; to some of which the guts will be frequently found adhering. On opening into the cavity of the bowels, these will be found greatly distended with air, and the great guts loaded with hardened excrement; and sometimes the inner membrane will appear highly inflamed, or even corroded, shewing evident marks of its having suffered considerable irritation, from some acrid substance.

Inflammation of the bowels is distinguished from colic, by the frequency and cord-like feeling of the pulse, by the presence of fever, by the tenderness of the belly, and by there being little or no remission of the pain. It is said that in colic the horse rolls much on his back, but is not so apt to do this in inflammation of the bowels. It will be seen by and by, that a long protracted colic frequently terminates in inflammation.

Inflammation of the bowels may be produced by acrid or poisonous substances taken into the stomach. It has been sometimes produced by giving hellebore to horses, as a purge; and it is said to arise sometimes from giving purgatives at improper times, or in too large a dose. It is very commonly brought on by giving the horse cold water, when he is much fatigued, and so much overheated, as to be in a profuse sweat, or by dashing cold water upon him, by wading in cold water, or by standing in a draught of cold air, under similar circumstances of fatigue and sweating. Costiveness too long neglected, or entangled rupture, is also not an uncommon cause.

In the treatment of the inflammation of the bowels, as in all other internal inflammations, we must begin with copious and repeated bloodletting, after which a free evacuation of the bowels must be attempted by back-raking and the injection of softening clysters, such as warm water-gruel, mixed with half an English pint of castor oil. All acrid clysters must be avoided, as they will only tend to increase the inflammatory affection of the bowels, and even Glauber salts and other saline purgatives are scarcely proper, from the irritation they may produce. After bleeding and evacuating the bowels, warm fomentations applied to the belly may be of service, and the cloths should be applied as hot as possible. After the fomentation, the belly may be rubbed with some stimulating liniment, such as oil of turpentine, or essence of mustard. Firing has been recommended below the belly, as also frequent friction with the curry-comb, so as to irritate the skin, and almost make it bleed. Probably no medicine should be given by the mouth, farther than softening, diluting drinks, such as warm water-gruel or linseed tea. Food at the beginning of the disease is out of the question; but when the inflammation is a little relieved, the horse may have a bran mash. The body should be kept warm by clothing, and all exercise should be avoided.

Inflammation of the bowels in sheep is called *dry braxy* in Scotland, and of this disease we have an excellent account in Mr Findlater's Survey of Peebles.

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Dry braxy in sheep.

This disease is most fatal to young and robust sheep about six or seven months old, called in many parts of the island *hogs*. It is more destructive upon some farms than others; and even upon these, in one season more than another. In a *hog fence*, or pasture capable of keeping 30 score of hogs, there is in some years a loss from three to four score. This is a very serious matter, as each of these would sell in the spring, or beginning of summer, for half a guinea or 11s. This disease begins at those times when inflammatory disorders are most apt to prevail, in the months of October and November, and is produced by the common causes of inflammation, cold, exertion, external injury, &c. During these months, slight frosts set in, and the ground in the morning is often covered with hoar frost, or what is called in some parts of Scotland *rhine*. It is probable, that eating grass covered with hoar frost, may be one cause of the disorder. If so, moving the animals about, and preventing them from eating, until the frost is melted by the sun, may tend to prevent the disease.

This disease runs its course very rapidly. When the shepherd leaves his flock at night upon their laires, he sometimes observes a hog look dull, loitering behind, and restless; sometimes lying down and suddenly getting up again: and in the morning, he will often find it dead, or nearly so. At other times he will discover no apparent ailment among his flock; and in the morning, he may find one or two dead or dying. From this it appears that the disease is very acute.

This is further evinced by the appearances after death, when the carcases are opened. Their bellies are excessively swelled, and distended with a putrid air: the whole intestines being red and inflamed, gangrenous, and in some degree mortified. This putrid taint seems to be communicated to the whole carcase, as all the muscular parts, and fat, smell strongly of corruption. The hogs that die of this disease, are frequently fat and in good order, which shews that the disease is of short duration.

We have already mentioned the eating of grass, which is covered with hoar frost, as a very probable immediate cause of this disorder. But is there any predisposing cause?

In answer to this question, we shall adduce a fact which is well authenticated. Many parts of the western Highlands of Scotland, had been for ages occupied by horses and horned cattle. At the introduction of sheep into those districts, the best grass was that which had sprung from the tath and excrements of these animals. During many years after these districts were converted into sheep farms, braxy remained unknown. It crept in at last, and the severity of the disease was long in proportion to the length of time the pastures had been occupied by sheep.

From these we would infer that pasturing upon their own tath, is a predisposing cause of braxy among sheep; and that a frequent alteration of the species of stock, upon every sheep pasture, might serve to prevent the evil. This idea corresponds with the general laws of the Supreme Being, who certainly never intended that this earth should be monopolized by any particular species of animals; but has so ordered matters, that the happiness of individuals shall result from the happiness of the whole family of animated beings.

Hence it would appear a beneficial practice in store farmers, in place of one fence, to keep two or more enclosures of this description, and to change the stock upon them every season. This we know to be contrary to general practice, and that which is called the hogs fence, is carefully guarded against the intrusion of every other animal.

Lambs, immediately after they are weaned, are frequently sent to poor pasture, which is called *burning* them. Now this appears to be a very bad practice; for the consequence is, that they fall off considerably, before they get at the rich grass in the hog's fence, of which they eat too freely; and thus become disposed to the disease treated of. Children, and all domesticated animals, are carefully fed with nourishing food for a considerable time after they are weaned; and yet they fall off for some time. It would certainly be better to give the lambs the hogs fence at once, and use every precaution to prevent them from falling off.

As the disease is generally advanced to a dangerous height before it is observed, we fear that medicine affords but a very faint hope of cure. The disease being inflammatory, the shepherd should attempt to bleed the distressed creature as soon as possible; which he can easily do, by cutting off part of the tail, or by nicking it underneath, or by cutting off part of the ears. The animal should then be removed to a house or shed, and attempts made to produce evacuations. In brute animals, it is difficult to produce these by medicines administered by the mouth. The speediest and most effectual method, is by injections into the rectum or anus. Such injection may consist of a small handful of chamomile flowers, two spoonfuls of aniseeds, and as much caraway seeds; to be boiled slowly in a Scotch mutchkin or English pint of milk and water, until the half is evaporated. The liquor should then be strained off, and two tea spoonfuls of castor oil added, or if this is not at hand, the same quantity of sweet oil may be used. This should be administered warm by an injection bag and pipe, or by an elastic gum bottle with a pipe properly fitted. Nothing can be easier, than to give a sheep a clyster in this way; and in all probability it will have a happy effect in evacuating the bowels and procuring relief.

If this does not appear very soon, it may be repeated an hour after, and a large spoonful of common salt added to the former ingredients. If, after all, the animal does not seem relieved, another clyster may be given, consisting of a small tea cupful of warm milk and water, to which are added from 20 to 25 drops of laudanum.

As there is a great distention of the stomach and bowels, arising from airs or elastic vapours, generated in the intestines, Mr Walker of Cumberland, in a treatise he wrote upon the diseases of brute animals, has suggested a remedy for this disorder, which has often proved successful in his district. It consists in pushing down their throats a flexible tube, such as Dr Monro has recommended, and which has proved successful in relieving cows that had over-gorged themselves with red clover early in the season (see N° 405.). This seems a probable means of affording temporary relief, and every shepherd that has the care of the hog flock, should be furnished with one of these tubes, adapted to the size of the sheep, for trying the experiment upon those that labour under the disease.

"In regard to the quality of pasture (adds Mr Findlater) as a cause of *sickness*, Tweeddale farmers seem of opinion that it arises from the *foulness of the grass* at the root in the hogs fences, which are never eaten bare. Some, therefore, take care to have the land to be saved for the hog fence, once eaten as bare as possible early in summer, by the black cattle upon the farm, or by old sheep.

"It seems ascertained in Tweeddale, that land which has been in use to be pastured by older sheep, when converted into a hog fence, is not liable for some time to produce sickness. Two accidental experiments occurring in which this practice took place, in consequence of new arrangements in the farms of Harehop in Eddlestone parish, and of Lyne in Lyne parish, confirm this conclusion. It is farther confirmed by an experiment of Mr Murray, tenant in Flemington mill. About 20 years ago, he bought in different parcels of lambs for hogs, and laid them upon the hog fence of his farm of Broughton-haup, in Broughton parish. In one of the parcels of much higher condition than the rest, the sickness broke out to such extent, that they were dying at the rate of two or three daily; so that the whole parcel seemed in imminent risk. He transferred this whole parcel to the farm of Fingland in Newlands parish, where only old sheep were kept, putting them on some of the lower pasture of that farm, which had been hained for feeding the crock ewes, and transferring a proportional quantity of these ewes to Broughton-haup hog fence. Not one of the lambs died upon Fingland. To the same effect, it deserves attention, that in small farms, not admitting of distinct hirsling, where, of course, old and young sheep pasture mixed together, hogs are very little liable to sickness, though perhaps worse in other respects.

"From November at smearing time till Christmas (1797), two facts with regard to the mode of cure have been stated to me, and which I am disposed to think authentic. In the farm of Drummelzier, parish of Drummelzier, three hogs (out of four upon which the experiment was tried) recovered, upon bleeding, and having poured down their throats, a decoction of tobacco; about a finger's length of twist tobacco boiled in water till the water has diminished to a gill, being the dose for each. In the farm of Broughton-haup, parish of Broughton, within the same space of time, nine or ten (out of 16 or 17 upon whom the experiment was made) recovered upon bleeding, and having an injection of tobacco smoke administered from a common tobacco pipe, by kindling the tobacco, inserting the pipe shank into the anus, and blowing: the experiment, however, was not so success-

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ful in some later instances. I have long ago seen a ewe cured by bleeding, and injection of Glauber salts from a common clyster-bag and pipe. When braxy breaks out, it might be useful, where attainable, to lay the hogs, nightly, upon a dry ground, if the hog fence is wet, the chilliness of wet ground contributing no doubt to the production of inflammation. Clover foggage or turnips might be good preventatives, from inducing a lax habit*."

### II. DYSENTERY. *Molten-grease*, or *Body-founder*. *Break-shaw*, (in sheep). Gras fondu, Fr.

499 Dysentery, or molten grease.

Dysentery is the other disease that, with catarrh, forms Dr Cullen's order of profluvia; but as there are evident marks of inflammation of the bowels observed on inspecting the bodies of such animals as have died of this complaint, we have placed it immediately after inflammation of the bowels, in which we have followed M. Pinel and some other late writers.

This disease is not uncommon in the horse, and probably it is still more frequent in cattle and sheep. It very commonly begins with some degree of fever, as a trembling, dryness of the mouth, loss of appetite, a great degree of weakness, drooping of the head and ears, sometimes a copious sweating, but more commonly dryness and heat of the skin. There is usually a heaving of the flanks, and the animal turns his head towards them, as if griped. There are frequent dejections from the anus, but these seldom consist of the natural excrement, but of a mucous, slimy discharge, accompanied with a peculiar fatty substance, like soft suet. There is evidently much distress during these evacuations, and sometimes the fundament appears excoriated. It is not uncommon to see blood pass with the stools, generally in streaks, but sometimes in such a quantity as to tinge the whole discharge of a red colour; and in the latter stages of the disease there generally appear membranous, filmy substances, which have been compared to soaked leather. These substances have been supposed to be the inner membrane of the bowels that has been eroded and thrown off by the violence of the purging; but they are merely coagulable lymph, such as is very commonly thrown off from inflamed surfaces. The pulse, towards the beginning of the disease, is commonly hard and full, but as the complaint goes on, it becomes quick, small, and sometimes irregular. The animal is very stiff, and much averse to motion, and if the disease continues long, there usually comes on a swelling of the legs.

When animals that have died of this disease are dissected, the inner coat of the bowels is found inflamed, in some places covered with coagulable lymph, such as we have described as being thrown out in the discharge, and not unfrequently ulcerated in various parts, sometimes mortified and corroded.

This disease does not appear so dangerous among the inferior animals in this climate, as in warmer countries; but it sometimes proves fatal, or terminates in a weakness of the bowels and scouring, that are not easily removed. If the fever is but little or soon abates, if the animal appears not to labour under much pain, and if the discharge of natural excrement soon returns, the disease will probably terminate favourably in a short time; but if there is great pain and fever, with excessive weakness, and if the mucous discharges continue very frequent, and mixed with much blood, the danger is considerable.

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It is necessary to distinguish this complaint from the common purging or scouring, with which it is very generally confounded. It must therefore be observed, that in scouring, there is no fever, whereas this is common in dysentery; that the discharge in scouring, though thin, has almost always the appearance of excrement, is not bloody, and is scarcely ever mixed with fatty matter.

Dysentery is more common in hot weather, and in hot seasons, than at other times; but is very commonly produced by the sudden application of cold, especially to the legs or belly, while the body is overheated and fatigued: hence swimming in autumn, drinking large quantities of cold water while in a profuse sweat, or other sudden changes from heat to cold, have commonly produced it. It is said to be frequently brought on by riding a horse very hard in hot weather. Mr Lawrence says that when a boy, he rode a horse that had a great deal of loose grass flesh about him, 21 miles in a warm summer morning, and thus brought on an attack of *molten grease*. It is also not an uncommon disease among post horses.

From the appearance of the fatty matter in the discharge that takes place in this complaint, the older writers on farriery were induced to give it the name of *molten grease*, conceiving that a principal part of the disease consisted in a melting down of the fat of the animal, which being conveyed by the absorbents into the circulation, is thrown out by the exhalants on the bowels, and carried off with the dung. Mr Blaine laughs very heartily at this idea, and seems to pride himself on the discovery, that what has been mistaken for fat, is nothing more than an increased secretion of the mucus of the intestines, and is as liable to a horse with little fat, as to one with much. Mr Lawrence, on the other hand, argues strenuously that this matter is really greasy, and says, that "with respect to the evidence of sense, had Mr Blaine ever seen a horse under the discharge of molten grease, he might have found on experiment, that part of the discharge in question is inflammable and liquefiable, which are not the characters of albumen, but of real grease; and (continues Mr Lawrence) viewing the matter through the medium of experience, I can see no sort of improbability in a colliquation of loose, substantial, internal fat, by sudden inflammation, and its consequent effusion and discharge by an unusual emunctory. Gibson gives an instance which convinced him (apparently incredulous before) of the possibility of a horse's grease being melted. He found the fat melted and turned into an oil, and drawn off from its proper cells into the blood vessels. He says farther, this disease is not unlike the greasy diarrhœa which happens to men." Not having ourselves seen a case of dysentery in horses, we are not prepared to decide the difference between these two champions of the old and new school; but as Mr Lawrence is very worthy of credit in whatever has passed under his own observation, we have no doubt that this debated substance is of a fatty nature.

As it seems certain that dysentery is of an inflammatory nature, it is proper to begin the cure by bleeding, especially if the horse is plethoric, or if the pulse is full and hard. It will then be proper to clear the bowels by

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* Findlater's Survey.

by a laxative clyster, and to give internally a drench composed of five or six ounces of Glauber's salt dissolved in a quart of water-gruel, or the drench N° 26. of the receipts; and this may be repeated every three or four hours. This will probably, in the course of the day, produce a plentiful discharge of excrement, and when the bowels appear well cleared, the horse may have a warm mash, be covered up warm, and perhaps a perspiration will be brought on, which, if the disease is slight, will probably complete the cure. If the disease should continue, an English pint, or pint and a half, of castor oil may be given, and clysters, composed of water-gruel, or starch boiled in water, should be given warm very frequently. When by these means a pretty copious discharge of excrement has been produced, the horse may have a ball composed of two drachms of opium, and half an ounce of ipecacuanha, or a drachm of emetic tartar, washed down with a quart of good porter. If there is considerable pain, it may be advisable to foment the belly for half an hour at a time, with flannels wrung out of a warm decoction of poppy heads. During this treatment the horse should be kept clothed, and currents of air in the stable should be avoided. When the disease is subdued, as the horse will probably remain very weak, it will be proper to revive him by nourishing diet, and cordial and strengthening remedies.

The appearances of dysentery in cattle are not unlike those that occur in the horse, only that perhaps in them there is not so much of the *gras fondu*. The disease among these animals is commonly called *fardel bound*. The treatment is the same as above described.

This disease is not uncommon in sheep, by the name of *breakshaw*; but shepherds very commonly confound it with diarrhœa or purging. Mr Loch of Rachan very properly distinguishes between them, and observes that the *breakshaw* is analogous to dysentery in the human species, and occurs most commonly in the end of wet summers. The discharge is thin and greenish (Mr Loch supposes from the wet grass becoming acid in the stomach, and turning the gall green); it is more or less mixed with blood, sometimes florid, sometimes black and grumous; the animal pines for a week or two, and dies, though sometimes he recovers. The cure commonly employed by Mr Loch's herd, is warm milk poured down the animal's throat; but Mr Loch proposes to try, in addition to this, nitre in half drachm doses, with chalk or some other absorbent powder, and 20 or 30 drops of laudanum twice or thrice a-day, with frequent injections of warm milk and water. This plan seems best adapted to the latter stages of the disease. According to Mr Gillespie of Glenquich (quoted by Mr Findlater), this disease is often produced by overheating, when the sheep are hunted by dogs, in folding them, &c. or when otherwise scared and terrified. It is stated by Mr Gillespie to be considerably infectious; and he considers tarring part of the flock to be the best means of checking the infection, under the idea that the smell of the tar will overcome that of the contagion.

### 12. INFLAMMATION of the KIDNEYS. Nephritis.
### *Strain of the Kidneys.*

This disease is not uncommon among horses and cattle; but it is more frequent in the former, as they are more exposed to those causes that appear generally to produce it.

The symptoms of this disease in horses, are tolerably well-marked. The horse stands wide with his hind-legs, appears dull, and expresses considerable pain, often looking at his flanks. When pressure is made on his loins the horse flinches, and is evidently much distressed; the pulse is hard and full, and commonly more frequent than natural. When both kidneys are inflamed, little or no urine is secreted, and what little is evacuated is generally bloody; but when only one kidney is inflamed, the other continues to secrete urine, but the natural quantity is on the whole much diminished, and there is commonly considerable pain during the evacuation.

Inflammation of the kidneys is liable to be confounded with inflammation of the neck of the bladder; and the best means of distinguishing them, is to pass the hand up the fundament, by which the state of the bladder beneath may be easily ascertained. If the bladder be considerably distended with urine, the inflammation is almost certainly seated in the neck of the bladder; but if the bladder be shrunk and empty, the disease is probably situated in the kidneys. It must be allowed, however, that this mark of discrimination will not hold good till the disease of the kidneys is pretty far advanced, as it very commonly happens that when a gland is inflamed, its secretion is at first increased. At the commencement of the disease, therefore, the symptoms which we have enumerated, especially the sensibility which the horse evinces on touching his loins, are chiefly to be depended on. It must be remarked that one of the kidneys has been found diseased, and even purulent, after death, when it shewed no marks of inflammation during life. This disease is attended with considerable danger, and unless the inflammation be speedily removed, matter will be formed, which, if it does not pass off by the urinary pipes into the bladder, will find a passage into the belly, or behind the peritoneum, and produce hectic fever and consumption, or the kidney may mortify, and death will soon follow.

The kidneys may become inflamed, either from external injury, or from irritating substances that pass through them in the course of the circulation. Inflammation of these organs is frequently produced by placing the saddle too far back upon the loins, and riding hard for a long time while it is in this position. It is sometimes the effect of throwing cold water upon the body while it is in a sweat; but according to Mr Blaine and Mr Feron, it is most frequently produced by the indiscriminate use of strong diuretic medicines.

In the treatment of this disease, we must vigorously employ the means that we have so often recommended for the cure of internal inflammations; bleeding in its full extent, emollient clysters, and the production of external inflammation: but it is necessary in this disease to caution the practitioner against the use of blisters, as the matter of cantharides, when taken into the circulation, and carried to the kidneys, will considerably increase the inflammation and distress. A good substitute for blisters of cantharides would be, to pour hot water on the loins, so as to raise a blister on each side, which, however cruel it may appear, could not produce so much pain, as the animal already feels from the disease. It has

has been recommended, to excite a degree of inflammation in the external part of the loins, by means of firing; but probably the hot water will do as well, and is less painful. No medicine should be given by the mouth, that is in the least heating or irritating; and nitre, turpentine, balsam of copaiva, &c. so warmly recommended by most of the writers on farriery, would only serve to aggravate the disease. The horse may drink frequently of water gruel, linseed tea, or such other mild, mucilaginous liquors; and if he seems to require food, bran mashes will be the most proper article of diet. If there is much costiveness, purgative clysters may be given, or in cases of necessity, six or seven drachms of socotorine aloes in a ball. All exercise must be avoided, and the horse should have a good bed of litter, on which he may lie down when fatigued.

### 13. Inflammation of the Bladder. Cystitis.

502 Inflammation of the bladder.

The bladder may be inflamed either in its body, or in its neck, and the symptoms differ somewhat in these two varieties. When the body of the bladder is inflamed, there is produced such a degree of irritation, that the bladder becomes incapable of retaining its contents for any length of time; and the animal is perpetually making small quantities of urine. He also makes frequent attempts to dung. On passing the hand up the fundament, the bladder will be found very hot and sensible; and in this variety of the complaint, as in inflammation of the kidneys, it is empty and collapsed.

When the neck of the bladder is inflamed, there is at first a suppression of the urine, but afterwards it is continually passing off in drops; and on examining the bladder by the fundament, it will be found more or less distended, according to the continuance of the complaint. There is usually considerable fever in both cases. The pulse is hard and full at the beginning of the disease, but after this has continued for some time, the pulse becomes small and oppressed.

Inflammation of the bladder takes place more frequently in male than in female animals; but it is said to be sometimes produced in the latter, at least in mares, by passing some irritating substance up the urethra, in order to make them horsy. Both cases of this disease are attended with considerable danger; but the latter is generally the most dangerous; but in a mare a cure is generally easier than in a horse.

The treatment of this complaint differs little from that of the inflammation of the kidneys, and chiefly consists in bleeding, the frequent use of softening clysters, low diet, and the production of external inflammation by any other means than the use of cantharides blisters. If the bladder be found considerably distended, it will be necessary to evacuate the urine, either by the means of a catheter, which may be easily passed up in a mare, or by making an opening into the bladder; for performing which in the male, Mr Feron gives the following directions. "It happens that the urethra is so constructed, that it is not in our power to introduce an instrument immediately into the bladder, without performing an operation; for the urethra of the horse forms two curvatures or angles, before it reaches the bladder, and therefore it is not possible to introduce an instrument into the bladder, which will preserve its curvity all the way. We therefore introduce a staff of a pliable wood, or whalebone, to the angle at the os pubis, as near the rectum as possible with safety; we make a cut upon it, and then introduce the female catheter, or some similar tube, without however removing the staff to prevent our losing the incision, taking care to avoid the instrument's passing into the cellular membrane, instead of entering the bladder. If such an accident was likely to happen, it is adviseable not to attempt the operation, but to continue and insist upon all the emollient remedies.

"We may also puncture the bladder with a trocar, by the rectum, or through the inferior part of the abdomen.

"In either case we are likewise directed by Mr Coleman, to make the puncture as near the os pubis as possible, that we may not wound the peritoneum anteriorly. By this method the operation recommended through the rectum may be performed without exposing or opening the cavity of the abdomen *."

In the female an opening may be easily made into the bladder, with a trocar, introduced by the vagina. It has been recommended in the mare to throw up an injection of some oily or mucilaginous fluid, to supply the place of mucus, in sheathing the bladder from the irritation of urine. As in the inflammation of the kidneys, every thing that can heat or irritate the urinary organs must be carefully avoided.

### 14. Cords.

503 Cords.

It is well known in most breeding countries, that a great many calves die every year, of an unknown disease, with which they are affected very shortly after birth. The common name which this disease receives in Scotland, is *the cords*; and while its fatal and widely extended effects are the subject of just regret, the disease itself is looked on as incurable, and no pains are taken to investigate its nature, symptoms and causes, and no remedies suggested as a cure or preventive. Whatever be its nature, this disease is exceedingly dangerous, and so extremely rapid, (terminating frequently in a night's time), that all means of relief are commonly useless even before it is observed.

Almost all calves, that are said to have died of *the cords*, appear, when they are opened up, exceedingly red, and the small leaders, or ligaments, are considerably swelled, and have some resemblance to strings passing through the internal parts, from which probably the disease has its name. Every symptom indicates a considerable degree of plethora, if not a very high degree of inflammation.

It is commonly observed, that calves are most liable to be affected during the first days, or weeks, after they are calved. If they outlive five or six weeks, they are seldom in any danger.

Calves that suck their mothers, we believe, it will be found, are not so liable to the disease, as those who are fed by the hand.

The greatest number of calves who fall a sacrifice to this disease, if not the whole of them, are those who are closely confined to the house from their birth, without ever being exposed to the free open air without doors. It is a well known fact, that calves who are dropt without, and remain in the fields, are in little or no danger. Cows that are laid on to graze for beef frequently turn out to be in calf; and it is no uncommon thing to see them drop their calves in the midst of frost and snow, and yet these

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* Feron's Farriery, p. 119.

these young creatures, if they can once get to their feet, without being frozen to the ground, are hearty and well. Calves, lambs, and foals, require exercise and fresh air; and nature directs them to take a great deal. It is astonishing to see with what force and vigour, (particularly the calf), and how long, they will run. But this free, unconstrained, and severe exercise without doors, seems to be the very thing that makes them thrive, and to be necessary to their very existence *.

The great object is to prevent this disease; and the following method of treating the new-born calves, practised by a correspondent of the Farmer's Magazine, seems to be attended with complete success.

The time when this gentleman's cows are bulled is regularly noted down in a book; and when they are near calving, they are watched frequently night and day. As soon as the calf is dropped, it is received into a large basket or skull, made of willows, with a handle at each end, and plenty of clean straw in it. It is then carried by two persons to the stall in the calf-house, where it is gently rubbed with straw. The calf-house is next to the cow-byre; and is fitted up with stalls like a stable, about three feet wide, and about five feet long. Every stall shuts in by itself, with a door and hinges, for fear of the calf lying back too far, to choke itself in its binding. As soon as the mother has had a little rest after calving, she is milked, and a little of the milk given to the calf as early as possible. If the weather is cold, and the mother long in giving milk, it is taken to the fire, and warmed in a pan until it is blood-warm, and then given to the calf; about six or eight gills, according to the size of the calf, and repeated four times in 24 hours. As the calf gathers strength, the quantity may be increased; but too much milk at one time is as bad as too little, until it is a month or six weeks old. When the calf is able to stand, it is tied to a stake; as it is more in the power of the servants to give it milk in that situation, than when going about loose. If a calf gets cold milk, it is sure to bring on a trembling: and the *cords* or some other malady follows; which he has often seen exemplified amongst the neighbouring young stock †.

### 15. Farcy. Le Farcin, Fr.

504 Farcy. We shall conclude this chapter with a brief account of two diseases; or rather, as it should seem, of two modifications of the same disease, that frequently take place in the horse, to whom they are almost peculiar; though something like them is occasionally found in other animals. We shall hereafter take notice of what farriers call the water farcy, which we consider as similar to *anasarca* in the human body; but the disease we are about to describe, appears to be rather a peculiar inflammatory affection of the absorbent vessels below the skin. There seem to be two varieties of farcy, acute and chronic; or rather a mild and a malignant variety.

The commencement of farcy appears to be rather obscure, and probably it is seldom observed in the beginning of the inflammation. The first appearances that are described by writers, are a number of swellings that rise in almost every part of the body, particularly the head, neck, and extremities. The lymphatic vessels below the skin appear like knotted cords; and this appearance is found to be owing to a distention and inflammation that take place in these vessels, especially at their valves, where the knots are produced. As the disease proceeds, these knotted swellings burst, and ulcers are formed which are very difficult to heal. The formation of these ulcers may be considered as terminating the mild stage, and commencing the malignant form of the disease; in which the horse loses his appetite, grows lean and weak, and commonly has a degree of hectic fever. If the progress of the disease has not been arrested, a swelling takes place in the head and nose, and there comes on from the latter a copious discharge of a peculiar glairy mucus, which shews that the disease has degenerated into *glanders*, under which name we shall proceed to describe it; and shall afterwards consider the nature, causes, and treatment of both.

### 16. Glanders. Le Morve, Fr.

505 Glanders. According to Mr Blaine, the usual symptoms of *glanders* are an increased secretion of the mucus of the nose, which is at first thick, and like the white of an egg. He has seen it continue so, while at other times it becomes purulent; but there is usually a degree of viscidity and glueiness about the matter, that as it were fixes the sides of the nostrils together, and is strongly characteristic of this disease. On examining the nostrils, there may generally be perceived a number of ulcerated surfaces, very similar to shankers that occur in the venereal disease. These ulcers do not always appear soon; but they are produced in all virulent cases, and never fail to appear when the disease terminates fatally. They are at first small, and disposed in lines along the lymphatic vessels; but as the ulceration proceeds, it becomes more extensive, till the whole inner surface of the nostrils is affected, and at length the bones of the nose are affected, and become carious. When the ulcers have continued for some time, the matter changes its glairy appearance, and becomes bloody and offensive; and this is more particularly the case when the bones become diseased. In the latter stages of the complaint, the emaciation and weakness of the animal are greatly increased; he becomes affected with a short tickling cough; the hair grows dry and harsh, and falls off on the slightest touch, and thus the horse gradually pines away.

Sometimes only one side of the head is affected, but more commonly both at the same time.

The best account of the appearances of glanders on dissection, has been given by M. Chabert, in a work which he published in 1785, on the means of ascertaining the existence of glanders, and of preventing their effects. From the numerous bodies which he opened, M. Chabert has drawn up the following general account of the morbid appearances.

The lungs are generally more affected than any other of the viscera; we find them often swelled and filled with hydatids, tubercles, and obstructions. The bronchial glands are very often swelled and ulcerated, and this is sometimes the only injury that we can perceive on dissection. The membrane that lines the bronchia and the wind-pipe, is most commonly inflamed and ulcerated; the bronchia are filled with a thick matter, that commonly resembles what the animal discharges by the nostrils. The internal surface of the bones that form the different cavities of the nose, and the gristly partition of the nostrils, are often carious, and covered with purulent matter; and the membrane which lines the

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* Farm. Mag. vol. iv. 59.

† Ib. p. 296.

nostrils is ulcerated. The spleen, the liver, and the kidneys, are also sometimes considerably diseased; and the ulcerated state of the kidneys, not unfrequently appears during life, by the purulent matter that is discharged with the urine. On opening the head, we sometimes find the brain softer and more flaccid than in a healthy animal. There is often a great quantity of serum in its cavities, and the glands are much swelled.

The glanders is liable to be confounded with several of those diseases, in which an unusual discharge proceeds from the nostrils; as catarrh, strangles, and consumptions; but chiefly with the two former. It may be distinguished from catarrh, by the absence of fever in the early stage; by the matter discharged from the nostrils being thick and glairy from the first; whereas, in catarrh, there is almost always considerable fever in the beginning, and the discharge is at first watery. In a common cold the general health is also more or less affected, and from the first there is usually a cough and loss of appetite; whereas, these symptoms scarcely ever come on in glanders, till the disease has subsisted for a considerable time. Glanders may be distinguished from strangles by the high fever which commences the latter, and by the swelling and speedy suppuration of the glands of the mouth and throat.

506 Of these two affections, glanders is the most dangerous; as farcy, when taken at its commencement, may frequently be removed; but we believe the instances of a perfect cure in glanders are very rare.

The causes of these complaints are very obscure. It is said that farcy may be brought on by the same causes that predispose to mange, as want of cleanliness, hard work, and low diet; and there is no doubt that this disease, as well as glanders, is contagious. Glanders, besides being produced by contagion, may also be the termination of several disorders, as of catarrh, strangles, and consumption, however different from these diseases in their commencement.

The nature of glanders is not well understood, although, of late, many ingenious men have investigated the subject, and made considerable discoveries. It is not certain when the disease was first known. Mr Lawrence dates it from the same period with the *Lues Venerea;* but there seems no doubt that the disease was known to the ancients, though we do not know by what name it was called. Vegetius speaks of a disease which he calls *humiditas*, which Mr Blaine supposes to be the same with our glanders; but which the learned Camper considers as analogous to the murrain, see N° 466. Blundevil, and after him Markham, give the following description of its rise, progress, and completion. "Of cold first cometh the pose, (that is stoppage of the head), and the cough, and then the glanders, and last of all the mourning of the chine." The two Messieurs Lafosse, made, as we have seen, several discoveries with respect to glanders, especially the father, who, in 1749, demonstrated before the academy of sciences at Paris, that the seat of the disease is wholly in the pituitary membrane; and he proposed curing it by injecting the whole of this membrane through openings made with the trepan, into the frontal, nasal, and maxillary sinuses. Lafosse divided the disease into several species; but it appears that all these may be reduced to two, the mild and malignant, or the chronic and acute; the chronic being that in which the running of the nose is trifling, and of a transparent colour, with no appearance of ulceration in the nostrils; while in the acute or malignant variety, there is considerable ulceration; the discharge is very offensive; there is a swelling below the under jaw, and the bones of the nose are carious.

The best of the English writers on farriery appear to have known little or nothing of the disease more than the symptoms. Dr Bracken considered it as not contagious, and Gibson gives but a poor account of it, for which he seems indebted to Snape.

"The late professor of the veterinary college (says Mr Blaine), published his remarks on this disease; but it is evident that he knew little or nothing relating to it, but what he gained from Lafosse, and consequently his opinions offered nothing new. The present professor has prosecuted the inquiries relative to it much farther, and by an extensive course of experiment has thrown very considerable light on the nature of the disease; and though we are not yet much more successful in attempts at the cure, yet we have less reason to despair. By Mr Coleman's experiments it is proved beyond a doubt that farcy and glanders are specifically the same disease, but affecting different parts: to establish this, horses have been inoculated with the matter of farcy, and glanders has been produced; which put the matter beyond a doubt. Farther, Mr Coleman produced glanders in a sound animal by the inoculation with the matter of glanders. This M. St Bel asserted could not be done. Farcy has likewise been produced by the same means, but it appears that it was some time before it could be effected; but it has been produced by Mr White. It cannot therefore be inferred, that because the farcy and glanders are so different in their apparent situations they are distinct diseases: every poison has its preference of parts; and likewise the same poison, under different modifications, affects different parts.

Mr Coleman is of opinion, that in glanders, the whole circulating fluids are affected. To prove this, he bled an ass from the jugular vein till he was to all appearance dead, when he introduced the blood from the carotid artery of a horse labouring under glanders, till the ass was reanimated. In a few days the most malignant glanders appeared. I believe another ass was inoculated from this, which became glandered. This experiment, I think, (adds Mr Blaine), throws great light on this complaint, and indeed on pathology in general; and we may hence be led to hope, that internal remedies may be more useful than external, which have been thought to be the only means by which we could hope for a cure; for provided we could destroy the poison existing in the blood, and keeping up the action in the part; the action, or at least the specific part of it, might cease in the affected part, and we might induce a healing process by the usual means. As such, our only hope must consist in exciting a new action in the system, whereby the glanderous one will be suspended, till by the continuance of the new action the virus of glanders is completely expelled by the change the fluids naturally undergo*."

The treatment of these diseases will differ according to their state and degree of malignity. For the cure

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* *Blaine's Outlines*, vol. ii. p. 625.

iseases.

of farcy, blisters are much extolled by Mr Feron, and the actual cautery is very generally employed to destroy the swellings of the lymphatics, and to excite these vessels into greater action. To assist this purpose, diuretics are to be administered, and the horse should take as much exercise, especially draught labour, as he will bear without considerable fatigue. Two remedies have of late been employed internally, when the system becomes considerably affected; these are verdigrise, and corrosive sublimate. Mr Feron directs the former to be given in the following manner. A ball composed of one drachm of verdigrise, and a quarter of an ounce of common turpentine, is to be given every night and morning, gradually increasing the quantity of verdigrise till the horse can take from three drachms to half an ounce in the course of the day. If the animal becomes costive, he is to have a clyster night and morning, and a purgative ball of seven drachms of aloes, and half a drachm of calomel, once a week. After having gone through a regular course of physic, he is to have the following balls. An ounce of green copperas (E) in powder is to be mixed up with Venice turpentine, and a sufficient quantity of linseed powder, to make eight balls, one of which is to be given every morning, while costiveness is to be avoided as before directed.

In giving the corrosive sublimate, we should begin with a small dose (see STIMULANTS), and gradually increase it so long as the stomach will easily bear it. As mercury in some form seems to be the best remedy that can be employed in these affections, calomel, or the common blue pill, may be given instead of the corrosive sublimate, if the latter should occasion much disorder, or if the horse is very much weakened. During this course the animal must be supported by nourishing diet, but should frequently have a change of succulent vegetable food. Mr Blaine speaks of a horse that was so far reduced (by glanders, we suppose) as not to be able to stand, and who was drawn into a field of tares, and suffered to take his chance; the consequence was, that when he had eaten all within his reach, he was able to rise and search for more, and eventually recovered.

The treatment recommended above has, it seems, often been successful in farcy, and the same internal remedies have been recommended in glanders, but we believe they have been employed with little success. Mr Feron advises to draw blood in the beginning of glanders, while the disease is still local, and to keep the animal upon warm mashes of bran, putting the same into a nose-bag, for the purpose of fomenting the nostrils. He is then to go through a course of gentle physic, while strict attention is paid to the necessary direction of the food, exercise, dressing, cleanliness, and water. The water must be always warm, and made white with bran or gruel. After this course, he recommends balls made of opium, arsenic, and sulphur, or of extract of hemlock, calomel, &c. avoiding costiveness during their exhibition. He thinks it necessary to insert two rowels, one below the under jaw near the swelling, and another under the chest; and he recommends frequently syringing the nostrils with a lotion made of two ounces of spirit of wine, and the same quantity of vinegar, mixed with a gallon of water; or with a solution of corrosive sublimate. According to this gentleman, if the disorder is attacked in its infancy, it will generally submit to the above course of treatment; but if the disorder is so far advanced as to exhibit the symptoms of virulence, which we have described as constituting the acute or malignant stage of it, it will increase in opposition to all art, and it will be necessary to take away a life that every degree of assiduity would not render worth preservation.

Diseases.

As the farcy is probably contagious, and the glanders in most cases is certainly so, it is proper, as soon as a horse is affected with either of these diseases, to keep him in a separate stable, and to take care that he does not come near any other horses: and no part of his harness, or furniture, should be used for any other horse, till it has been well washed with soap and water, and exposed for a long time to the pure air.

Glanders is considered by Dr Darwin, and some other writers, as a contagious catarrh, and in some cases it certainly is so; but when it is the consequence of farcy, or of dangerous chronic diseases, it appears to be an affection of a peculiar kind. Mr Lawrence considers the glanders as so perfectly incurable, that he recommends the *collarmakers knife* as the easiest, cheapest, and most infallible remedy.

## CHAP. III. *Of Lethargic or Comatose Diseases.*

507 Apoplexy or staggers.

### 1. APOPLEXY. Vertige, Fr. *Staggers*, *Sleepy Staggers*, *Lethargy*, or *Vertigo*.

STAGGERS is one of the most comprehensive terms in farriery; and under it are confounded almost every affection of the brain, or all those diseases in which there take place giddiness, unusual heaviness, drowsiness, or convulsions. We have already seen the term applied to inflammation of the brain, and we have no doubt that many cases are described as *staggers*, which are really instances of *epilepsy*. Of this kind we consider the case so humorously related by Mr Lawrence in his treatise on horses, vol. ii. p. 406. "Walking up Fleet-street, I observed a crowd of people wonderfully diverted with the agonies of a cart-horse beating himself almost to pieces, in, I think, the most violent convulsions I ever witnessed. He threw himself repeatedly upon the foot-path, and was very near going headlong into a shop," &c.

Mr Feron, who in general keeps very clear of the errors of ordinary farriers, which he often ridicules with much success, has confounded *inflammation of the brain* and *apoplexy*, under the general name of *staggers*, considering them as both inflammatory, and merely modifications of the same disease. Even Mr Blaine, who, as Mr Lawrence expresses himself, seems upon every occasion eager to catch the *dernier goût* of science, has described

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(E) Mr Feron directs green *copper*: but we suppose this is merely a typographical error, for copperas, or sulphate of iron; and we have therefore ordered it by this name, as sulphate of iron is a good tonic, and may be very properly employed in this disease.

described staggers under the name of *lethargy*, and does not even mention its identity with apoplexy in the human body.

We consider *staggers*, properly so called, as the same with *apoplexy;* the appearances, the causes, and the treatment of both are the same, making allowance for some slight variations in the structure and economy of the different animals whom they affect.

This complaint sometimes comes on suddenly; but in general it is preceded by symptoms that mark a considerable determination of blood to the head, such as heaviness, drowsiness, insensibility, (see N° 317.) occasional fits of giddiness, (see N° 318.) and partial blindness, (see N° 321.). There seems no doubt that the horse is sometimes affected with headache, which appears by the animal's hanging down his head and drooping his ears, by the eyes being dull and watery, by dropping of urine, and costiveness. These symptoms often precede an attack of apoplexy, though they are sometimes only signs of a disordered stomach.

When a fit of staggers comes on, the animal falls suddenly, and is perhaps convulsed for a few minutes, but more commonly appears quite insensible. The pulse during the fit is usually slower than natural, and much oppressed; the breathing is slow, heavy, and laborious, and there is evidently an increased accumulation of blood in the vessels of the head. The animal remains for a longer or shorter time in the fit, and sometimes he never recovers; but, in general, in eight or ten minutes the fit goes off, and the animal rises. Sometimes after a fit of the staggers, the animal appears for a time more active and lively than before; but very often he remains heavy and sleepy, especially after repeated attacks, and sometimes a paralytic affection of some of the limbs is the consequence of the fit.

*Apoplexy* may be distinguished from inflammation of the brain, by the fever, restlessness, and fiery appearance of the eyes, that never fail to usher in the latter complaint. We would distinguish it from *epilepsy*, by the foaming at the mouth, and strong convulsions, by which this latter is always accompanied.

An apoplectic fit may be the consequence of an overloaded or otherwise disordered stomach; and is no uncommon termination of several diseases, as *epilepsy*, *locked jaw*, &c. But it is generally the consequence of too much fulness of blood, brought on by a full diet, attended by idleness or want of exercise. It is more common to old than to young animals, especially such as have large heads and short necks. For the immediate and many of the exciting causes of this complaint, see APOPLEXY, MEDICINE *Index*.

A fit of apoplexy is often produced in an animal that is predisposed to it, by some sudden or violent exertion, such as drawing a heavy load, &c.

The means of preventing apoplexy when an attack of it is threatened, have been already explained (in N° 317, 318, and 407.). When a fit of *apoplexy* takes place, if the animal is full of blood, which generally happens, it will be proper to bleed, from the temporal artery, or jugular vein, to an extent proportioned to the state of the animal. If the animal appears weak, bleeding should not be attempted; but the determination of blood to the head may be effectually checked by making pressure upon the *carotid artery*, taking care at the same time, not to include the jugular veins. Mr Coleman recommends tying up the carotid arteries in dangerous cases of staggers, and Mr Feron says, that he has often repeated this experiment with success. The bowels should be emptied in the usual manner, as soon as possible; and a strong stimulating clyster should be injected. When the animal comes to himself, if fat and plethoric, he should have a good strong purgative ball, and afterwards some gentle diuretic medicines. He should be kept quiet for some hours after the fit; but when the physic has properly wrought, he should have gentle exercise, which must be gradually increased, according as he is able to bear it; and great care should be taken to keep the bowels open, and to prevent too great an accumulation of blood.

### 2. PALSY. Paralysis. *Thortor-ill*, (in sheep.)

508 Palsy. The inferior animals sometimes become *paralytic*; and we have seen that a palsy in the hind legs is one of the principal symptoms of the *distemper* in dogs. A paralytic disorder is not uncommon among sheep, and is called by the shepherds the *thortor-ill*. It sometimes arises from their having eaten some poisonous or narcotic plants, but is very generally the effect of great weakness produced by want of proper nourishment. The best remedy seems to be white vitriol, given three times a day; and the food should be of the most wholesome and nourishing kind.

We had intended in this chapter to consider pretty much at large, the various cases of suspended animation, or *asphyxia*, such as *drowning*, *hanging*, *suffocation* from fixed air or other noxious gases, as *torpor* from cold; but this article has already swelled to an unexpected length, and we have yet much important matter on our hands. We must therefore refer our veterinary readers to the article MEDICINE; as the means to be there directed for restoring suspended animation in man will, with some little modification, apply to similar cases in the domestic animals.

## CHAP. IV. *Of Spasmodic Diseases.*

### 1. LOCKED JAW. Tetanus. *Stag-evil.* Mal de Cerf.

509 Locked jaw. IT has been remarked in N° 10. that horses are extremely subject to the locked jaw, which proves one of the most obstinate and fatal diseases by which they are affected. It seems also occasionally to appear among cattle, but it occurs to them much less frequently than to horses. We do not know that any writer has described this disease in the horse better than Mr Gibson, whose description we shall therefore copy, though it is expressed in rather an uncouth style.

"As soon as a horse is seized in this manner, his head is raised with his nose towards his rack, his ears pricked up, and his tail cocked, looking with an eagerness, as an hungry horse when hay is put down to him, or like an high-spirited one, when upon his mettle; in so much that those who are strangers to such things, when they see a horse stand in this manner, will scarce believe any thing of consequence ails him; and I have seen such persons greatly surprised when they have been told of the danger. But they are soon convinced, when they see other symptoms come on apace; that his neck

grows

grows stiff, cramped, and almost immoveable; and if a horse in this condition lives a few days, several knots and ganglions will rise on the tendinous parts thereof; and all the muscles, both before and behind, will be so pulled and cramped and stretched, that he looks as if he was nailed to the pavement, with his legs stiff, wide, and straddling; his skin so tight on all parts of his body, that it is almost impossible to move it; and if trial be made to make him walk, he is ready to fall at every step, unless he be carefully supported; his eyes are so fixed with the inaction of the muscles, as gives him a deadness in his looks. He snorts and sneezes often, pants continually with shortness of breath; and this symptom increases till he drops down dead, which generally happens in a few days, unless some very sudden and effectual turn can be given to the distemper.

This disease is generally primary or idiopathic; but it is sometimes symptomatic. The pulse is not always much affected; there is seldom any fever, and the internal functions are seldom impaired till towards the latter stages of the disease.

We have not many accounts of the appearances that have been discovered on dissecting horses which have died of this disease. In two dissections by M. Huzard, the bowels within the belly, especially the stomach and large intestines, were considerably inflamed; the liver was full of black and fluid blood, and in one case a considerable quantity of blood had escaped into the cavity of the belly; the substance of the liver was very tender, as if it were decomposed or rotten. The other viscera of the belly, and the heart and lungs, were in their natural state. On opening the head, considerable marks of inflammation appeared in the brain, the *choroid plexus* was distended with blood, and in one case the maxillary and frontal sinuses of the right side were full of black blood; the *dura mater* was inflamed, and its vessels, as well as those of the brain, were turgid with blood; the ventricles of the brain contained a quantity of serous fluid. In one of the cases the inflammation had extended even to the periosteum on the right side, which was much redder than that on the left.

It is difficult to say whether the disease depended on an inflammatory affection of the brain, or whether this was the consequence of the violent spasmodic contraction of the muscles during the height of the disease: but we are inclined to think the latter was the case.

Instances of recovery from this disease in horses are very rare; we shall presently give one from Mr Gibson, which is rather remarkable. A cautious opinion ought therefore to be given in every case of locked-jaw.

This affection may be produced by various causes, particularly from wounds, where the nerve is partially divided; from cold, when the body is in a profuse sweat. It may arise also from internal irritation, as from worms, which, in Mr Gibson's opinion, are a very common cause of it. Probably it more frequently proceeds from wounds, as a puncture in the foot or any other part; and it has certainly often been brought on by the barbarous operations of *docking* and *nicking*. There seems no doubt that the brain is the principal seat of the affection.

In the treatment of locked jaw, it is necessary to use some vigorous measures as early as possible; but unhappily no method hitherto adopted has proved successful, even in a few cases. Opium, aconite, hellebore, &c. have been tried in the veterinary college in very large doses, but without any beneficial effects. From considering it as a disease of the brain, trepanning has been used, with the view of making pressure on the brain, and this has sometimes appeared to take off the spasm of the muscles; but as soon as the pressure was removed, the spasms returned with nearly equal violence. An infusion of tobacco, to the amount of two pounds, has been given by Mr Coleman, but the symptoms appeared to be aggravated. Mr Feron recommends bleeding, and immersing the animal in a warm bath at 90° of Fahrenheit, so as to keep the whole body covered with the water for two or three hours, which he has known to be successful; but the horse must afterwards be clothed and kept very warm. The most probable means to relieve the animal seem to be giving opium in large doses by way of clyster, frequently repeated, and rubbing the whole body frequently with some stimulating liniment, such as oil of turpentine and tincture of cantharides. Mr Blaine recommends a clyster composed of a strong decoction of poppy heads, with two ounces of camphire dissolved in brandy; or if this be thought too expensive, one with two ounces of spirit of hartshorn and four ounces of oil of turpentine, mixed with two or three yolks of eggs, and a pint of ale. The cold bath is found one of the most effectual remedies in the human body, and we should conceive that it is more likely than any other means to do good in the horse; but it will be necessary to rub him as dry as possible after throwing the water over him.

If it is ascertained that the disease proceeds from a punctured or lacerated wound, it will be proper immediately to scarify the wounded part, so as, if possible, completely to divide the affected nerve, as in some cases where this has been done, the spasms have been removed. It must be confessed, however, that even this has frequently failed. If it has proceeded from a punctured wound in the foot, Mr Blaine thinks it advisable to take up the nerves of that foot on each side; for though this might occasion temporary lameness, yet, if the horse were saved, this might be removed in a few weeks.

510 Case.

The following case related by Mr Gibson, in his last work on the diseases of horses, is very instructive; even though it should be contended that the cure was effected by nature, and not by Mr Gibson's remedies.

A young troop horse was suddenly seized with this kind of convulsion, which was first discovered as he was leading out to water, at the afternoon's watering time. "I happened, (says Mr Gibson), to be then present, and perceived him come reeling along with his nose turned out, his eyes fixed and immoveable, with all the other signs that usually attend this fatal distemper; and when he came to the trough he could not reach the water because of the cramp and stiffness of his neck; and when it was held to him in a pail, could not drink, though he shewed an eagerness for it; his mouth being shut up so close, that it was scarce possible to put a knife between his teeth. When we found it impossible to administer any kind of medicine, till by rubbing his cheeks, jaws, and temples, and his whole neck, for a considerable time, we made a shift, with great difficulty, to thrust down part of a calomel ball, on the end of a small stick, and then to put into his nostrils a very small portion of a strong cephalic drink, thinking by that means

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to convey the ball downwards into his stomach, which however had but little effect, any farther than this, that he had not such sudden fits and agitations as I have seen in others in the like circumstances, but continued more quiet; neither did his fever increase, as usually happens when the distemper is gaining ground; but all this while his mouth continued so much shut, that he could neither eat nor drink for three weeks; only by continually rubbing his jaws and neck, he would sometimes make a shift to suck a handful of scalded bran, or sometimes a little oat-meal, moistened with warm water; but in so small a quantity, that it is possible he might have starved, if other methods had not been taken to keep him alive.

"I have often observed that the forcing the jaws open by violent means, puts a horse into such agonies, that it rather increases than abates the symptoms; and therefore I contrived to give him both food and physic by the fundament, through a pipe fourteen inches long, by which he seemed to receive great benefit; for we could perceive the symptoms to abate daily. His flanks grew more quiet, he stood more still, and free from sudden fits and startings; all which symptoms are usual in the continuance and increase of the distemper. The clysters were contrived in the following manner.

"Rue, pennyroyal, and chamomile flowers, of each a handful; savin and box, of each a handful; garlic, an ounce; castor and assafœtida, of each half an ounce.

"In making this clyster, the herbs are to be boiled first, in two quarts of water, in a covered vessel, the space of ten or fifteen minutes, with the castor and assafœtida cut in small pieces, and tied in a rag; not only to save the castor from waste, but that it may be squeezed into several clysters. Then the garlic to be added and continued, close covered, over the fire the space of ten minutes longer; after this the liquor to be poured off into a pan, or any other convenient vessel; then add of linseed oil and treacle, of each four ounces, with half an ounce of unrectified oil of amber; the treacle and the oils are to be mixed with the decoction, when it is put into the bag.

"This clyster was repeated once a-day for a fortnight; and by way of diet, was given every day three or four quarts of milk, boiled with oat-meal and water, a bag with a long pipe being left in the stable for that purpose. He retained every thing that was administered that way, which he generally sucked up of himself without force. This perhaps was in some measure owing to the nature of this universal convulsion, which causes such irregular motions in the midriff and muscles of respiration, as in some measure inverts the natural motion of the guts; and for the same reason horses in this condition seldom dung, but stale often; and when they dung, it drops from them in a manner insensibly, and often no more than one or two balls at a time: and therefore as this horse could receive little or no sustenance by the mouth, I was determined to make trial how far he might receive nourishment by way of injection backwards; whether a thin diluted food thrown into the straight gut, and from thence over into the small guts, by the help of a long pipe, might not find a passage into the blood through the lacteals, especially the experiments of this kind made on the human body, both in administering food and physic, particularly in giving the bark, by way of clyster, in agues and intermitting fevers, which has been found successful where the stomach was not able to bear its austerity. It was upon this footing that I treated him in the manner I have described, which I imagined was not altogether without effect; for he scarce ate in three weeks what was sufficient to sustain him one day; so that it was impossible for him to have lived, had he not been supported by what was thrown into his bowels; and though by this means he lost his flesh very sensibly, yet he still retained a good deal of vigour and vivacity. He had two men constantly to look after him, and these relieved by others, who had orders to rub his whole body often, which greatly helped to relax his skin, and remove the crampness of his muscles; and though he had not for the first fortnight recovered the use of his jaws, yet we observed him daily to move with less stiffness, and often to lick in his manger, as if he craved after food. He also breathed with less difficulty, and had several other good signs. This encouraged me to try another experiment with opium, from the known quality of that drug in relaxing the animal fibres; which I therefore thought might be of service to remove the contractions of the muscles about his mouth and jaws, which all this while continued in some measure obstinate, and, without some powerful relief, might prove fatal, even though the original cause was in a great measure taken away; therefore I caused an ounce of crude opium to be dissolved in one of his clysters, which was followed with these circumstances, that the horse soon lay down, began to point his ears backwards and forwards, and could move his neck pretty freely, and his mouth was so far at liberty, that he took his drink with little or no difficulty, and could eat hay and bran sufficient to sustain him. He likewise moved his whole body so readily, that we could walk him an hour every day; and that I might follow what I imagined had been so successfully begun by the opiate clyster, I ordered him some days after an ounce of the common Matthew's pill, which contains about two drachms of opium, and the same quantity of assafœtida, made into a ball, which was given at his mouth, and washed down with a hornful of gruel, which was done with great ease, his mouth being grown pretty pliable. This ball being once more repeated, he recovered daily, being continued for some time in the use of the drinks, which were now administered only twice a-week, with a good rubbing; and as soon as he began to recover his flesh, he was gently purged. By these means he was perfectly cured, without any other ill effect than a blemish upon one eye, caused by the violent and strong contraction of the muscles during the convulsions, which indeed were as bad as any I ever saw, even where they proved the most fatal."

We have related the above case thus particularly, in the author's own words, because we have scarcely ever seen a case of locked-jaw in horses so well described, both as to its progress and treatment. Whatever might have been the cause that produced the complaint in this horse, it was evident that it did not depend upon any congestion of blood in the head, and Gibson judged very properly in not employing bleeding, purging, and rowels, which appear to have been the indiscriminate practice of farriers in his time; and which might be very proper where the convulsions proceed originally from

from the head. Gibson says, that he has seen the farriers in such cases put a rowel on each side of the neck, one on the belly, one on the forehead, and one on each side. It appears, however, that this practice met with but little success, as in this complaint the skin is drawn so tight in all parts that the rowels seldom suppurate kindly, but very commonly produce a mortification, and thus increase the animal's distress.

### 2. Epilepsy, or Falling-sickness. *Convulsions.*

We have already stated our opinion, that several cases that are commonly called staggers are really instances of epilepsy, and we have no doubt that several strange convulsive disorders that are described as affecting domestic animals may be referred to the same head. Of this kind we consider the skipping complaint among lambs described by Mr Lawrence; "I remember in former days, (says he), on the borders of Suffolk, several scores of lambs were seized with an uncommon malady, leaping and jumping about the fold-yard in a strange manner; and a dung-heap being raised to the level of the eaves of a low-tiled barn, a number of the lambs ran skipping up to the top of the roof, as though they had been possessed by more devils than Mary Magdalen, or even the nuns of Loudun. The whole parish wisely concluded they were bewitched, and a wretched and aged pauper became the object of their suspicions and their deadly hatred. I do not precisely recollect, but I fear the brutal, senseless, and infernal supposed preventive of witchcraft was recurred to, burning one of the poor animals alive." We should be disposed to account for so many animals being seized with it at once, on the principle of imitation, just as we have seen a number of children at school fall into fits from seeing one of their number affected with epilepsy. The treatment of this complaint must be regulated by the state of the body at that time. If this is plethoric, bleeding, purging, and low diet, will be necessary; if it is weak, a strengthening plan must be adopted.

### 3. Canine Madness. Hydrophobia. *Rabies Canina.* La Rage, Fr.

Of this most dreadful malady, the nature of which is so little understood, and of which the cure still remains a desideratum in medicine, the accounts hitherto given are very imperfect.

Our principal object should certainly be to ascertain the origin and progress of the symptoms, as they appear in the dog, in whom the disease appears to originate. The account of these symptoms, as given by different authors, is exceedingly contradictory. The best account that we have seen is that of Meynell of Querndon in the county of Leicester, and which is published by Dr Arnold in his account of a case of hydrophobia. Before we give Mr Meynell's view of the symptoms, we shall quote a passage from that part of Mr Lawrence's treatise on horses, in which he speaks of canine madness. The passage is as follows. "The diagnostics of canine madness are, hunger and thirst, without power to eat or drink; trembling, eyes fierce and flaming, hanging of the ears and tail, which is bent inwards; lolling of the tongue, foaming, barking of the dog at his own shadow, panting, running a straight and heedless course against any thing in his way, biting with violence; other dogs fly him by instinct.

By comparing the above diagnostics with the following account of Mr Meynell's, it will be seen how little dependence is to be placed on the description of those who have not written from their own actual observation. We doubt not that Mr Lawrence derives his account from what he conceived to be the best information, and he is therefore not accountable for his errors.

513 Mr Meynell's account of the symptoms.

According to Mr Meynell, the first symptom of canine madness in dogs appears to be a failure of appetite in a small degree, that is, the dog does not eat his usual food with his usual eagerness, though, if better food be offered him, he may eat it greedily. A disposition to quarrel with other dogs comes on early in the disease. A total loss of appetite generally succeeds, though dogs sometimes eat and lap water the day before their death, which generally happens between seven and ten days after the first symptoms have appeared. A mad dog will not cry out on being struck, or show any sign of fear on being threatened; though he will, very late in the disease, appear sensible of kind treatment. A mad dog, in the height of the disorder, has a disposition to bite all other dogs, animals, or men. When not provoked, he usually attacks only such as come in his way; but having no fear, it is peculiarly dangerous to strike at or provoke him.

Mad dogs appear to be capable of communicating the infection early in the disorder, and as soon as they begin to quarrel with and bite other dogs.

The eyes of mad dogs do not look red or fierce, but dull, and have a peculiar appearance, which is easily distinguished by such as have been used to observe it, but which is not easy to be described.

Mad dogs never bark, but occasionally utter a most dismal and plaintive howl, expressive of extreme distress, and which they who have once heard can never forget. So that dogs may be known to be going mad without being seen, when only this dismal howl is heard from the kennel.

Mad dogs do not foam or froth at the mouth, but their lips and tongue appear dry and foul or slimy.

Mad dogs are generally sufficiently sensible to know those to whom they have been accustomed.

Mr Meynell is confident that dread of water is not a symptom of this disease in dogs.

Though mad dogs generally refuse both food and drink, in the latter stage of the disorder, yet they never show any *abhorrence* or *dread of water*, will pass through it without difficulty, and lap it eagerly to the last. But it is remarkable, that though they will lap water for a long time, and eagerly, and do not seem to experience any uneasiness from it, yet they do not appear to swallow a single drop of it; for however long they may continue lapping it, no diminution of quantity can be perceived.

He has never known a dog shew symptoms of the disease in less time after the bite than ten days; and he has known many instances of dogs having died mad as late as eight months after the bite. The symptoms generally appear between three and eight weeks after the bite.

A dog had been bitten, and confined by accident, and

and not from any suspicion of danger, for a whole year, so as to have no communication with any other dog all the time; and went mad at the end of that period.

Mr Meynell makes the following additional observations. "I am persuaded that the disorder never originates from hot weather, putrid provisions, or from any other cause but the bite. For however dogs may have been confined, however fed, or whatever may have been the heat of the season, I never knew the disorder commence, without being able to trace it to that cause; and it was never introduced into the kennel but by the bite of a mad dog. I do not say that I am certain that the disorder never originated from any cause except the bite; but I say that I never knew a dog go mad that I had no reason to believe had been bitten.

"Some dogs, in the last stage of the disorder, have a locked jaw.

"I do not recollect ever to have heard a dog bark after I have perceived symptoms of madness upon him.

"I consider an *unusual disposition to quarrel with other dogs as a certain sign of beginning madness;* and it is the only one I know.

"I believe the disorder always comes on so gradually that mischief may be prevented by proper care.

"I believe after symptoms have ever appeared, they never go entirely off; and that the disease, though sometimes very slow in its progress, always terminates in death.

"Dogs known to have been bitten frequently escape, but I believe not near so frequently as men.

"Almost all the mad dogs that I have seen have been confined.

"The hairs of a mad dog do not stand erect more than those of other dogs.

"I do not know that there is any thing remarkable in the manner of a mad dog's carrying his head or his tail.

"I do not know that there is any thing fierce in the appearance of the eyes of a mad dog. I believe I should know a mad dog to be mad from the appearance of his eyes, but I cannot describe this appearance.

"I do not know that a dog in the beginning of this disorder, is disposed to sneak away growling, or to shun the society of other dogs; but if I observed any thing particular in the manner of a dog, I should certainly confine him.

"I do not believe that dogs are more afraid of a mad dog than they are of any other dog that seems disposed to attack them."

(Mr Daniel was witness to an instance of this innate dread of a mad dog in other dogs, at Bradwell in Essex, where he was hunting with the reverend H. Bate Dudley. Mr Dudley walked his hounds to the water to swim them; he had himself swam over to an island about a hundred yards from the shore, and most of the hounds had followed him, but some of them could not be compelled to do so. At this juncture an alarm of a mad dog was given, who had been pursued many miles, and done variety of mischief in his progress; he seized one of the hounds that would not go into the water, and the remainder, to the number of seven or eight, immediately upon his approach to them, took to the water, and swam across to those in the island *.)

"There are two kinds of madness, both of which I have known to originate from the bite of the same dog. Among huntsmen, one is known by the name of *raging*, the other by that of *dumb madness*. In dumb madness, the nether jaw drops, and fixes; the tongue hangs out of the mouth, and slaver drops from it. In raging madness, I believe the mouth is shut, except when the dog snaps or howls, and that no moisture drops from it *."

514 The following facts and observations upon the consequences of the madness among Earl Fitzwilliam's hounds, perhaps mark the attack and symptoms of this disorder more accurately than any other description of a similar accident.

In the night of the 8th of June 1791, the man who slept in the kennel was unusually disturbed by the hounds fighting; he got up to quiet them several times, and always found the same hound quarrelling. Noticing the riotous behaviour of this particular hound, and at the same time an appearance of stupidity in him, he was induced to suppose that he was going mad, and accordingly confined him in a place by himself, after which the pack was quiet the remainder of the night. When the huntsman came to the kennel in the morning, he was told what passed, and the supposed mad hound shewn to him; his appearance was suspicious; some meat was given to him, part of which he ate, although there was an apparent difficulty in swallowing. Two days passed in suspense; but at the end of the third day his disorder was confirmed; and at the end of the fifth day he died mad. Immediate preparations were made for confining 42 couple of hounds separately, until the month of September, which was rigidly adhered to. By this means, Mr Hopkinson, a medical gentleman of Petersborough, had an opportunity wherein he very skilfully and exactly minuted the symptoms and progress of this disease.

Six hounds went mad in the following order.

| | |
|---|---|
| Nº 1 attacked | July 1st. |
| 2 | August 3d. |
| 3 | September 3d. |
| 4 | Ditto 4th. |
| 5 | November 10th. |
| 6 | December 8th. |

The hounds were first taken from their chains in September, and exercised for about half an hour together, not more than four or five couple at a time, and not trusted out of the sight of the attendant. When this exercise was over, they were again confined separately, and fed at separate troughs. In the beginning of October, they were taken out ten couple at a time; at the latter end of that month, twenty couple; still observing the same caution with respect to separate confinement after they returned from exercise. In the beginning of November they were hunted, but were chained up, as at first, after hunting, until the third week of that month, when they were let loose in different apartments of one, two, three, four, and five couple together. This regulation was continued till the month of June 1792, as the huntsman, who has had much experience in this disease, did not deem them safe under a year.

The only remedy employed was mercurial ointment; and all the hounds, except the bitches that were in whelp,

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* *Daniel's Rural Sports.*

* *Arnold on Hydrophobia.*

whelp, underwent two frictions, so as to produce in some of them a violent salivation.

Mr Hopkinson remarks, that from the above statement it seems that the disorder is as virulent, as to the power of inoculation (by which process it is always communicated) at its commencement, as at the advanced stage of it; for all the six dogs that went mad were probably infected on the 8th of June, within a few hours of each other.

It is a common opinion, that when a dog is bitten by one that is mad, a few weeks confinement, sea-bathing, or the popular nostrums, are either of them sufficient to prevent his taking the disease, and from spreading its mischievous effects; but in this case, there was a fair opportunity of proving that there is no security after six months, perhaps not after twelve; that mercury has no certain power to prevent it; and it appears that the huntsman had repeatedly employed all the popular remedies, without any effect whatever. He had also observed nearly the same progress of the disease in several packs of hounds, where no expence had been spared, for every medicine in use, sea-bathing, &c. In the present instance, there was this remarkable difference, that no internal medicine had been given, and the huntsman never knew fewer hounds attacked with the disease.

The result of the huntsman's experience in the preventive plan is therefore in favour of a separate confinement; for whenever he had depended on medicine, and not on the above plan of treatment, the disease had made dreadful havock.

There is no reason to suppose that the hound which first went mad, was not bitten by any other dog, but that it was in him a spontaneous disease. The whole pack were examined very attentively, and bites found upon four couple, one of which was seen fighting with the mad hound twice; he underwent a longer confinement than the rest; however, none of them were attacked by the disease, and it is singular that no bites were discovered upon the six hounds that went mad. The infection taking place or not, is therefore perhaps the result of chance; yet, although no bites were perceived upon the hounds which went mad, there is every ground to believe they were bitten, but that the wounds being small, were concealed by the hair. Mr Daniel suggests, that most probably there were bites within side of the lips or jaws, where the venomous saliva might be more fatally and quickly absorbed into the habit, than where the teeth had to penetrate through the thick outer skin of the dog.

Mr Hopkinson continues his remarks with respect to the symptoms of madness in dogs, and states that those which distinguish the attack of the hydrophobia, are in general a loathing of food, although this is not universal, as they will sometimes eat solid food, but refuse liquid. The first and only symptom that N° 3. had of the disease, was eating his own excrement when food stood by him; the feeder knowing this to be contrary to what the dog would do if he were well, he immediately confined him. For a day or two he was in some doubt whether his suspicions were well founded; but he proved right, for the dog died raving mad upon the fifth day.

At the commencement of the disorder, the mad dog has a particular tendency (if loose) to lick and smell the penis and fundament of another dog; this should be looked upon as a very suspicious symptom. The huntsman speaks of this as an almost never failing one.

There seems for the first two or three days to be intervals of sense; and during that time they usually recognise their master, their eyes look clear and well, their tongues moist, and of the proper colour; but if a dog is loose at this time, he will in general bite every thing he meets with. He will sometimes, during this stage of the disease, leave his home for several hours, spread his disorder by biting men and beasts, and return home again. The mad dog, when confined, seldom survives the fifth day from the first attack; if suffered to run about, there is reason to believe his death is hastened by a day or two. At the end of the third or fourth day, his appearance is much altered, his eyes are sunk, his tongue black and dry, he makes horrid howlings, and seems much disturbed; indeed the concluding scene is dreadful to witness. In the first stage of the canine madness, it is difficult for a person not conversant with the disposition of dogs in general, and of the mad dog in particular, to ascertain whether the dog is really mad or not; even Lord Fitzwilliam's huntsman was doubtful for a day or two respecting the hound mentioned in this account, as being the first attacked with the disease; however, in the advanced stage of it, no one can be mistaken.

It is the generally received opinion, that mad dogs will not take the water; but in the summer of 1791, there occurred in the neighbourhood of Petersborough, two instances of mad dogs, when closely pursued, swimming a large navigable river. A doubt might have arisen, as to their being mad, but that two hogs went mad from the bite of one, and the other was pursued for many miles by Lord Fitzwilliam's huntsman, who, from his experience in the disease, was not likely to be mistaken. Both dogs completely swam the river *.

Of all the remedies that have been employed for the cure of this dreadful disorder, none seems so likely to be successful as the cold bath. This remedy was recommended about 200 years ago by the Seigneur d'Esparron, in his "Fauconnerie," and he gives a curious instance of its success in the cure of a mad dog. "I will relate (says he), what happened to a gentleman of my acquaintance. He discovered that some of his dogs had been bitten by a mad dog; and after some time, several of them betrayed symptoms of the disease. These he ordered to be killed; but it happened that one which was a great favourite was seized, and he desired his servants to throw him into the river. By chance, the dog in coming up from the bottom, got entangled in the roots of a tree by the cord with which he had been tied, but in such a manner that his nose just remained above the water. In this situation he remained for three days, at the end of which period he got loose and returned to the house, to the great astonishment of his master; and here I afterwards saw him, as cheerful and healthy as before. I have no doubt (continues d'Esparron) that if mad dogs could be plunged into water without danger of their biting, they would all recover; and I believe that if the same practice were pursued with men, which might easily be done, many an unfortunate wretch might be saved. The danger of being bitten might be prevented by first putting a muzzle on the animal, and he might then be re-

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* *Daniel's Rural Sports.* 515

tained in the water, so long as may be judged prudent or necessary [*]."

Another writer, Defouilloux, who published a work on hunting in 1583, recommends plunging into salt-water such dogs as have been bitten, for the purpose of preserving them from the effects of the disease.

As the effect of remedies when the complaint once appears is so uncertain, it should be our principal object to use all the preventive means in our power. When, therefore, it is discovered that an animal has been bitten by one that is mad, the wounded part should immediately be cut out, where this can be done with safety, or at least should be deeply scarified to the very bottom of the bite. The wound should then be repeatedly washed with soap and water, or with a solution of soda poured upon it in a stream from a considerable height; and afterwards the wound should be seared to the bottom with a hot iron; or where this cannot conveniently be done, a quantity of aquafortis, or oil of vitriol, should be poured into it, so as to destroy all the remains of the virus or poison. If the part bitten be the ear, it should be cut off and seared. After these means, it will be proper to plunge the animal once a day into cold water, or where convenient into the sea; and he should be strictly watched, that if these means should have proved unsuccessful, the earliest appearance of the disease may be perceived.

Dr Arnold, to whom we are indebted for Mr Meynell's account of the symptoms of madness in dogs, gives the following advice with respect to the method of treating a dog that is suspected of being mad.

516 "Though every dog that is bitten does not receive the disorder, yet, as the time of its appearance after the bite is so very uncertain, and as a great proportion of those that are bitten do actually receive it, and as there is no criterion by which we can ascertain whether a dog has or has not received the infection, but the breaking out of the disorder, it is earnestly to be wished that all owners of dogs would immediately destroy, or secure for a great length of time, every dog known, or but suspected, to have been bitten by a mad dog.

"It is also earnestly to be wished, that all persons possessing dogs would immediately tie up or destroy such of their dogs, whether known to be bitten or not, as shall begin to be disordered in any way, of which the nature and cause is not perfectly obvious; and especially if there be the smallest reason to suspect that the dog was bitten, and that the disorder is really an incipient madness.

"It is still more to be wished that they would immediately destroy all dogs known to be in any state of madness, if it be at the same time known that they have not yet bitten any other animal, and particularly no person whatsoever; and that no dog that has bitten any animal or person be destroyed as a mad dog if it can be avoided, but that every dog be secured and tied up, that it may be certainly known whether he be mad or not. If he has the symptoms of confirmed madness, they will plainly discover themselves, and he will die in ten days and less; if he is not, he may be safely enlarged in the space of a fortnight, and the person bitten will be freed from the most distressing apprehensions [*]."

Worming of dogs.

517 Before we dismiss the subject of canine madness, it will be expected that we should take some notice of the operation of worming dogs, so celebrated among huntsmen and breeders of dogs, as a supposed preventive of this dreadful malady. This operation is as old as the days of Pliny, and has ever since been more or less esteemed among the vulgar. But neither the operation itself, nor its effect, seem to have been well understood. The idea of a worm being lodged in the tongue of the puppy, the extraction of which is to prevent the animal from going mad, is truly ridiculous; and as such has been deservedly laughed at by sensible people in all ages. But though it is neither a worm that is extracted, nor is the extraction a preventive of madness, it seems, however, pretty well ascertained, that the performing of this operation is productive of considerable advantage, in preventing the dog from doing mischief, even though he should run mad. It seems that in dogs who have been wormed, and are afterwards seized with hydrophobia, the tongue swells to such a degree as to prevent the animal from closing his jaws upon the object which he attempts to bite. The following observations of a late ingenious and entertaining writer on the subject are entitled to much attention.

Very strong proofs have been adduced of its utility; nor is it natural to imagine, that so easy and effective an operation would have been omitted, had no more virtue been attributed to it than it really possesses; and wherein it failed, the absolute prevention of madness was said to be the consequence; whereas the fact was and is, that taking out the worm hath nothing to do with annihilating the disorder, although it will most certainly hinder the dog, seized with it, from doing any hurt to man or beast. A late author asserts, he had three dogs, that were wormed, bit by mad dogs at three several periods, yet, notwithstanding they all died mad, they did not bite to do any mischief; that being determined to make a full experiment, he shut one of the dogs up in a kennel, and put to him a dog he did not value; the mad dog often ran at the other to bite him, but his tongue so swelled, that he could not make his teeth meet. The dog was kept in the kennel until the mad one died, and was purposely reserved for two years afterwards, to note the effect, but he never ailed any thing, although no remedies were applied to check any infection that might have been received from the contact of the mad dog.

Mr Daniel has had various opportunities of proving the usefulness of worming, and inserts three of the most striking instances, under the hope of inducing its general practice.

A terrier bitch went mad that was kept in the kennel with 40 couple of hounds: not a single one was bitten, nor was she seen to offer to bite. The bitch being of a peculiar sort, every attention was paid to her, and the gradations of the disease, (which were extremely rapid) minutely noted. The hydrophobia was fast approaching before she was separated from the hounds, and she died the second day after. At first warm milk was placed before her, which she attempted to lap, but the throat refused its functions; from this period she never tried to eat or drink, seldom rose up, or even moved; the tongue swelled very much, and long before her death the jaws were distended by it.

A spaniel was observed to be seized by a strange dog, and was bit in the lip; the servant who ran up to

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[*] *D'Esparron Fauconerie*, p. 290.

[*] *Arnold on Hydrophobia.*

part them, narrowly escaped, as the dog twice flew at him; a few minutes after the dog had quitted the yard, the people who had pursued gave notice of the dog's madness, who had made terrible havock in a course of ten miles from whence he had set off. The spaniel was a great favourite, had medicine applied, and every precaution taken; upon the fourteenth day he appeared to loathe his food, and his eyes looked unusually heavy; the day following he endeavoured to lap milk, but could swallow none; from that time the tongue began to swell, he moved himself but seldom, and on the third day he died. For many hours previous to his death, the tongue was so enlarged, that the fangs or canine teeth could not meet each other by upwards of an inch.

The hounds were some years after parted with, and were sold in lots. A madness broke out in the kennel of the gentleman who purchased many of them; and although several of these hounds were bitten and went mad, only one of them ever attempted to bite, and that was a hound from the duke of Portland's, who, in the operation of worming, had the worm broke by his struggling, and was so troublesome that one half of it was suffered to remain; the others all died with symptoms similar to the terrier and spaniel, viz. a violent swelling of the tongue, and a stupor rendering them nearly motionless, and both which symptoms seemed to increase with the disease.

The idea that worming prevents a dog from receiving the infection when bitten should be exploded; but the foregoing facts show how far it may be recommended for the restriction of a malady horrid in its effects where a human being is concerned, and which to the sportsman and the farmer is attended with such dangerous and expensive consequences.

We cannot pretend to say, what it is that the wormers of dogs take away from the tongue; but we cannot suppose, that Mr Daniel, though he calls it a worm, really believes that it is so. The following are his directions for performing the operation.

"The *worming* of whelps should be previous to their being sent out to quarters; this operation is to be performed with a *lancet*, to slit the thin skin which immediately covers the worm; a small *awl* is then to be introduced under the centre of the worm, to raise it up; the further end of the worm will with very little force make its appearance, and with a cloth taking hold of that end, the other will be drawn out easily. Care must be taken that the *whole* of the worm comes away without breaking; and it rarely breaks, unless cut into by the lancet, or wounded by the awl *."

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### 4. Colic. Colica. *Spasmodic* or *Flatulent Colic, Gripes, Bats, Fret*, or *Gulliom*. Tranchée, Fr.

This is one of the most painful disorders with which horses are affected; and it seems to occasion them as much distress as inflammation in the bowels, with which it is very commonly confounded by ordinary farriers.

In this disease the horse expresses his pain, by frequently lying down and rolling on his back, and after having remained a short time in this position, starting up again. The hair is staring, and there are sometimes cold sweats. He frequently makes attempts to stale, looks anxiously at his flanks, and sometimes strikes his belly with his hind feet. There is seldom any fever in this disease; and when it does occur, it is only after the disease has existed for some time. The pulse is seldom affected; but when the pain is very great, it is a little quicker than natural. The belly commonly feels hard and tense. Colic is almost always accompanied with costiveness, though griping pains not unfrequently attend severe scouring.

If the above symptoms are attentively examined, they will commonly serve to distinguish this disease from inflammation of the bowels. It is generally observed, that the pain in colic returns only at intervals, and the extremities are seldom cold. It must not be overlooked, however, that when colic continues for a considerable time, it may terminate in inflammation, so that the distinguishing symptoms mentioned here and in N° 497. are to be depended on, only in the early stage of the disease.

Cattle are extremely subject to colic; but it is said to be more common in young than in old cattle. The symptoms do not differ from what we have described, only that it is said, that these animals, when affected with gripes, strike their heads and horns against every thing in their way.

Colic is easily removed, when the proper remedies are employed, before any symptoms of inflammation make their appearance; but if the remedies be delayed till inflammation takes place, the cure is very precarious.

Colic is very commonly the consequence of neglected costiveness, and by this it is always increased. It may be ascribed to improper food, especially such as is apt to produce flatulence or sourness in the stomach or bowels; by drinking cold water immediately after eating; and by exposure to cold, during violent sweating.

As it is not always easy to distinguish flatulent colic from inflammation, it is the safest plan to begin the treatment by bleeding, to the extent of three or four English quarts; and the appearance of the blood will generally inform us whether it will be necessary to repeat the operation. See N° 162. The next circumstance to be attended to, is the evacuation of the bowels by back-raking and softening clysters. In general, after this operation, a large quantity of air will be evacuated, and considerable relief will be afforded. After these means have been employed, some stimulating aromatics, such as oil of turpentine, oil of aniseseed, essence of peppermint, or some of the other stimulants enumerated in N° 285, and 286, should be given by the mouth; and if these do not procure relief, it will be proper to give a ball containing half an ounce of calomel, and immediately after it, a drench of peppermint water, with five or six drachms of laudanum. The cure will be considerably assisted by rubbing the belly gently with a warm cloth; and the animal should be gently trotted, for a considerable time, while led by the halter. Warm fomentations to the belly have been recommended; but if there is a considerable accumulation of air in the stomach and bowels, these would do harm by increasing the expansion of the air, and thus adding to the animal's distress; for it must be remembered, that a horse cannot easily belch up wind by the mouth; and where there is any obstruction backwards, every thing that can increase the expansion of the confined air, must do harm. On the contrary, every thing that is capable of diminishing the volume of air, may probably relieve the pain. It might be worth while to try how far the application of cold to the belly would be attended with advantage; and this might easily and safely be effected, by bathing the belly with strong spirit of wine, which speedily evaporating, will considerably diminish the temperature of the belly. It will be proper, where the disease continues obstinate, to administer warm softening clysters, every hour or two; as well for the purpose of obviating costiveness, as for removing the spasmodic constriction of the bowels. We are assured, that where most other means have failed in procuring relief in flatulent colic, this has been obtained by means of the smoke of tobacco drawn up the fundament. The simplest way of administering this remedy, is to introduce the small end of a tobacco pipe, after having filled the bowl and lighted it; when the smoke will insensibly be drawn up by the action of the horse's bowels.

## Chap. V. *Of Dropsical Diseases.*

519 Dropsy. Our domestic animals are sometimes affected with dropsy; and this may be either diffused through the cellular membrane below the skin; or the water may be contained within one or more of the cavities, as the head, the chest, and the belly.

520 Water farcy. External dropsy, or what medical writers call *anasarca*, and farriers *water farcy*, is not common, unless it accompanies a dropsical collection within the body. It sometimes affects particular parts, as the legs, the sheath, or the lips; and at other times it is diffused over the whole cellular membrane. It is known by the swelling of the part, which is cold, and retains the impression of the finger for some time. The urine is generally more sparing and of a deeper colour than is natural; and the animal appears considerably weak. This disease, when it has proceeded to any considerable height, and when the animal is much debilitated, is not easily removed; but when it is slight and of no long standing, it will in general yield to remedies.

All the species of dropsy more commonly affect old than young animals; and such as are debilitated by any previous cause, are more subject to it. It is said that horses are more likely to become dropsical in spring and autumn when they are moulting.

The cure of general dropsy is to be attempted by the use of diuretic medicines, accompanied with a nourishing diet, gentle exercise, and frequent friction all over the body, especially over those parts where the accumulation of fluid is situated. The action of the diuretics must be assisted by a sufficient quantity of drink; and it will be proper to give the animal some of the more powerful strengthening remedies, such as white vitriol, oak bark, logwood, &c.

### 521 1. Dropsy of the Head. Hydrocephalus. *Sturdy. Turnsick.*

Dropsy of the head seldom affects horses or cattle; but a peculiar collection of water in the head is very common among sheep, in whom it is called the *Sturdy* or *Turnsick*. One of the best accounts of this disease that we have seen is that which is given in the second appendix to Mr Findlater's Survey of Peebles, which we shall give nearly in the words of the author.

This disease is peculiarly incident to young sheep, or hogs, of a year or eighteen months old. It consists of a collection of water generally formed upon the external surface of the brain, immediately below the skull; and sometimes, though not often, in the centre or ventricles of the brain. When the water forms in the last-mentioned parts, we apprehend it is almost universally mortal.

The disorder is first discovered, by the animal not keeping up with the rest of the flock, and by its appearing dull and stupid. It is afterwards observed to go round in a giddy manner; and at length it appears blind, and the pupil of the eye seems wide and relaxed. It may continue a long time in this situation before it dies; and it is believed that sheep sometimes recover of this disease without any thing being done for them. They are often in good order when they die, as they continue to feed tolerably well, until near the last period. Though some recover, with or without means, perhaps it may be most adviseable to kill them early in the disease, provided they be in good order, as this local distemper does not affect the goodness of the mutton.

When the collection of water is on the outside of the brain, it is often cured by thrusting a sharp wire up the animal's nostrils, until it reaches the water, and opens a passage for it to run off. In other cases, it is cured by an operation which some shepherds perform very dexterously. The water is contained in a bladder, or vesicle, (a *hydatid*) generally about the size of a walnut. The part of the skull immediately above where it is situated, feels softer than the other parts. This the shepherd discovers, by pressing with his thumb and fingers, upon different parts of the fore and upper parts of the skull. The bone here has become thinner, and feels soft; from which he is certain that the watery collection is formed. After the disease has gone on a considerable time, and he judges it ripe for the operation, he raises the scalp, and lays the bone bare to a sufficient breadth, with a sharp knife; he then discovers more accurately the extent of the thin soft part of the bone, and with a strong and sharp-pointed knife, he makes a circular incision in the skull, raises up, and takes out the part. He then sees the clear thin bladder underneath, which he lays hold of with a small hook, or the point of a needle, and gently draws it out; taking all possible care that it be not broken, or the water spilled, which would prove unfavourable to recovery. He finds a considerable hollow in the brain where the bag was situated, over which he brings the flap of skin that was raised, so as to cover it as neatly as possible. Over the whole, he applies a plaster of tar, and leaves the rest to nature. This operation frequently proves successful.

Mr Findlater remarks, that in Tweeddale, one case in three, where a perforation is made by the pointed wire, or the trepan, usually ends favourably. Of late it has been the custom among the shepherds of that district, to bore into the skull of sheep affected with the sturdy, with a common gimlet; and however rough or apparently dangerous the operation, it seems frequently to prove successful. The operation is made by boring from the root of the nostrils, in an oblique

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ases. direction to the root of the horn on the opposite side of the head.

### 2. WATER in the CHEST. Hydrothorax.

2. y of iest. This complaint appears but seldom in the inferior animals: but it may take place from excessive debility; and according to Mr Blaine, it is sometimes the consequence of inflammation in the lungs. Here however this writer is probably mistaken, and confounds water in the chest with *empyema*, or a collection of matter within the chest, which is not an uncommon termination of *pneumonia*.

When dropsy in the chest does occur, the animal labours under a difficulty of breathing, especially when lying down; and the pulse is feeble, and commonly irregular. The urine is scanty and high coloured. If the collection of water is pretty considerable, it may be perceived by the sound that is produced, when the chest is struck with the hand; but this is often a deceitful sign, and should not be tried till a long time after the animal has drunk; as, for some time after drinking, the water that remains in the stomach will, when the ribs are struck, produce a sound that might lead us to suppose there was water in the chest.

This complaint commonly proves fatal, both in man and animals, and probably there is no means of cure, except by evacuating the water, by an opening into the chest; an operation which is always precarious, and commonly as dangerous as the disease which it is intended to relieve. If it is determined however to try the experiment, the opening should be made between the seventh and eighth rib, near the breast bone, on that side of the chest where the water is supposed to be accumulated. In making the opening, the skin should be drawn tight towards the edge of the seventh rib; when a cut is to be made in the place above directed, with a sharp knife, not cutting too boldly, but rather scratching with the point of the knife, till the skin and the muscles are completely divided. After this, a pipe must be introduced through the opening, and fastened by a bandage round the animal; some soft linen or a piece of sponge being placed over the opening, after as much water as possible has run off, to suck up the remaining moisture, and exclude the air.

### 3. WATER in the BELLY. Ascites.

3 y of lly. This is the most common species of dropsy, and is known by the general symptoms of dropsy that have been described in N° 319. and 320. attended with an unusual swelling of the belly; while the skin is cold, and very tight. When the belly is struck with one hand, while the other is held upon the opposite side, a fluctuation may be perceived, much more distinctly than in the last species.

It is brought on by the usual causes of dropsy that we have already mentioned, and it is not an uncommon consequence of jaundice and other chronic disorders. It is not quite so dangerous as dropsy in the chest, but it is very apt to return after having been removed.

The treatment should be begun with diuretics, and now and then a mercurial purge, while the body is strengthened by tonic medicines, nourishing diet, and gentle exercise. If the accumulation of water becomes very great, it may be easily evacuated, by making a puncture into the belly, and introducing a pipe as in the last case. Mr Lawrence has gone into the mistake generally committed, of supposing that little drink should be given in cases of dropsy. It is now well ascertained that moderate drinking considerably increases the efficacy of diuretic medicines. Diseases.

## CHAP. VI. *Of Anomalous Diseases.*

### 1. DIABETES. *Profuse Staling*, or *Pissing-evil.*

524 Profuse staling. IT sometimes happens, that horses or cattle make a much greater quantity of urine than is natural; so that the quantity evacuated exceeds the quantity of fluid drunk by the animal. Probably this disease occurs more frequently among cattle than among horses, though it is scarcely mentioned by the writers on cattle medicine, and the account that is given of it by veterinary writers is extremely imperfect. Mr Blaine describes the urine, as being five or six times the natural quantity, as milky or watery, and depositing a sediment which has the taste and appearance of sugar. As we have never observed a case of this disease in horses or cattle, we cannot say how far this description of the urine is correct; but if the urine evacuated by these animals in *diabetes* resembles the human urine in the same disease, it is clear and almost colourless, has the smell and taste of honey, deposits little sediment, but on being evaporated, leaves a thick substance like treacle.

Considerable thirst accompanies this disease; and when it has continued long, the animal becomes extremely weak and emaciated. The skin is usually dry and harsh, the pulse is small and quick, and the appetite in the early part of the disease is much increased.

This complaint commonly proves fatal; few instances of a recovery having been observed in man; and we do not know that any successful case in any of the domestic animals is on record.

The causes of *diabetes* are very obscure, especially in the inferior animals; it seems to be the consequence of great weakness, and some unusual action of the digestive organs. The various theories that have been given in explanation of this disease, as far as relates to the human body, will be noticed in the article MEDICINE; and if we shall meet with an opportunity of examining the disease in horses or cattle, we shall endeavour to give a more accurate account of it, under VETERINARY *Art.*

In the treatment of *diabetes* in horses, &c. the method proposed by Dr Rollo for the cure of this disease in man, has been recommended, and we believe adopted, by Mr Coleman; with what success we cannot say. This method consists in making the animal abstain as much as possible from vegetable food; and giving him broth and balls made of flesh, mixed up with paste of wheat flour. He should have as little drink as possible. Astringent remedies are commonly employed in these cases, such as Japan earth, alum, white vitriol, muriate of iron, oak bark. See receipts, N° 29.

### 2. BLACK-QUARTER, QUARTER-ILL, or BLACK SPALD.

525 Quarter-ill. There is a disease that proves very fatal in some districts to calves or cattle of a year or two old, the nature of which is little understood, but it seems nearly allied

allied to the *Hawkes* or *Hocks*, described in Nº 428. Mr Lawrence considers the disease as appearing under various forms, to which he gives the following names; *shewt of blood; vomit of blood; blood in the back; blood in the legs*, or *crateuch; blain in the tongue*, or *overflow of blood; striking-in*, or *rising of the blood; higham*, or *iron-striking; joint murrain*, or *garget; black quarter; quarter-evil; black leg.*

We have given as a synonym the name of *black spald*, because we consider the disease so called in Scotland, as nearly, if not entirely, the same with the *black quarter* of the writers on cattle medicine. As we have not seen the disease, we shall copy what Mr Lawrence says of it, in his treatise on cattle.

"All our animals, oxen, sheep, and pigs, I have observed, are subject to sanguineous effusion or overflow of the blood, on being put, in a low and weak state, to rich or succulent keep. They very commonly drop on a sudden, and die in the blood, as it is termed; when the carcases putrify almost immediately, and are totally lost. Pigs which die in this way, have their skins so universally suffused with the blood, that they appear enveloped, or rather shrouded, in Morocco leather. In oxen, chiefly young cattle, nature commonly finds a vent for the disease, in an eruption on the leg, quarter, or shoulder, attended with *pneumatosis* or a collection of air in the cellular membrane, or, as it is commonly termed, between the flesh and the skin; whence the crepitating or crackling noise, which is heard on pressure. Another termination of the disease, is by a deposition of matter upon the joints, whence the term of joint garget or murrain. I know not whether I am correct in referring the *cruteuch* to this class, which is said, in Scotland, to be a swelling and lameness in the legs; but the old writers particularly mention *blood in the legs. Blain* or *garget in the tongue*, attended with inflammation and vesicles or bladders in that part, is said to be a symptom of the disease, and also to arise from heat and fatigue.

"This disease has swept off great numbers of yearling and two-year old cattle, and become indeed endemial in certain districts, where any such scourge was unknown, it is said, previously to the introduction of artificial grasses, with the full feeding on which the animals become surfeited: thus the improvident use of good produces evil. The breeders being alarmed at the ravages occasioned by this murrain, which generally carried off the forwardest and best of the cattle, no wonder that the fertile brains of cow-doctors were put into intestine motion, and that the ideas of the favourite engines, the knife or fire, were whirled uppermost. In effect, some skilful leech introduced the following most extraordinary operation, as a preventive of the disease in question; which I apprehend in the contemplation, either of physiology or common-sensology, could have no better prophylactic or preventive view, than shaving the animal would have; which I beg leave to recommend in the stead, as at least free from cruelty. The ill-starred beast is cast, bound to a stake, all his four legs are cut open from the claws upwards to the height of several inches, in order to find among the tendons and ligaments a strong blood vessel of a bluish colour, which said offending vessel, guilty of the original sin of producing joint murrain, being caught with a crooked needle, is cut away. It is great pity, for the sake of hypothetical uniformity, that the above-said blue blood-vessel had not been called a worm, since the brains of so many of our cattle folk have been infested with worms from very high antiquity *."

After much jocose, but rather coarse ridicule of methods that have been proposed for the cure of this disease, Mr Lawrence thus proceeds. "Prevention of this malady is the only cure worth notice: because, after the attack, the very nature of the case renders all remedy either uncertain, or of very little profit, even if successful, on account of the expence of time and money. With this view the young cattle must not be pushed so forward in condition; and indeed the same precaution may be useful in some degree, with respect to the full aged. A piece of short or inferior keep should be reserved, as a *digesting place*, in which the cattle may be occasionally turned to empty and exercise themselves. Those observed to advance very fast may be blod monthly for several months: of the efficacy of this practice, however, I have by no means so good an opinion as that of giving medicines which prevent internal obstruction. I am well aware of the difficulty, or rather total impracticability, of such measures with a number of cattle in the field, or I am convinced, that occasional purges, or alterative medicines, would prevent those diseases which seem to take their rise in over repletion and accumulation. Six drachms, daily, of equal parts sulphur and antimony, in fine powder, would be sufficient for a young beast; but to be of any permanent use, it must be continued at least a month; or salt might be of use. Rowelling also might be an efficacious preventative. Keep two rowels or setons open in each beast during several months †."

In the 5th vol. of the Farmer's Magazine, is the following communication from a practical farmer respecting the cure of this complaint.

"The first cure for this complaint that I ever saw performed, was on an ox of four and a half years of age. As he was going in the plough, I observed him a little lame in one of the hinder feet. At first I thought he had trampled upon a stone; but as it still grew worse, I soon suspected it was the quarter-ill; the more so, as there was a good year-old died of that disorder three weeks before. By the time he was got to the byre, the crackling between the skin and the flesh was very perceptible on the top joint of the off-side hinder leg. As our blacksmith had some skill among live stock, he was instantly sent for. The first thing he did was to take a little blood from a vein in the neck. He then pulled the skin from the flesh on the side that seemed most pained, still keeping the beast walking as much as possible. He then caused cold water to be poured in large quantities on the part affected, still rubbing and keeping the skin loose on the affected part. Finding the skin to adhere much to the flesh, he then made three cuts with a penknife, two inches long, into which he rubbed salt and water. In this manner he continued four hours: the one time driving him, then pouring on water, rubbing in salt, and loosening the skin from the flesh. By this time he was not near so cripple, and began to take his food. We were ordered, however, to keep him in motion all night, and in the morning he was well for his food, and never had any more signs of the disease. Since that time I have followed the blacksmith's practice, and have often been successful. Only instead of pouring water on the place, I fasten a rope

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* Lawrence on Cattle. p. 534.

† Ibid. p. 535.

ses. rope about the beast's head, and take it to a deep pool, causing it to swim up and down, and drive it frequently, giving it an ounce or half an ounce of laudanum, according to the size or age of the beast, but I never did cut the skin. I have good reason to believe that the above method has been the means of curing several of my young cattle, as I never saw any that took that disease, and no means used for their recovery, but died; those I opened, had all the blood collected in the affected quarter. I find it more difficult to cure in the fore quarters than in the hinder, and if it seize the bowels, I hardly think that it will cure by any means."

### 3. On the Rot in Sheep. *General or True Rot.* Hydropic Rot.

The name of the rot in sheep, and the ravages that are annually made by it among the flocks of most sheep districts, are familiar to every one; but little pains have been taken to fix the precise meaning of the word, and the particular disease, to denote which it should be exclusively employed. Some of those who appear to have paid particular attention to the subject, have yet followed the example of shepherds and farmers, in confounding under the name of *rot*, several diseases which differ considerably in their nature, causes, and method of treatment. Two medical men who have lately published; the one, Dr Dickson, on the General Management of Sheep, as connected with practical agriculture; the other, Dr Harrison, on this particular subject of the *rot*, have still considered it as one disease. In the second appendix to Mr Findlater's Survey of Peebles, and in the fourth number of the Edinburgh Medical and Surgical Journal, the distinction of the rot into three different morbid affections, is, however, clearly marked; and there seems no doubt that these three diseases are very similar to consumption, hepatitis or inflammation of the liver, and scurvy, in the human body. The first of those which we have briefly noticed in N° 490. under the name of *pulmonic rot*, is distinguished by cough, hectic fever, wasting of flesh, and in many cases by the formation of a watery swelling below the chin. The second, mentioned by the name of *hepatic rot* in N° 493. is characterized by a degree of fever accompanied by inflammation, and thickening of the outer coat of the liver, or some diseased state of the biliary ducts or pipes, connected with the presence of flukes in the liver, if not sometimes produced by them. The third species has been called *general rot*, as in this the whole system is more or less affected; *true rot*, because it appears to be the most common of the three, and to be that to which the name seems more peculiarly applicable; and *hydropic rot;* because, if the animal is suffered to live, the disease commonly terminates in partial or general dropsy. This species is what we are now to consider; and after having given as clear an account of it as we can collect from the descriptions that have been lately published, we shall make a few observations on the causes, treatment, and prevention of the *rot in general*, endeavouring as much as possible to discriminate between the three varieties.

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It is probable that the first symptoms of the rot have seldom been observed. The earliest marks of the disease of which writers give an account, one, falling of in flesh, and unusual dullness and heaviness. The flesh feels loose and flabby, especially about the loins; and if pressure is made about the hips, a crackling is sometimes perceptible. It is said that those who are accustomed to handle the ears and legs of sheep, may in the earliest stage of rot discover symptoms of *low fever*, but probably this is only the case in *pulmonic* and *hepatic rot*. Now, or soon afterwards, the countenance looks pale, as do the gums and tongue. On parting the fleece, the skin is found to have lost its fine rosy colour, and is become of a pale red. As the disease advances, the skin appears dappled with yellow and black spots. The eyes have a peculiar appearance; they lose their lustre, and look like the eyes of dead fish. Mr Findlater says, that in Tweeddale, the principal mark of rottenness is taken from the appearance of the eye in the corner next the nose, when the eyeball is turned so as to look away from the nose; as the flesh that adheres to the eyeball below the eyelids, in the corner next the nose, is in a sound sheep of a florid red colour: whereas, in a rotten sheep, the flesh is of a dull appearance, and of a yellowish red colour, resembling that of a rotten egg, when the white and the yolk are confounded together. When the disease has continued long, the breath becomes fetid, the gums spongy, the teeth and sometimes the horns loose, the animal is commonly affected with a scouring, the fleece looks torn and ragged, and the whole separates from the skin with a slight pull. Great weakness and emaciation attend the latter stage of the disease; and these continually increase till the animal dies, or till dropsy comes on, which always terminates fatally.

Diseases.

The principal appearance on dissection is presented by the liver, which is found in various states, according to the progress or severity of the disease. When a sheep is killed a few days after contracting the rot, the thin edge of the small lobe of the liver appears of a transparent white or bluish colour, and this colour spreads to a greater extent according to the severity of the complaint. Sometimes it does not extend more than an inch from the edge; at others it occupies a considerable part of the lobe. In severe cases, the whole external coat of the liver is found diseased, commonly assuming an opaque colour interspersed with lines or patches of a darker red. The upper end of the liver is sometimes found speckled like the back of a toad, to which it is said to bear a striking resemblance. Very commonly the liver is found full of hard knots, and sometimes there are ulcers in various parts of it. Are not some of these appearances peculiar to the hepatic rot? When the liver of a sheep affected with the rot is boiled, it loses its consistency, and breaks down into small pieces; whereas it is well known that a sound liver becomes by the same process firm and solid.

When sheep have died suddenly in the first stage of this disorder, there may commonly be discovered a quantity of wheyish-coloured fluid in the cavity of the belly; and in these cases the outside of the liver is generally covered with a coat of coagulable lymph. This is one of the appearances described by Dr Harrison; and is similar to what is often observed in the belly of animals that have died of dropsy in the belly.

In stating the causes and treatment of *general rot*, we 528 we cannot perhaps do better than copy what is given on this subject in Mr Findlater's Survey of Peebles, to which we have already been so much obliged. "It arises from deficient or bad aliment, whether the food itself be bad and scanty, or the animal be incapable of digesting it properly. It is most common from the former cause, want of food; and the disease is much the same with scurvy among the human race. In addition to these causes, whatever tends to depress the spirits, frequently excites, or at least exasperates, the malady. It is said that soldiers in a garrison have been known to be seized with the scurvy on hearing bad news; and I doubt not but terrifying sheep with dogs, or other means, may produce or aggravate this disease. We may hence see what mischief a fox chase, or any exhibition of that sort, is calculated to bring upon a flock of sheep. The disease is also said to be produced by feeding upon watered grass; and hence shepherds, in many parts of Scotland, are careful to keep off their sheep from the tender grass produced by the occasional overflowing of rivulets. Feeding also in marshy and damp pastures, is known to be a powerful cause of the rot.

"The only means of cure are, a supply of good and wholesome food, and invigorating the stomach by permitting the animal to feed on those stimulating and aromatic herbs which are agreeable to its taste. It is believed that on dry sweet pastures, where there is a sufficient quantity of furze and broom, juniper, and other shrubs that are palatable to sheep, the rot is seldom heard of. When ground is sown down for sheep pasture, parsley, thyme, peppermint, and other aromatic herbs, should be sown with the grass seeds, as these plants serve both to prevent and to cure the rot. In addition to these means of cure, every thing that tends to annoy or depress the animal in its weakly state ought to be avoided *.

529 The following facts with respect to the production of rot, considered as a general disease, are chiefly taken from Dr Harrison's Inquiry.

Poor, clayey, and loamy lands are most subject to rot.

Grounds that are always dry, or always under water, and such as are always sufficiently wet to preserve a constant running of water, were never known to suffer from the rot.

Ponds of living water are equally safe; but when attempts to drain lands have been made, and have not fully succeeded, sheep which feed on such lands are very much exposed to the rot.

Grounds newly laid down for pasture, or ploughed fields that have been exhausted by repeated crops, where the sward is thin, and where the water remains in plashes for want of proper outlets, are peculiarly subject to the rot.

Marshes that are overflowed by the sea, and boggy situations, especially in Ireland, are seldom known to rot.

Lands that have been limed, and many soils that are chiefly composed of calcareous matter, are considered as very likely to produce the rot.

Ewes that are with lamb, or are giving suck, are less liable than other sheep to be affected with the rot.

Eight causes have been assigned for the production of rot, viz.

1. A vitiated dew. It is stated in the Survey of Lincolnshire, that a shepherd, who, when young, was shepherd's boy to an old man that lived at Nettlam near Lincoln, a place famous for the rot, declared his persuasion that sheep took the rot, only in a morning before the dew was well off. His master's shepherd always kept his flock in fold till the dew was gone, and with only this attention his sheep were kept sound when all his neighbours lost their flocks. Dr Harrison remarks, that if this cause were just, the rot should appear equally on all lands.

2. The disease has been attributed to a crust or earthy sediment that adheres to the grass after wet weather, or after the overflowing of running water.

3. It has been supposed to be owing to the luxuriant and quick growing herbage that is produced in hot moist seasons. But all luxuriant pastures do not produce the rot.

4. It has been attributed to the sheep grazing on some particular herbs, such as the butterwort (*pinguicula vulgaris*), the white rot (*hydrocotyle vulgaris*), round-leaved sundew (*drosera rotundifolia*), and long-leaved sundew (*drosera longifolia*); but these plants do not grow on every rotting soil.

5. The disorder has been imputed to flukes in the liver. We have already stated our opinion, that flukes may produce the hepatic rot.

6. The rot has been supposed to depend on the infection of *sheep-pox*. This opinion seems to have arisen from a confusion of terms.

7. M. Daubenton considered the disease to be produced by poverty of food, and too much water. There is no doubt that these causes commonly produce the last species of rot which we have mentioned.

530 Dr Harrison's theory of the rot.

8. Dr Harrison is of opinion that the rot is always generated by the exhalation or effluvia produced by the action of the sun's rays on soils that are partially covered with stagnant water. After adducing a number of ingenious arguments in support of his opinion, Dr Harrison sums up the amount of his doctrine in the following manner.

"From the various circumstances enumerated, I think I am justified in attributing the rot in sheep and other animals to paludal effluvia; but with respect to their nature and constitution, it is very difficult to form any rational judgment, as they have hitherto eluded the most subtle and delicate inquiries. It must, however, be admitted, *si causa latet, vis est notissima;* and consequently the subject, from its great importance to the public in general, is entitled to a serious investigation.

"Without heat and moisture, no deleterious vapours can be generated; and yet it is equally certain, that both these causes are insufficient to produce either a recurrent fever, or the rot, since they are confined to particular situations. Other auxiliaries are therefore necessary; and I am inclined to believe that vegetable or earthy particles, and probably both, are required, as well as heat and moisture, to constitute the noxious emanations or gasses called *miasmata paludum*.

"Probably it will be found, on further inquiry that a great variety of animal and vegetable effluvia are extricated in different places; and that many disorders should be

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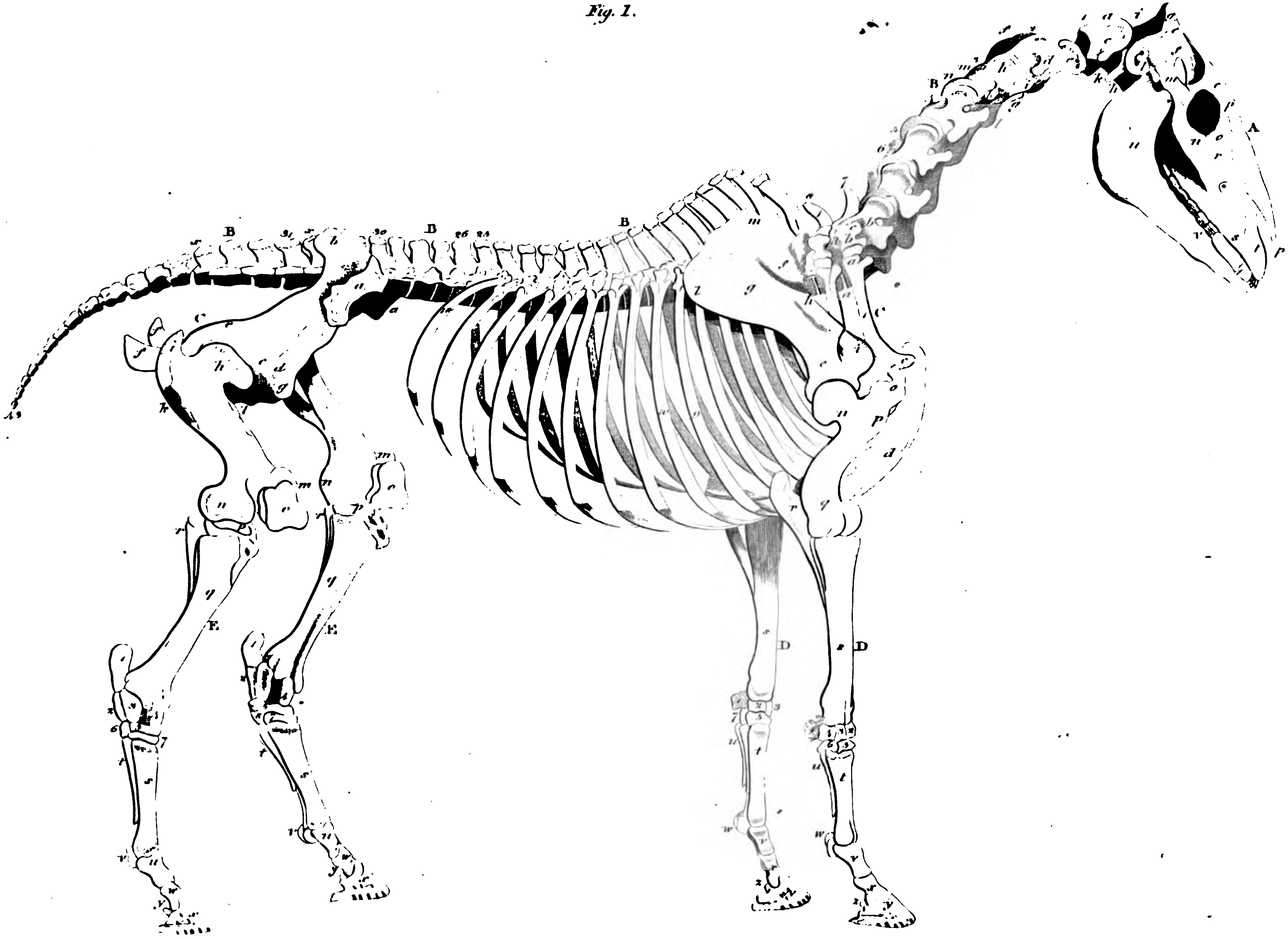
* *Findlater's Survey*, p. 404.

Fig. 1.



W. Archibald sculp.

## FARRIERY. PLATE CCXII.

*Fig. 2.*

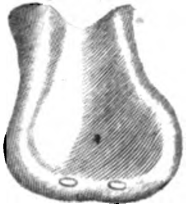


*Fig. 4.*

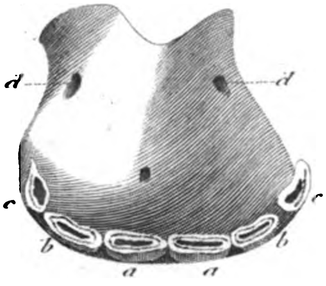


*Fig. 3.*

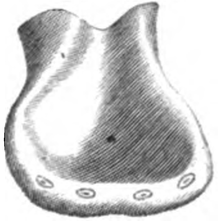


*Fig. 5.*

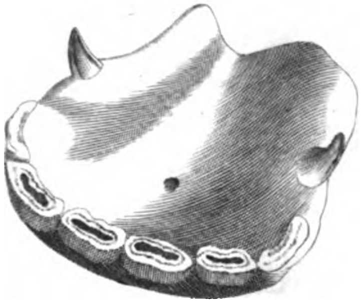


*Fig. 6.*

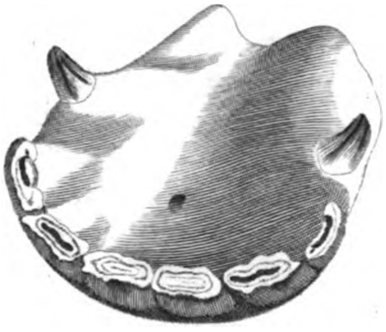


*Fig. 7.*

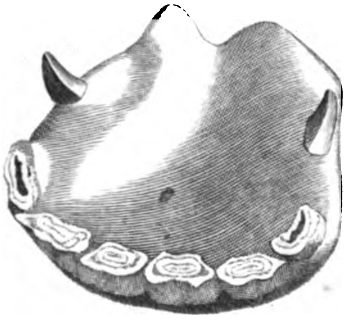
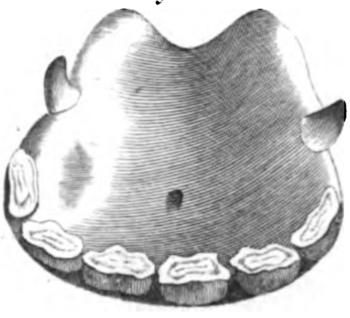


*Fig. 8.*



W. Armstrong Sculp.<sup></sup>

# FARRIERY. PLATE CCXIII.

Fig. 9.

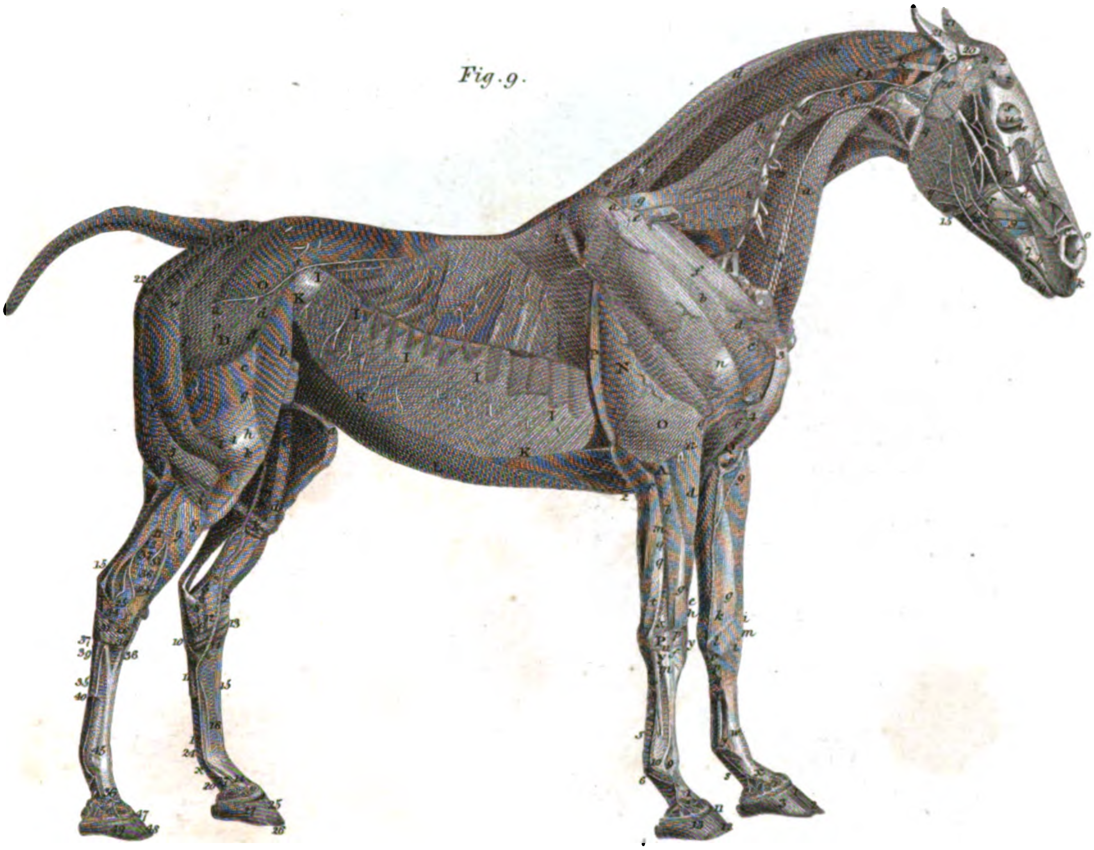
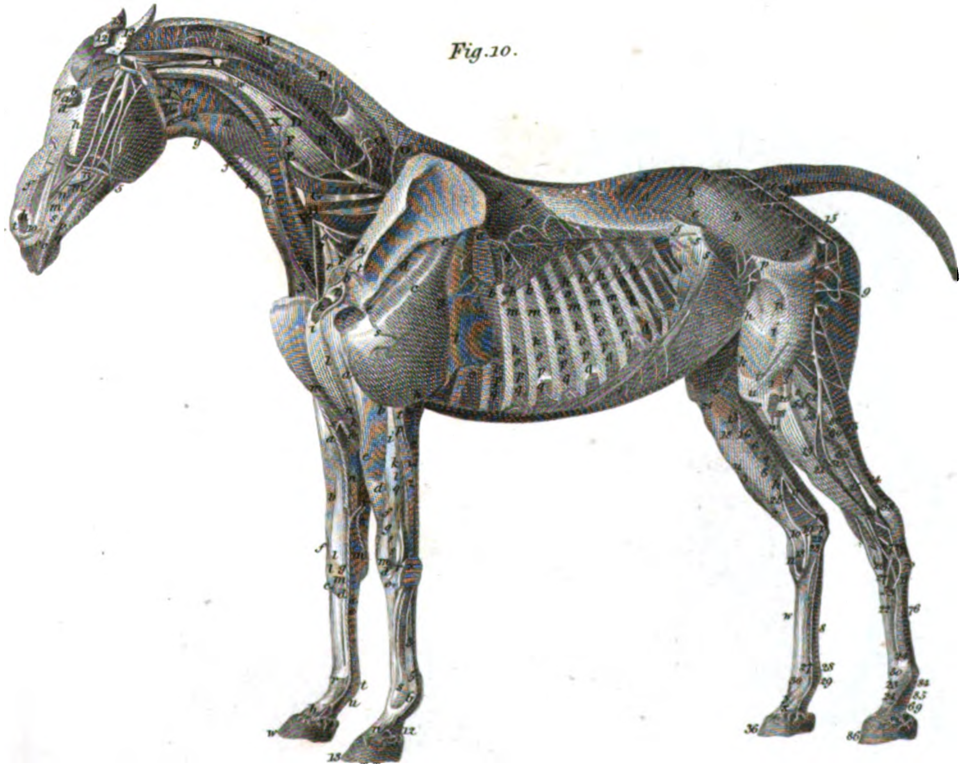


Fig. 10.



Engraved by W. Archibald Edin^r.

**FARRIERY.** **PLATE CCXIV.**

*Fig. 11.*

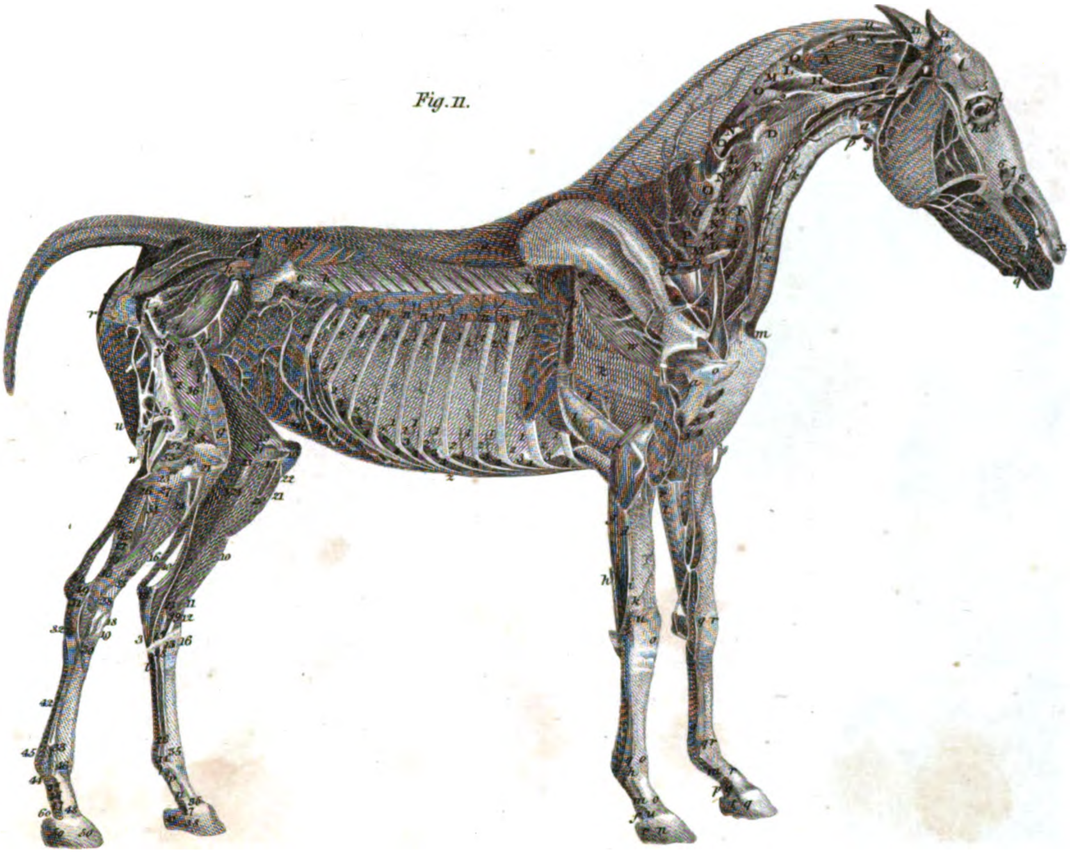
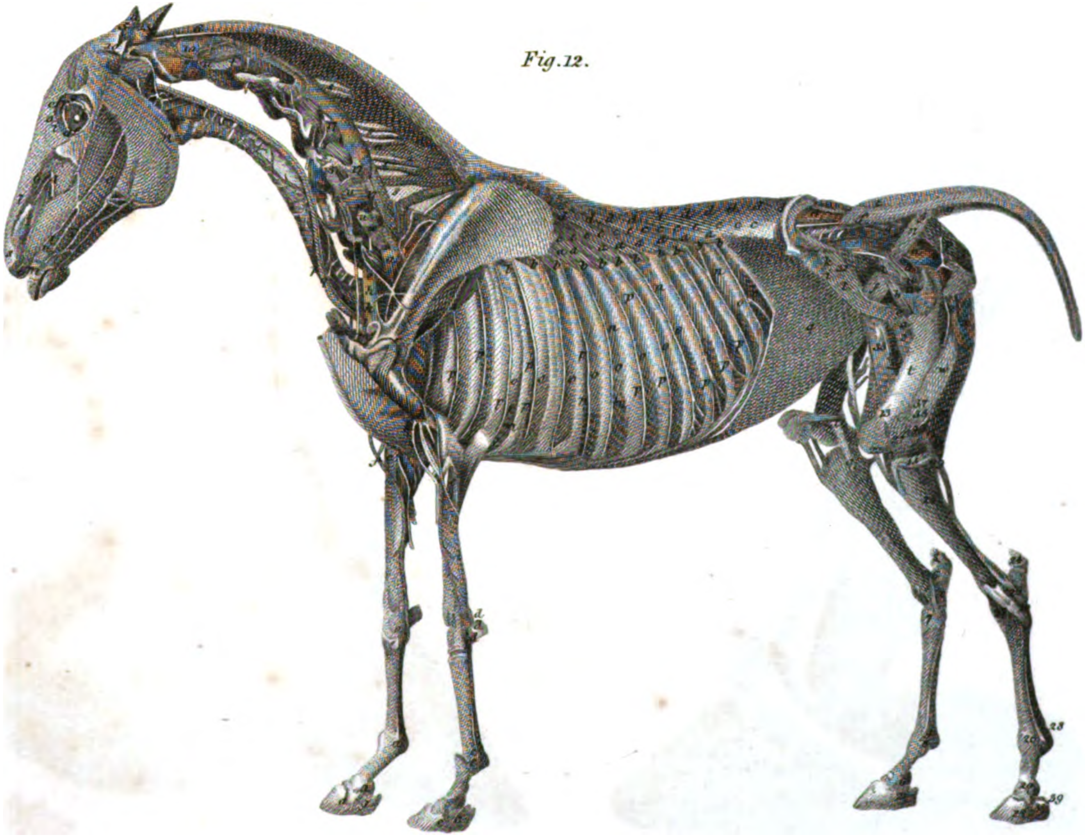


*Fig. 12.*



Engraved by W. Archibald Edin.r

# FARRIERY. PLATE CCXV.

Fig. 13.

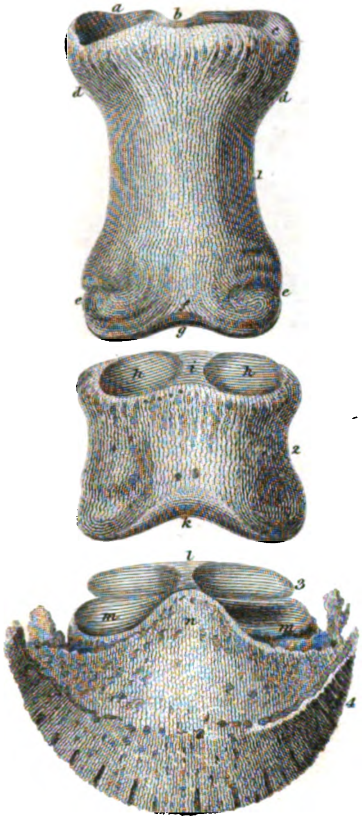


Fig. 14.

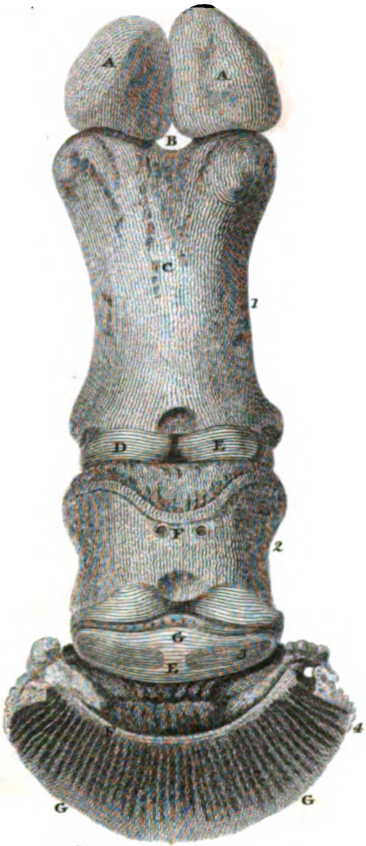


Fig. 15.

Fig. 16.

Engraved by A. Wilson Edin.r

# FARRIERY.

PLATE CCXVI.

Fig. 17.

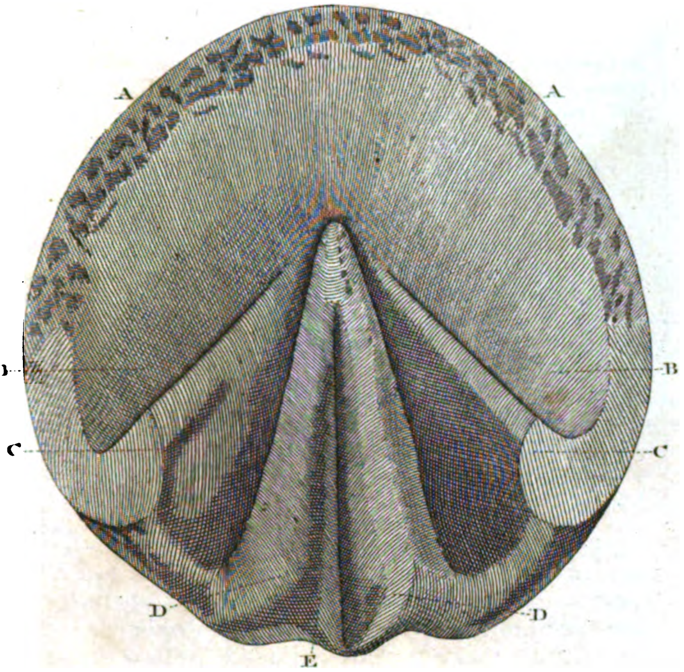


Fig. 18.

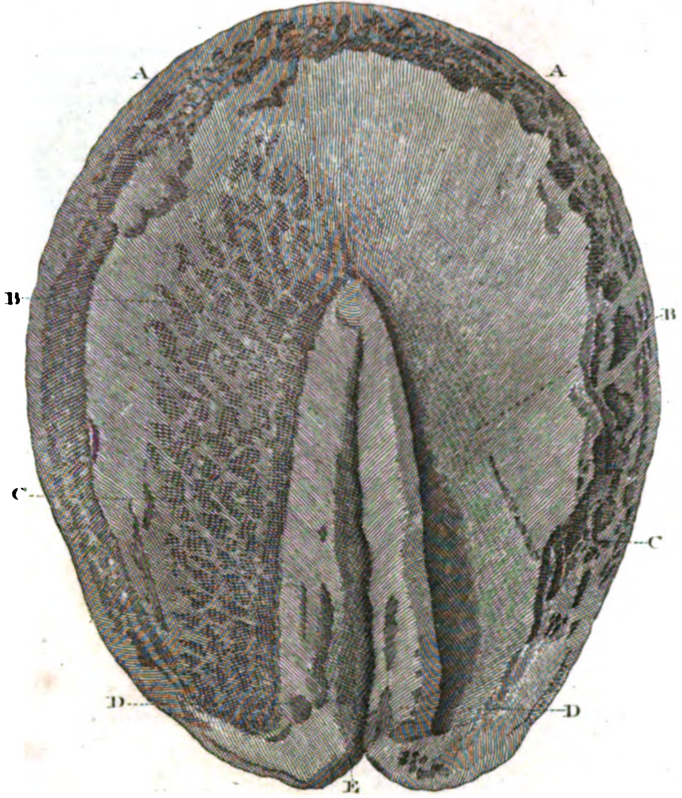


Fig. 19.

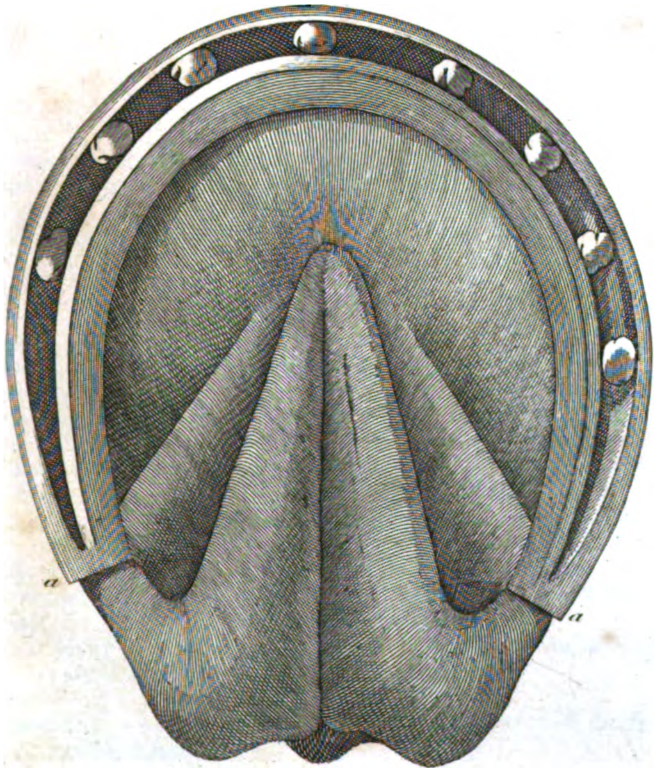


Fig. 20.

W. Archibald Sculp.^t

be attributed to them, which are at this time imputed to other causes.

"Poisonous vapours are extremely active and sudden in their effects, of which proofs may be found in the history of every contagious and endemic disorder. We have, therefore, no reason to be surprised, that sheep and animals are so immediately affected by pasturing in moist places, where these effluvia are copiously produced in hot weather. Other causes operate slowly, and require such a long-continued application, that I do not think the rot can be introduced by them, though I am of opinion, that by occasioning general weakness, they make the constitution more susceptible, and lay it more open to morbid impressions. In the human body, we know that fatigue, cold, fasting, and other debilitating causes, are efficacious auxiliaries, although of themselves they are totally inadequate to produce any contagious disorder. They, therefore, seem to contribute equally, and in the same manner, to facilitate the operations of marsh miasmata, upon the human body and other animals*."

It is said, that for a short time after contracting the *rot*, sheep feed more heartily than usual; and for this reason, butchers and graziers, when they wish to fatten sheep speedily for the market, not unfrequently turn them into a rotting pasture.

The prevention of the *rot* will be easily suggested by attending to the facts and observations that have just been given, as it consists in avoiding the causes that seem to produce it, and avoiding or correcting the soil where it is found most readily to take place. "It is confidently asserted, that decoctions of bitter herbs, with salt, have frequently preserved sheep from the *rot*. Salt is supposed to constitute part of Fleet's celebrated nostrum; and we know that bitters are deservedly recommended to prevent intermittents, the dysentery, and other disorders, which originate from exhalations.

"In Oxfordshire, Dr Lower has frequently known six or seven spoonfuls of strong brine, and stale urine, with soot steeped in it, to be given with great success. This is done at spring and fall of the year, when the dew is counted the most dangerous. This course of physic is continued eight or ten days, or till the sheep eat their meat heartily; and if they were taken in time, there seldom died any in a whole flock. For the same purpose, Ellis recommends the following medicine in his Practical Husbandry.

"Take a peck or better of malt, and mash it as though you would brew it into ale or beer, and make eleven or twelve gallons of liquor; then boil in it a quantity of shepherds purse, comfrey, sage, plantain, penny-royal, wormwood, and bloodwort; add yeast, and afterwards salt, to the mixture; then turn the liquor into a vessel. After April comes in, give seven or eight spoonfuls to every sheep, once in the week, if the weather be wet; and if dry, not so often*."

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* *Harrison on the Rot*, p. 31.

* *Harrison on the Rot*, p. 41.

# INDEX.

*Stables*,

Farthing.

FARTHING, a small English copper coin, amounting to one-fourth of a penny. It was anciently called *fourthing*, as being the fourth of the integer or penny.

*Farthing of Gold*, a coin used in ancient times, containing in value the fourth part of a noble, or 20d. silver. It is mentioned in the stat. 9 Hen. V. cap. 7. where it is enacted, that there shall be good and just weight of the noble, half-noble, and farthing of gold.

*Farthing of Land* seems to differ from *Fardingdeal.* For in a survey-book of the name of West-Hapton in Devonshire, there is an entry thus: A. B. holds six farthings of land at 126l. per annum. So that the farthing of land must have been a considerable quantity, far more than a rood.

Farthing, Fasces.

FASCES, in Roman antiquity, axes tied up together with rods or staves, and borne before the Roman magistrates as a badge of their office and authority.

According to Florus, the use of the fasces was introduced by the elder Tarquin, the fifth king of Rome; and were then the mark of the sovereign dignity. In after times they were borne before the consuls, but by turns only, each his day; they had each of them 12, borne by as many lictors. These fasces consisted of branches,

branches of elm; having in the middle a securis or axe, the head of which stood out beyond the rest. Publicola took the axe out of the fasces, as Plutarch assures us, to remove from the people all occasion of terror. After the consuls, the pretors assumed the fasces. In the government of the decemvirs, it was the practice at first for only one of them to have the fasces. Afterwards each of them had twelve after the manner of the kings.

When the magistrates who by right had the axes carried before them, had a mind to show some deference to the people, or some person of singular merit, they either sent away the lictors, or commanded them to lower the fasces before them, which was called *submittere fasces*. Many instances of this occur in Roman history.

FASCETS, in the art of making glass, are the irons thrust into the mouths of bottles, in order to convey them to the annealing tower.

FASCIA, in antiquity, a thin sash which the Roman women wrapped round their bodies, next to the skin, in order to make them slender. Something of this sort seems also to have been in use amongst the Grecian ladies, if we can depend upon the representation given by Terence, Eun. act ii. sc. 4.

*Haud similis est virginum nostrarum, quas matres student*
*Demissis humeris esse—vincto corpore, ut graciles fiant.*

FASCIA, in *Architecture*, signifies any flat member having a considerable breadth and but a small projecture, as the band of an architrave, larmier, &c. In brick buildings, the juttings out of the brick beyond the windows in the several stories except the highest are called *fascias* or *fasciæ*.

*FASCIA Lata*, in *Anatomy*, a muscle of the leg, called also *semi-membranosus*. See ANATOMY, *Table of the Muscles*.

FASCIÆ, in *Astronomy*, the belts seen on the disk of the superior planets, Mars, Jupiter, and Saturn.—See ASTRONOMY, *passim*.

FASCIALIS, in *Anatomy*, one of the muscles of the thigh, called *sartorius*. See ANATOMY, *Table of the Muscles*.

FASCINATION (from the Greek *βασκαινειν*, to *fascinate* or *bewitch*), a sort of witchcraft supposed to operate either by the eye or the tongue.

Ancient writers distinguish two sorts of fascination, one performed by looking, or the efficacy of the eye. Such is that spoken of by Virgil in his third eclogue:

*Nescio quis teneros oculus mihi* fascinat *agnos.*

The second by words, and especially by malignant praises. Such is that mentioned by the same poet in his seventh eclogue:

*Aut, si ultra placitum laudârit, baccare frontem*
*Cingite, ne vati noceat mala lingua futuro.*

Horace alludes to both kinds in his first book of epistles:

*Non istic obliquo oculo mea commoda quisquam*
*Limat, non odio obscuro, morsuque venenat.*

FASCINATION of serpents, a faculty which these animals are supposed to possess of attracting birds from the air, and making them their prey. See OPHIOLOGY *Index*.

FASCINES, in *Fortification*, faggots of small wood, of about a foot diameter, and six feet long, bound in the middle, and at both ends. They are used in raising batteries, making chandeliers, in filling up the moat to facilitate the passage to the wall, in binding the ramparts where the earth is bad; and in making parapets of trenches to screen the men. Some of them are dipped in melted pitch or tar; and, being set on fire, serve to burn the enemy's lodgments or other works.

In corrupt Latin *fascenina*, *fascennia*, and *fascinata*, &c. are used to signify the pales, fascines, &c. used to enclose ancient castles, &c.

FASCIOLA, the FLUKE or GOURD WORM, a genus belonging to the order of vermes intestina. See HELMINTHOLOGY *Index*.

FASHION-PIECES, in the sea-language, the aftmost or hindmost timbers of a ship, which terminate the breadth, and form the shape of the stern. They are united to the stern-post, and to the extremity of the wing-transom, by a rabbit, and a number of strong nails or spikes driven from without.

FAST, in general, denotes the abstinence from food, (see FASTING); but is more particularly used for such abstinence on a religious account.

Religious fasting has been practised by most nations from the remotest antiquity. Some divines even pretend its origin was in the earthly paradise, where our first parents were forbidden to eat of the tree of knowledge. But though this seems carrying the matter too far, it is certain that the Jewish church has observed fasts ever since its first institution. Nor were the neighbouring heathens, viz. the Egyptians, Phœnicians, and Assyrians, without their fasts. The Egyptians, according to Herodotus, sacrificed a cow to Isis, after having prepared themselves by fasting and prayer; a custom which he likewise ascribes to the women of Cyrene. Porphyry affirms, that the Egyptians, before their stated sacrifices, always rested a great many days, sometimes for six weeks; and that the least behoved to be for seven days; during all which time the priests and devotees not only abstained from flesh, fish, wine, and oil; but even from bread, and some kinds of pulse. These austerities were communicated by them to the Greeks, who observed their fasts much in the same manner. The Athenians had the Eleusinian and Thesmophorian fasts, the observation of which was very rigorous, especially among the women, who spent one whole day sitting on the ground in a mournful dress, without taking any nourishment. In the island of Crete, the priests of Jupiter were obliged to abstain all their lives from fish, flesh, and baked meats. Apuleius informs us, that whoever had a mind to be initiated in the mysteries of Cybele were obliged to prepare themselves by fasting ten days; and, in short, all the pagan deities, whether male or female, required this duty of those that desired to be initiated into their mysteries, of their priests and priestesses that gave the oracles, and of those who came to consult them.

Among the heathens fasting was also practised before some of their military enterprises. Aristotle informs us, that the Lacedæmonians having resolved to succour a city of the allies, ordained a fast throughout the whole extent of their dominions, without excepting even the domestic animals; and this they did for two ends; one to spare provisions in favour of the besieged; the other to draw down the blessing of heaven upon their enterprise. The inhabitants of Tarentum, when besieged by the Romans, demanded succours from their neighbours of Rhegium, who immediately commanded a fast throughout their whole territories. Their enterprise having had good success by their throwing a supply of provisions into the town, the Romans were obliged to raise the siege; and the Tarentines, in memory of this deliverance, instituted a perpetual fast.

Fasting has always been reckoned a particular duty among philosophers and religious people, some of whom have carried their abstinence to an incredible length. At Rome it was practised by kings and emperors themselves. Numa Pompilius, Julius Cæsar, Augustus, Vespasian, and others, we are told, had their stated fast days: and Julian the apostate was so exact in this observance as to outdo the priests themselves, and even the most rigid philosophers. The Pythagoreans kept a continual lent; but with this difference, that they believed the use of fish to be equally unlawful with that of flesh. Besides their constant temperance, they also frequently fasted rigidly for a very long time. In this respect, however, they were all outdone by their master Pythagoras, who continued his fasts for no less than 50 days together. Even Apollonius Tyaneus, one of his most famous disciples, could never come up to him in the length of his fasts, though they greatly exceeded those of the ordinary Pythagoreans. The Gymnosophists, or Brahmans of the east, are also very remarkable for their severe fastings; and the Chinese, according to Father le Comte, have also their stated fasts, with forms of prayer for preserving them from barrenness, inundations, earthquakes, &c. The Mahometans too, who possess so large a part of Asia, are very remarkable for the strict observance of their fasts; and the exactness of their dervises in this respect is extraordinary.

Fasting was often used by the heathens for superstitious purposes; sometimes to procure the interpretations of dreams; at others, to be an antidote against their pernicious consequences. A piece of superstition prevails to this day among the Jews; who, though expressly forbidden to fast on Sabbath days, think themselves at liberty to dispense with this duty when they happen to have frightful and unlucky dreams the night preceding, that threatened them with great misfortunes. On these occasions they observe a formal fast the whole day; and at night the patient, having invited three of his friends, addresses himself to them seven times in a very solemn manner, saying, "May the dream I have had prove a lucky one!" And his friends answer as many times, "Amen, may it be lucky, and God make it so!" After which, in order to encourage him, they conclude the ceremony with those words of Ecclesiastes, "Go eat thy bread with joy;" and then set themselves down to table. They have also added several fasts not commanded in the law of Moses, particularly three, in memory of sore distresses their nation has suffered at different times. The abstinence of the ancient Jews commonly lasted 27 or 28 hours at a time; beginning before sunset, and not ending till some hours after sunset next day. On these days they were obliged to wear white robes in token of grief and repentance; to cover themselves with sackloth, or their worst clothes; to lie on ashes; to sprinkle them on their head, &c. Some spent the whole night and day following in the temple or synagogue, in prayers and other devotions, barefooted, with a scourge in their hands, of which they sometimes made a good use in order to raise their zeal. Lastly, in order to complete their abstinence, at night they were to eat nothing but a little bread dipped in water, with some salt for seasoning; except they chose to add to their repast some bitter herbs and pulse.

The ancients, both Jews and Pagans, had also their fasts for purifying the body, particularly the priests and such as were any way employed at the altars; for when nocturnal disorders happened to these, it was unlawful for them to approach all the next day, which they were bound to employ in purifying themselves. On this account at great festivals, where their ministry could not be dispensed with, it was usual for them, on the eve thereof, not only to fast, but also to abstain from sleep, for the greater certainty. For this purpose the high priest had under officers to wake him, if overtaken with sleep; against which other preservatives were also made use of.

FASTERMANS, or Fasting-men, q. d. *homines habentes*, was used in our ancient customs for men in repute and substance; or rather for pledges, sureties, or bondsmen; who, according to the Saxon polity, were fast bound to answer for one another's peaceable behaviour.

FASTI, in Roman antiquity, the kalendar wherein were expressed the several days of the year, with their feasts, games, and other ceremonies.

There were two sorts of fasti, the greater and less: the former being distinguished by the appellation *fasti magistrales*, and the latter by that of *fasti kalendares*.

1. The *fasti kalendares*, which were properly and primarily called *fasti*, are defined by Festus Pompeius to be books containing a description of the whole year: i. e. ephemerides, or diaries, distinguishing the several kinds of days, *festi*, *profesti*; *fasti*, *nefasti*, &c. The author of these was Numa, who committed the care and direction of the fasti to the pontifex maximus, whom the people used to consult on every occasion. This custom held till the year of Rome 450, when C. Flavius, secretary to the pontifices, exposed in the forum a list of all the days on which it was lawful to work; which was so acceptable to the people, that they made him curule ædile.

These lesser fasti, or fasti kalendares, were of two kinds, *urbani* and *rustici*.

The *fasti urbani*, or fasti of the city, were those which obtained or were observed in the city. Some will have them thus called, because they were exposed publicly in divers parts of the city; though by the various inscriptions or gravings thereof on antique stones, one would imagine that private persons had them likewise in their houses. Ovid undertook to illustrate these fasti urbani, and comment on them, in his Libri

Fastorum, whereof we have the first six books still remaining; the last six, if ever they were written, being lost.

In the *fasti rustici*, or country fasti, were expressed the several days, feasts, &c. to be observed by the country people: for as they were taken up in tilling the ground, fewer feasts, sacrifices, ceremonies, and holidays, were enjoined them than the inhabitants of cities; and they had also some peculiar ones not observed at Rome. These rustic fasti contained little more than the ceremonies of the kalends, nones, and ides; the fairs, signs of the zodiac, increase and decrease of the days, the tutelary gods of each month, and certain directions for rural works to be performed each month.

2. In the greater fasti, or *fasti magistrales*, were expressed the several feasts, with every thing relating to the gods, religion, and the magistrates; the emperors, their birth-days, offices, days consecrated to them, and feasts and ceremonies established in their honour, or for their prosperity, &c. With a number of such circumstances did flattery at length swell the fasti; when they became denominated *Magni*, to distinguish them from the bare kalendar, or fasti kalendares.

FASTI was also a chronicle or register of time, wherein the several years were denoted by the respective consuls, with the principal events that happened during their consulates; these were called also *fasti consulares*, or *consular fasti*.

FASTI, or *Dies Fasti*, also denoted court days. The word *fasti, fastorum*, is formed of the verb *fari*, "to speak," because during those days the courts were opened, causes might be heard, and the prætor was allowed *fari*, to pronounce the three words, *do*, *dico*, *addico*: The other days wherein this was prohibited were called *nefasti*: thus Ovid,

> *Ille nefastus erit, per quem tria verba silentur:*
> *Fastus erit, per quem lege licebit agi.*

These *dies fasti* were noted in the kalendar by the letter *F*: but observe, that there were some days *ex parte fasti*, partly *fasti*, partly *nefasti*; i. e. justice might be distributed at certain times of the day, and not at others. These days were called *intercisi*, and were marked in the kalendar thus; *F. P. fastos primo*, where justice might be demanded during the first part of that day.

**FASTING**, the abstaining from food. See FAST.

Many wonderful stories have been told of extraordinary fasting; great numbers of which undoubtedly must be false. Others, however, we have on very good authority, of which some are mentioned under the article ABSTINENCE. Another we have in the

*FASTING WOMAN*. A full account of this very uncommon case is given in the Phil. Trans. Vol. LXVII. Part I. the substance of which follows: The woman, whose name was *Janet M'Lleod*, an inhabitant of the parish of Kincardine in Rosshire, continued healthy till she was 15 years of age, when she had a pretty severe epileptic fit; after this she had an interval of health for four years, and then another epileptic fit which continued a whole day and a night. A few days afterwards she was seized with a fever, which continued with violence several weeks, and from which she did not perfectly recover for some months. At this time she lost the use of her eyelids; so that she was under a necessity of keeping them open with the fingers of one hand, whenever she wanted to look about her. In other respects she continued in pretty good health; only she never had any appearance of menses, but periodically spit up blood in pretty large quantities, and at the same time it flowed from the nose. This discharge continued several years; but at last it ceased: and soon after she had a third epileptic fit, and after that a fever from which she recovered very slowly. Six weeks after the crisis, she stole out of the house unknown to her parents, who were busied in their harvest work, and bound the sheaves of a ridge before she was observed. In the evening she took to her bed, complaining much of her *heart* (most probably her *stomach*, according to the phraseology of that country) and her head. From that time she never rose for five years, but was occasionally lifted out of bed. She seldom spoke a word, and took so little food that it seemed scarce sufficient to support a sucking infant. Even this small quantity was taken by compulsion; and at last, about Whitsunday 1763, she totally refused every kind of food or drink. Her jaw now became so fast locked, that it was with the greatest difficulty her father was able to open her teeth a little, in order to admit a small quantity of gruel or whey; but of this so much generally run out at the corners of her mouth, that they could not be sensible any had been swallowed. About this time they got some water from a noted medicinal spring in Brae-Mar, some of which they attempted to make her swallow, but without effect. They continued their trials, however, for three mornings; rubbing her throat with the water, which run out at the corners of her mouth. On the third morning during the operation, she cried out, "Give me more water; and swallowed with ease all that remained in the bottle. She spoke no more intelligibly for a year; though she continued to mutter some words, which her parents only understood, for 14 days. She continued to reject all kinds of food and drink, till June 1765. At this time her sister thought, by some signs she made, that she wanted her jaws opened; and this being done, not without violence, she called intelligibly for a drink, and drank with ease about an English pint of water. He father then asked her why she would not make some-signs when she wanted a drink? to which she answered, why should she when she had no desire. It was now supposed that she had regained the faculty of speech; and her jaws were kept open for about three weeks by means of a wedge. But in four or five days she became totally silent, and the wedge was removed because it made her lips sore. She still, however, continued sensible; and when her eyelids were opened, knew every body, as could be guessed from the signs she made.

By continuing their attempts to force open her jaws, two of the under foreteeth were driven out; and of this opening her parents endeavoured to avail themselves by putting some thin nourishing drink into her mouth; but without effect, as it always returned by the corners. Sometimes they thought of thrusting a little dough of oatmeal through this gap of the teeth, which she would retain a few seconds, and then return with something like a straining to vomit, without one particle

ticle going down. Nor were the family sensible of any thing like swallowing for four years, excepting the small draught of Brae-Mar water and the English pint of common water. For the last three years she had not any evacuation by stool or urine, except that once or twice a-week she passed a few drops of urine, about as much, to use the expression of her parents, as would wet the surface of a halfpenny. In this situation she was visited by Dr Mackenzie, who communicated the account of her case to the Royal Society. He found her not at all emaciated; her knees were bent, and the hamstrings tight, so that her heels almost touched her buttocks. She slept much, and was very quiet: but when awake, kept a constant whimpering like a new-born weakly infant. She never could remain a moment on her back, but always fell to one side or another; and her chin was clapped close to her breast, nor could it by any force be moved backwards.

The doctor paid his first visit in the month of October; and five years afterwards, viz. in October 1772, was induced to pay her a second visit, by hearing that she was recovering, and had begun to eat and drink. The account given him was most extraordinary. Her parents one day returning from their country labours (having left their daughter fixed to her bed as usual), were greatly surprised to find her sitting upon her hams, on the side of the house opposite to her bed place, spinning with her mother's distaff. All the food she took at that time was only to crumble a little oat or barley cake in the palm of her hand, as if to feed a chicken. She put little crumbs of this into the gap of her teeth; rolled them about for some time in her mouth; and then sucked out of the palm of her hand a little water, whey, or milk; and this only once or twice a day, and even that by compulsion. She never attempted to speak; her jaws were fast locked, and her eyes shut. On opening her eyelids, the balls were found to be turned up under the edge of the os frontis; her countenance was ghastly, her complexion pale, and her whole person emaciated. She seemed sensible, and tractable in every thing except in taking food. This she did with the utmost reluctance, and even cried before she yielded. The great change of her looks Dr Mackenzie attributed to her spinning flax on the distaff, which exhausted too much of the saliva; and therefore he recommended to her parents to confine her totally to the spinning of wool. In 1775, she was visited again, and found to be greatly improved in her looks as well as strength; her food was also considerably increased in quantity; though even then she did not take more than would be sufficient to sustain an infant of two years of age.

The following remarkable instances of animals being able to live long without food, are related by Sir William Hamilton in his account of the late earthquakes in Italy (*Phil. Trans.* vol. lxxiii.). "At Soriano (says he), two fattened hogs that had remained buried under a heap of ruins, were taken out alive the 42d day; they were lean and weak, but soon recovered. Again, "At Messina two mules belonging to the duke de Belviso remained under a heap of ruins, one of them 22 days, and the other 23 days; they would not eat for some days, but drank water plentifully, and are now recovered. There are numberless instances of dogs remaining many days in the same situation; and a hen belonging to the British vice-consul at Messina, that had been closely shut up under the ruins of his house, was taken out the 22d day, and is now recovered; it did not eat for some days, but drank freely; it was emaciated, and showed little signs of life at first. From these instances, and those related before of the hogs at Soriano, and several others of the same kind that have been related to me, but which being less remarkable I omit, one may conclude, that long fasting is always attended with great thirst, and total loss of appetite."

An instance of a similar kind, not less remarkable than either of the two preceding, we find in the Gentleman's Magazine for January 1785, communicated by a correspondent, as follows: "During the heavy snow which fell in the night of the 7th of January 1776, a parcel of sheep belonging to Mr John Wolley, of Matlock, in Derbyshire, which were pastured on that part of the East Moor that lies within the manor of Matlock, were covered with the drifted snow: in the course of a day or two all the sheep that were covered with the snow were found again, except two, which were consequently given up as lost; but on the 14th of February following (some time after the break of the snow in the valleys, and 38 days after the fall), as a servant was walking over a large parcel of drifted snow which remained on the declivity of a hill, a dog he had with him discovered one of the two sheep that had been lost, by winding (or scenting) it through a small aperture which the breath of the sheep had made in the snow; the servant thereupon dug away the snow, and released the captive from its prison; it immediately ran to a neighbouring spring, at which it drank for a considerable time, and afterwards rejoined its old companions as though no such accident had befallen it. On inspecting the place where it was found, it appeared to have stood between two large stones which lay parallel with each other at about two feet and a half distance, and probably were the means of protecting it from the great weight of the snow, which in that place lay several yards thick: from the number of stones around it, it did not appear that the sheep had been able to pick up any food during its confinement. Soon afterwards its owner removed it to some low lands; but as it had nearly lost its appetite, it was fed with bread and milk for some time: in about a fortnight after its enlargement it lost its sight and wool: but in a few weeks afterwards they both returned again, and in the course of the following summer it was quite recovered. The remaining sheep was found dead about a week after the discovery of the other."

In the same publication [†] is recorded the death of one Caleb Elliot, a visionary enthusiast, who meant to have fasted 40 days, and actually survived 16 without food, having obstinately refused sustenance of every kind.

**FASTOLF**, Sir John, a valiant and renowned English officer, a knight banneret and of the Garter, who served in France under Henry IV. V. and VI. was descended from an ancient family in Norfolk, and was born about the year 1377. He was as much distinguished for his virtue at home, as for his valour abroad; and became no less amiable in his private, than he had been admirable in his public character. He died in 1457, upwards of 80 years of age, as we

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[†] Suppl. for 1789. Obituary. p. 1211.

learn from his noted cotemporary William Caxton the first English printer. By an unaccountable mistake it has been asserted, that Shakespeare's Falstaff was drawn to ridicule this great man; and this has made judicious biographers more studious to preserve his reputation.

**FAT**, an oily concrete substance, deposited in different parts of animal bodies. See BOTANY *Index*.

Strong exercise, preternatural heat, an acrimonious state of the juices, and other like causes, by which the oily parts of the blood are attenuated, resolved, or evacuated, prevent the generation of fat; labours of the mind also have this effect, as well as labour or intemperature of the body. Hence rest and plentiful food are sufficient to fatten brutes; but with men it is often otherwise. It is surprising how soon some birds grow fat; ortolans, it is said, in 24 hours, and larks still sooner.

Fats may be divided, from their consistence, into three kinds: (1.) The soft and thin, which grew perfectly liquid in a very small heat; (2.) The thick and consistent, which liquefy less readily; and, (3.) The hard and firm, which require a still stronger heat to melt them. The first is called *Pinguedo;* the second *Axungia;* and the third, *Adeps*, as taken from the animal, and *Sebum*, or *Sevum*, when freed from the skins, &c. This use of the names, however, is not constant, some employing them differently.

A great number of fats have been kept in the shops, for making ointments, plasters, and other medicinal compositions; as hog's lard, the fat of the boar, the fox, the hare, dog, wild cat, Alpine mouse, beaver; that of hens, ducks, geese, storks; of the whale, pike, serpents, viper, &c. as also human fat.—In regard to all these kinds of substances, however, much depends upon the manner of purifying or trying, and of keeping them.

To obtain fat pure, it must be cut into pieces, and cleaned from the interposed membranes and vessels. It must then be cleansed from its gelatinous matter by washing with water, till the water comes from it colourless and insipid; it is afterwards to be melted with a moderate heat in a proper vessel with a little water; and it is to be kept thus melted till the water is entirely evaporated, which is known by the discontinuance of the boiling, which is caused by the water only, and which lasts till not a drop of it remains; yet it is afterwards to be put into an earthen pot, where it fixes; then it is exceedingly white, sufficiently pure for the purposes of pharmacy or chemical examination.

Fat thus purified has very little taste, and a weak, but peculiar smell. For its analysis and chemical properties, see CHEMISTRY *Index*.

One of the chief uses of fat probably is, to receive into its composition, to blunt and correct a great part of the acids of the aliments, and which are more than are requisite to the composition of the nutritive juice, or which nature could not otherwise expel. This is certain, that the greater the quantity of aliments taken by healthy animals, above what is necessary for their nourishment and reproduction, the fatter they become. Hence animals which are castrated, which are not much exercised, or which are come to an age when the loss and production of the seminal fluid is less, and which at the same time consume much succulent aliment, generally become fatter, and sometimes exceedingly so.

Although fat be very different from truly animalized substances, and appears not easily convertible into nutritive juices, it being generally difficult of digestion, and apt to become rancid, as butter does in the stomachs of many persons; yet in certain cases it serves to the nourishment and reparation of the body. Animals certainly become lean, and live upon their fat, when they have too little food, and when they have diseases which prevent digestion and the production of the nutritive juice; and in these cases the fatter animals hold out longer than the leaner. The fat appears to be then absorbed by the vessels designed for this use, and to be transformed into nutritive juice.

FAT, in the sea language, signifies the same with broad. Thus a ship is said to have a fat quarter, if the trussing in or tuck of her quarter be deep.

FAT likewise denotes an uncertain measure of capacity. Thus a fat of isinglass contains from 3¼ hundred weight to 4 hundred weight; a fat of unbound books, half a maund or four bales; of wire, from 20 to 25 hundred weight; and of yarn, from 220 to 221 bundles.

FAT, or VAT, is used also for several utensils: as, 1. A great wooden vessel, employed for measuring of malt, and containing a quarter or eight bushels. 2. A large brewing vessel, used by brewers to run their wort in. 3. A leaden pan or vessel for the making of salt at Droitwich.

**FATA MORGANA**; a very singular phenomenon, mentioned by different philosophical writers and travellers, particularly by Brydone and Swinburne. They inform us that it is seen in the straits of Messina, and sometimes denominated the *castles of the Fairy Morgana*. The accounts of this phenomenon differ considerably from each other, and travellers are not unanimous as to the causes which are necessary for its production. It would perhaps be difficult to determine how far the imagination of those who have spoken of it may be considered capable of producing astonishment, yet the actual existence of such a phenomenon admits of no dispute.

The first chapter of Minasi, in his dissertation on the Fata Morgana, speaks of this phenomenon in the following manner. When the rising sun shines from that point whence its incident ray forms an angle of 45° on the sea of Reggio, and the bright surface of the water in the bay is not disturbed either by the wind or the current, the spectator being placed on an eminence of the city, with his back to the sun and his face to the sea; on a sudden there appear in the water, as in a catoptric theatre, various multiplied objects, that is to say, numberless series of pilasters, arches, castles well delineated, regular columns, lofty towers, superb palaces, with balconies and windows, extended alleys of trees, delightful plains with herds and flocks, armies of men on foot and horseback, and many other strange images, in their natural colours and proper actions, passing rapidly in succession along the surface of the sea during the whole of the short period of time while the above-mentioned causes remain.

"But if, in addition to the circumstances before described, the atmosphere be highly impregnated with vapour and dense exhalations, not previously dispersed by the action of the wind or waves, or rarefied by the sun, it then happens that in this vapour, as in a curtain extended along the channel to the height of about 30 palms, and nearly down to the sea, the observer will behold the scene of the same objects not only reflected from the surface of the sea, but likewise in the air, though not so distinct or well defined as the former objects from the sea.

"If the air be slightly hazy and opake, and at the same time dewy and adapted to form the iris, then the above-mentioned objects will appear only at the surface of the sea, as in the first case, but all vividly coloured, or fringed with red, green, blue, and other prismatic colours."

From this account of Minasi it appears, that there are three different species of Fata Morgana; the first appearing at the surface of the sea, denominated the *Marine Morgana;* the second in the air, called the *Aërial Morgana*, and the third only at the surface of the sea, or *Morgana* fringed with prismatic colours. The same ingenious author attempted to trace the etymology of the word *Morgana*, which he thinks is derived from *μωρος*, *tristis*, and *γανοω*, *lætitia officio*. This splendid sight affects all descriptions of men with such joy, that they run towards the sea, exclaiming *Morgana, Morgana!* This etymology of Minasi may seem at first view to be a contradiction in terms; but it will appear most natural, when we consider the joy which the Morgana inspires, and the corresponding sorrow or dejection which must be felt when it vanishes away. Our author informs us, that he beheld this magnificent appearance three times, and would rather behold it again than the "most superb theatrical exhibition in the world."

In his physical and astronomical remarks on this phenomenon, he observes that the sea in the straits of Messina exhibits the appearance of a large inclined speculum; that, in the alternate current or tide which flows and returns in the straits for six hours each way, and is constantly attended by an opposite current along shore to the medium distance of about half a league, there are many eddies and irregularities at the time of the change of its direction; and that the Morgana usually appears at this period. He ascribes the effects produced by it to the supposed inclination of the surface of the sea, and its subdivision into different planes by the contrary eddies. The effects produced in the air he considers as the result of saline and other effluvia suspended in the air. These appearances are produced by a calm sea, and one or more strata of superincumbent air differing in refractive, and consequently in reflective power, rather than from any considerable change in the surface of the water, with the laws of which we are much better acquainted than with those of the atmosphere.

To the above account we shall add the following, given by M. Houel, whose judgment and veracity render his authority highly respectable. "In fine summer days, when the weather is calm, there arises above the great current a vapour, which acquires a certain density, so as to form in the atmosphere horizontal prisms, whose sides are disposed in such a manner, that when they come to their proper degree of perfection, they reflect and represent successively, for some time (like a moveable mirror), the objects on the coast or in the adjacent country. They exhibit by turns the city and suburbs of Messina, trees, animals, men, and mountains. They are certainly beautiful aerial moving pictures. There are sometimes two or three prisms, equally perfect; and they continue in this state eight or ten minutes. After this, some shining inequalities are observed upon the surface of the prism, which render confused to the eye the objects which had been before so accurately delineated, and the picture vanishes. The vapour forms other combinations, and is dispersed in air. Different accounts have been given of this singular appearance; which for my part I attribute to a bitumen that issues from certain rocks at the bottom of the sea, and which is often seen to cover part of its surface in the strait of Messina. The subtile parts of the bitumen being attenuated, combined, and exhaled with the aqueous globules that are raised by the air, and formed into bodies of vapour, give to this condensed vapour more consistence; and contribute, by their smooth and polished particles, to the formation of a kind of aerial crystal, which receives the light, reflects it to the eye, and transmits to it all the luminous points which colour the objects exhibited in this phenomenon, and render them visible."

FATE (*fatum*), denotes an inevitable necessity depending upon a superior cause. The word is formed *à fando*, "from speaking:" and primarily implies the same with *effatum*, viz. a word or decree pronounced by God; or a fixed sentence whereby the Deity has prescribed the order of things, and allotted to every person what shall befal him.

The Greeks called it *ειμαρμενη*, as it were a chain or necessary series of things indissolubly linked together. It is also used to express a certain unavoidable designation of things, by which all agents, both necessary and voluntary, are swayed and directed to their ends. See NECESSITY.

In this last sense, fate is distinguished into, 1. Astrological fate, arising from the influence and position of the heavenly bodies; which (it was supposed) gave laws both to the elements and mixed bodies, and to the wills of men. 2. Stoical fate, defined by Cicero an order or series of causes, wherein, cause being linked to cause, each produces another, and thus all things flow from one prime cause. To this fate the Stoics subject even the gods.

Fate is divided by later authors into physical and divine. Physical fate is an order and series of natural causes appropriated to their effects. By this fate it is that fire warms, bodies communicate motion to each other, &c. and the effects of it are all the events and phenomena of nature. 2. Divine fate is what is more usually called *Providence*. See PROVIDENCE.

FATES, in *Mythology*. See PARCÆ.

FATHEMITES, FATEMITES, or FATHIMITES, the descendants of Mahomet by Fathema, or Fatima, his daughter. They never enjoyed the caliphate of Mecca or Bagdad, but reigned in Barbary and Egypt. See the history of these countries.

FATHER, a term of relation denoting a person who hath begot a child. See PARENT and CHILD.

By the laws of Romulus, a father had an unlimited power over his children. Amongst the Lacedæmonians, as we learn from Aristotle's Politics, the father of three children was excused from the duty of mounting guard for the security of the city; and a father of four children was exempted from every public burden. The Poppæan law, amongst the Romans, granted many valuable privileges to the fathers of three children; amongst which one was, that he should be excused from civil offices, and that the mother should have liberty, in her father's lifetime, to make a will, and manage her estate without the authority of tutors.

*Natural Father*, is he who has illegitimate children. See BASTARD; and LAW *Index*.

*Adoptive Father*, is he who takes the children of some other, and acknowledges them as his own. See ADOPTION.

*Putative Father*, is he who is only the reputed or supposed father. Joseph was putative father of our Saviour.

*Father-in-law*, is a person married to a woman who has children by a former husband, &c. to which children he is said to be a father-in-law.

FATHER is also used in theology for the First Person in the Trinity.

FATHER is also used in a figurative sense on divers moral and spiritual occasions. Thus, it is applied to the patriarchs; as we say Adam was the father of all mankind, Abraham the father of the faithful, &c.

FATHER, in church history, is applied to ancient authors who have preserved in their writings the traditions of the church. Thus St Chrysostom, St Basil, &c. are called *Greek fathers*, and St Augustine and St Ambrose *Latin fathers*. No author who wrote later than the 12th century is dignified with the title of *Father*.

FATHER, is also a title of honour given to prelates and dignitaries of the church, to the superiors of convents, to congregations of ecclesiastics, and to persons venerable for their age or quality. Thus we say, the right reverend father in God, the father general of the Benedictines, the fathers of the council of Nice, father of his country, &c.

FATHERLASHER, a species of fishes belonging to the genus cottus. See COTTUS, ICHTHYOLOGY *Index*.

FATHOM, a long measure containing six feet, used chiefly at sea for measuring the length of cables and cordage.

FATNESS. See CORPULENCY.—It is observed, that for one fat person in France or Spain, there are a hundred in England and Holland. This is supposed to be from the use of new malt liquors, more than from the difference of climates or degrees of perspiration. Indolence may cause fatness in some few constitutions; but, in general, those who are disposed to this habit will be fat in spite of every endeavour to the contrary, but that of destroying health.

FATUARII, in antiquity, were persons who, appearing inspired, foretold things to come. The word is formed of *Fatua*, wife of the god Faunus, who was supposed to inspire women with the knowledge of futurity, as Faunus himself did the men.—Fatua had her name from *fari*, q. d. *vaticinari*, "to prophesy."

FAVERSHAM, a town of Kent, in England. See FEVERSHAM.

FAVISSÆ, in antiquity, were, according to Festus and Gellius, cisterns to keep water in: but the favissæ in the Capitol at Rome were subterraneous cellars, where the old statues, broken vessels, and other things used in the temple, were laid up. They were much the same with the *archives* and *treasury* of modern churches.

FAUNA, a deity among the Romans. She was daughter of Picus, and was originally called *Marica*. Her marriage with Faunus procured her the name of *Fauna*, and her knowledge of futurity that of *Fatua* and *Fatidica*. It is said that she never saw a man after her marriage with Faunus, and that her uncommon chastity occasioned her being ranked among the gods after death. She is the same, according to some, as *Bona Mater*.

FAUNALIA, in antiquity, Roman feasts celebrated in honour of the god Faunus, who was the same among the Romans with the *Pan* of the Greeks.

The Faunalia were held on the day of the nones of December; i. e. on the fifth day of that month. The principal sacrifice was a roe-buck; or rather, according to Horace, a kid, attended with libations of wine and burning of incense. It was properly a country festival, being performed in the fields and villages with peculiar joy and devotion. Horace gives us a very gay description thereof in the 18th ode of his third book:

*——Tener pleno cadit hædus anno:*  
*Larga nec desunt Veneris sodali*  
*Vina crateræ: vetus ara multo*  
*Fumat odore.*

Struvius in his Roman kalendar marks the feast of Faunus on the day of the ides of February, which is the 30th day of that month; and the Faunalia he places on the fifth of the ides of December, or the 9th of that month: and in chap. ix. he shews, that there really were two Faunalia; the one in February, mentioned by Ovid, Fast. lib. iv. ver. 246, the other on the 9th of December, mentioned by Horace in the place just cited.

FAUNS, (FAUNI), among the ancients, were a species of demi-gods inhabiting the forests; called also *Sylvans* (*Sylvani*), and little differing from the Satyrs. They delighted more particularly in vineyards; and they generally appear as attendants of Bacchus, in the representations of Bacchanal feasts and processions.—They were represented as half men, half goats, having the horns, ears, feet, and tail of a goat, a very flat nose, and the rest human. Though the Fauns were held for demi-gods, yet they were supposed to die after a long life. Arnobius shows that their father or chief, Faunus himself, lived only 120 years.

FAUNUS, in fabulous history, a son of Picus who reigned in Italy about 1300 years before the Augustan age. His bravery, as well as wisdom, have given rise to the tradition that he was son of Mars. His great popularity, and his fondness for agriculture, made his subjects revere him as one of their country deities after death. He was represented with all the equipage of the satyrs, and was consulted to give oracles.

FAVONIUS, amongst the Romans, the wind which blew directly from the west.

FAVORINUS, an ancient orator and philosopher of Gaul, who flourished under the emperor Adrian, and taught with high reputation both at Athens and Rome. Many works are attributed to him; among the rest, a Greek miscellaneous history often quoted by Diogenes Laertius.

FAUSTUS. See FUST.

FAWKES, FRANCIS, an ingenious poet, had his school education at Leeds; from whence he was transplanted to Jesus College, Cambridge, where he took the degrees in arts. Entering early into holy orders, he settled first at Bramham in Yorkshire, near the elegant seat of that name (Mr Lane's), which he celebrated in verse in 1745, in a 4to pamphlet anonymous. His first poetical publications were, Gawen Douglas's Description of May and Winter modernized. Removing afterwards to the curacy of Croydon in Surry, he recommended himself to the notice of Archbishop Herring, then resident there on account of his health, to whom, besides other pieces, he addressed an ode on his recovery in 1754, printed in Mr Dodsley's collection. In consequence, his grace collated him in 1755 to the vicarage of Orpington with St Mary Gray in Kent; and Mr Fawkes lamented his patron's death in 1757 in a pathetic elegy styled *Aurelius*, first printed with his grace's seven sermons, in 1763. He married about the same time Miss Purrier of Leeds. In April 1774, by the late Dr Plumtree's favour, he exchanged his vicarage for the rectory of Hayes. He was also one of the chaplains to the princess dowager of Wales. He published a volume of poems by subscription in 8vo, 1761; the Poetical Kalendar 1763; and Poetical Magazine 1764, in conjunction with Mr Woty; Partridge Shooting, an eclogue, to the honourable Char. Yorke, 1767, 4to; and a Family Bible, with notes, in 4to, a compilation. But his great strength lay in translation, in which, since Pope, few have equalled him. Witness his fragments of Menander (in his Poems); his works of Anacreon, Sappho, Bion, Moschus, and Musæus, 12mo, 1760; his Idylliums of Theocritus, by subscription, 8vo, 1767; and his Argonautics of Apollonius Rhodius, by subscription also (a posthumous publication, completed by the Reverend Mr Meen of Emanuel College, Cambridge), 8vo, 1780. He died August 26. 1777.

FAWN, among sportsmen, a buck or doe of the first year; or the young one of the buck's breed in its first year.

FE, Fo, or *Fohi*, the name of the chief god of the Chinese, whom they adore as the sovereign of heaven. They represent him shining all in light, with his hands hid under his robes, to show that his power does all things invisibly. He has at his right hand the famous Confucius, and at his left Lanza or Lanca, chief of the second sect of their religion.

FEAL, a provincial term for sod or turf.

*Feal-Dykes*, a cheap sort of fence common in Scotland; built with feal or sod dug up by the spade from the surface of grass ground, consisting of the upper mould rendered tough and coherent by the matted roots of the grass thickly interwoven with it. If only a very thin bit of the upper surface is pared off with a paring spade, the pieces are called *divots*. These being of a firmer consistence, are more durable when built into dykes than feal, but much more expensive also.

FEALTY, in *Law*, an oath taken on the admittance of any tenant, to be true to the lord of whom he holds his land: by this oath the tenant holds in the freest manner, on account that all who have fee hold *per fidem et fiduciam*, that is, by fealty at the least.

This fealty, at the first creation of it, bound the tenant to fidelity, the breach of which was the loss of his fee. It has been divided into general and special; general, that which is to be performed by every subject to his prince; and special, required only of such as, in respect of their fee, are tied by oath to their lords. To all manner of tenures, except tenancy at will, and frank-almoign, fealty is incident, though it chiefly belongs to copyhold estates held in fee and for life. The form of this oath, by stat. 17 Edw. II. is to run as follows: "I A. B. will be to you, my lord D. true and faithful, and bear to you faith for the lands and tenements which I hold of you; and I will truly do and perform the customs and services that I ought to do to you. So help me God."

FEAR, one of the passions of the human mind: (see Passion). It is defined, an apprehension of impending evil, attended with a desire of avoiding it.

Fear in the extreme is called *fright* or *terror*. See Fright.

Fear, in Scripture, is used in various senses.

The *fear of God* is either filial or servile. The filial fear is a holy affection or gracious habit in the soul, whereby it is inclined to obey all God's commandments, and to hate and avoid evil. Slavish or servile fear is the consequence of guilt; it is a judicial impression from the sad thoughts of the provoked majesty of heaven; it is an alarm within that disturbs the rest of a sinner. Though this fear be in wicked men, yet it often proves preparative to faith and repentance.

*Fear* is likewise used for the *object* of fear. Thus it is said, "the *fear* of Isaac," to describe the God whom Isaac feared; (Gen. xxxi. 24.), and in Prov. i. 16. "I will mock when your *fear* cometh;" that is, the calamity you feared. God says, that he will send his *fear* before his people; that is, a dread wrought by him, in order to terrify and destroy the inhabitants of Canaan.

Fear (*Metus*, *Pavor*, or *Timor*), was deified by the Pagans. Tullius Hostilius brought the worship of this deity to Rome. The Ephori of Sparta erected a temple to Fear, near their tribunal, to strike an awe into those who approached it. Fear was likewise worshipped at Corinth. The poets did not forget this imaginary deity. Virgil places her in the entrance of hell, in company with diseases, old age, &c. *Æn.* vi. 273. Ovid places her in the retinue of Tisiphone one of the furies, *Met.* iv. 483.

FEAST, or Festival, in a religious sense, is a ceremony of feasting and thanksgiving. The word is formed of the Latin *festum*, which some derive *à feriari*, "to keep holiday;" others from the Greek *εστιαω*, "I feast or entertain," of *εστια*, "hearth, fire."

Feasts, and the ceremonies thereof, have made great part of the religion of almost all nations and sects; witness those of the Greeks, Romans, Hebrews, Christians, and Mahometans.

The first feasts among the Greeks were celebrated in solemn assemblies of the whole nation, on occasion of their games, as the Olympic, the Pythian, the Isthmian, and Nemæan: in process of time they had many others, the principal of which are enumerated in the course of this work.

The Romans also had abundance of stated feasts in honour of their deities and heroes; such were the Saturnalia, Cerealia, Lupercalia, Liberalia, Neptunalia, Consualia, Portumnalia, Vulcanalia, Palilia, Divalia, &c. See Saturnalia, &c.

They had also feasts instituted occasionally; as Carmentalia,

mentalia, Quirinalia, Terminalia, Floralia, Compitalia, Lemuria, Vernalia, beside other moveable and occasional ones: as to give thanks to the gods for benefits received; to implore their assistance, or to appease their wrath, &c. as the Paganalia, Feralia, Bacchanalia, Ambarvalia, Amburbalia, Snovetaurilia, and divers others, particularly denominated *feriæ;* as Sementinæ, Latinæ, &c. See each of these feasts, and *feriæ* in its proper place. The feasts were divided into days of sacrifice, and days of banqueting and feasting; days of games, and days of rest or *feriæ*.

There being but little history written, or at least published in those days, one end of feasts was to keep up the remembrance of past occurrences.

The principal feasts of the Jews were the feast of trumpets, that of the expiation, of tabernacles, of the dedication, of the passover, of pentecost, and that of purification. See Expiation. &c.

The modern Jews have other feasts marked in their kalendar, of modern institution. The Mahometans, besides their weekly feast or Sabbath, which is kept on Friday, have two solemn feasts, the first of which is called the *Feast of Victims*, and celebrated on the tenth day of the last month of their year; and the second called *Bairam*. The Chinese have two solemn feasts in the year, in the memory of Confucius, besides others of less note on the other days of the year.

Feasts among us are either *immoveable* or *moveable*.

*Immoveable Feasts* are those constantly celebrated on the same day of the year; the principal of these are Christmas day or the Nativity, the Circumcision, Epiphany, Candlemas or the Purification, Lady Day or the Annunciation, called also the *Incarnation* and *Conception*, All Saints and All Souls; besides the days of the several Apostles, St Thomas, St Paul, &c. which with us are feasts, though not *feriæ*. See each feast under its proper article.

*Moveable Feasts* are those which are not confined to the same day of the year. Of these the principal is Easter, which gives law to all the rest, all of them following, and keeping their proper distances from it; such as Palm-Sunday, Good-Friday, Ash-Wednesday, Sexagesima, Ascension Day, Pentecost, and Trinity-Sunday. See Easter, Sexagesima, Pentecost, Trinity, &c.

The four feasts which the English laws take special notice of are, the Annunciation of the blessed Virgin Mary or Lady Day, the 25th of March; the nativity of St John the Baptist, held on the 24th of June; the Feast of St Michael the Archangel, on the 29th of September; and that of St Thomas the Apostle, on the 21st of December: on which quarterly days rent on leases is usually reserved to be paid (5 and 6 Edw. VI. cap. 3. 3 Jac. I. cap. 1. 12 Car. II. cap. 30.).

Besides these feasts, which are *general*, and enjoined by the church, there are others *local* and *occasional*, enjoined by the magistrate, or voluntarily set on foot by the people; such are the days of thanksgiving for delivery from wars, plagues, &c. Such also are the vigils or wakes in commemoration of the dedications of particular churches. See Vigil, &c.

The prodigious increase of feast days in the Christian church commenced towards the close of the fourth century, and was occasioned by the discovery that was then made of the remains of martyrs and other holy men, for the commemoration of whom they were established. These, instead of being set apart for pious exercises, were abused in indolence, voluptuousness, and criminal practices. Many of them were instituted on a pagan model, and perverted to similar purposes.

*Feast of Death*, or *Feast of Souls*, a solemn religious ceremony in use among the savages of America; some of whom thus testify their respect for the deceased every eight years; and others, as the Hurons and Iroquois, every ten years.

The day of this ceremony is appointed by public order; and nothing is omitted, that it may be celebrated with the utmost pomp and magnificence. The neighbouring tribes are invited to be present, and to join in the solemnity. At this time all who have died since the last solemn occasion are taken out of their graves; those who have been interred at the greatest distance from the villages are diligently sought for, and brought to this great rendezvous of carcases.

It is not difficult to conceive the horror of this general disinterment; but it cannot be described in a more lively manner than it is done by Lafitau, to whom we are indebted for the most authentic account of those nations.

"Without question (says he), the opening of these tombs displays one of the most striking scenes that can be conceived; this humbling portrait of human misery, in so many images of death, wherein she seems to take a pleasure to paint herself in a thousand various shapes of horror, in the several carcases, according to the degree in which corruption has prevailed over them, or the manner in which it has attacked them. Some appear dry and withered; others have a sort of parchment upon their bones; some look as if they were baked and smoked, without any appearance of rottenness; some are just turning towards the point of putrefaction; whilst others are all swimming with worms, and drowned in corruption. I know not which ought to strike us most, the horror of so shocking a sight, or the tender piety and affection of these poor people toward their departed friends; for nothing deserves our admiration more than that eager diligence and attention with which they discharge this melancholy duty of their tenderness; gathering up carefully even the smallest bones, handling the carcases, disgustful as they are, with every thing loathsome, cleansing them from the worms, and carrying them upon their shoulders through tiresome journeys of several days, without being discouraged from the offensiveness of the smell, and without suffering any other emotions to arise than those of regret, for having lost persons who were so dear to them in their lives, and so lamented in their death.

"They bring them into their cottages, where they prepare a feast in honour of the dead; during which their great actions are celebrated, and all the tender intercourses which took place between them and their friends are piously called to mind. The strangers, who have come sometimes many hundred miles to be present on the occasion, join in the tender condolence; and the women, by frightful shrieks, demonstrate that they are pierced with the sharpest sorrow. Then the dead bodies are carried from the cabins for the general re-interment. A great pit is dug in the ground, and thither,

thither, at a certain time, each person, attended by his family and friends, marches in solemn silence, bearing the dead body of a son, a father, or a brother. When they are all convened, the dead bodies, or the dust of those which were quite corrupted, are deposited in the pit: then the torrent of grief breaks out anew. Whatever they possess most valuable is interred with the dead. The strangers are not wanting in their generosity, and confer those presents which they have brought along with them for the purpose. Then all present go down into the pit, and every one takes a little of the earth, which they afterwards preserve with the most religious care. The bodies, ranged in order, are covered with entire new furs, and over these with bark, on which they throw stones, wood and earth. Then taking their last farewell, they return each to his own cabin.

"We have mentioned, that in this ceremony the savages offer, as presents to the dead, whatever they value most highly. This custom, which is universal among them, arises from a rude notion of the immortality of the soul. They believe this doctrine most firmly, and it is the principal tenet of their religion. When the soul is separated from the body of their friends, they conceive that it still continues to hover around it, and require and take delight in the same things with which it formerly was pleased. After a certain time, however, it forsakes this dreary mansion, and departs far westward into the land of spirits. They have even gone so far as to make a distinction between the inhabitants of the other world; some, they imagine, particularly those who in their lifetime have been fortunate in war, possess a high degree of happiness, have a place for hunting and fishing, which never fails, and enjoy all sensual delights, without labouring hard in order to procure them. The souls of those on the contrary, who happen to be conquered or slain in war, are extremely miserable after death."

**Feast** is also used for a banquet, or a sumptuous meal, without any immediate view to religion.

The use of the word, in this sense, arises hence; that a part of the ceremony of many of the ancient festivals, both those of the heathens and the agapæ of the Christians, was good eating; though Mr Huet chooses to derive the word from *festinare*, which in an ancient Latin version of Origen's Comment on Matthew, signifies "to feast:" *Ut veniens illuc Jesus festinet, cum discipulis suis.*

Social or civil feasts were also expressed by the words *convivium* and *compotatio* or *concœnatio*. Cicero says that in the Roman tongue, the word *convivium*, which means "people assembled at table," is more significant than the Greek word *compotatio* or *concœnatio*: the Roman, says he, expresses the conjunction of body and mind which ought to take place at an entertainment; the Greek denotes what relates to the body alone.

As food is necessary to our existence, it makes a bond of association among mankind. People at a feast, says one of the ancients, seem to form but one body, one soul. All nations, whether savage or civilized, have regarded the pleasure of the table as the occasion of the most agreeable society. This species of enjoyment (abstracting from its susceptibility of abuse) makes but one family of all that it brings together. It levels the distinctions introduced by policy or prejudice, and disposes men to regard one another as brethren. It is here that people feel the equality established by nature; here they forget the evils of life; they extinguish their hatred, and make their enmities cease. For this reason Aristotle considers as a breach of the social principle that custom of the Egyptians of eating apart, and praises the convivial repasts established by Minos and Lycurgus.

The Persians generally deliberated on business at table, but never determined or put their determinations in execution except in the morning before having eaten.

When the Germans, says Tacitus, wanted to reconcile enemies, to make alliances, to name chiefs, or to treat of war and peace, it was during the repast that they took counsel; a time in which the mind is most open to the impressions of simple truth, or most easily animated to great attempts. These artless people during the conviviality of the feast spoke without disguise. Next day they weighed the counsels of the former evening; they deliberated at a time when they were not disposed to feign, and took their resolution when they were least liable to be deceived.

People of rank among the Rhodians, by a fundamental law of the state, were obliged to dine daily with those who had the management of affairs, in order to deliberate with them concerning such things as were necessary or useful for the country; and on this account the principal ministers of the kingdom were obliged to keep open table for all who could be of use to the state.

Among the Romans, the place where they supped was generally the vestibule, that a more retired part of the house might not encourage licentiousness and disorder. There were several laws that restricted their meals to those vestibules.

When luxury reigned at Rome, they had superb halls for their entertainments. Lucullus had many, each of which bore the name of some deity; and this name was a mark which indicated to the servants the expence of the entertainment. The expence of a supper in Lucullus's hall of Apollo amounted to 50,000 drachmas.

The hall in which Nero feasted, by the circular motion of its walls and ceiling, imitated the revolutions of the heavens, and represented the different seasons of the year, changing at every course, and showering down flowers and perfumes on the guests.

The Romans did not, as we do, use but one table at their feasts; they had generally two; the first was for the services of animal food, which was afterwards removed, and another introduced with fruits; at this last they sung, and poured out their libations. The Greeks and eastern nations had the same custom, and even the Jews in their solemn feasts and at sacrifices.

The Romans, in the time of Nero, had tables made of citron wood brought from Mauritania; they were varnished with purple and gold, and were raised on feet of carved ivory. It is said that they were more precious than gold. Dion Cassius affirms that Seneca had 500 of these, which he made use of one after another; and Tertullian tells us that Cicero had but one. The Romans chose the king of the feast by a throw of the dice.

We learn from Herodotus, that the ancients had neither cups nor bowls, but that they drank out of little horns tipt with silver or gold.

Under the reign of Charles V. of France, the custom of placing the lights upon the table was not yet introduced. A number of domestics held the candles in their hands during the whole time of the repast.

The Greeks and Romans kept a domestic for the purpose of reading during their meals and feasts. Sometimes the chief of the family himself performed the office of reader; and history informs us, that the emperor Severus often read while his family ate. The time of reading was generally at supper; and guests were invited to a reading as they are now a-days to play cards.

The Greeks, in their flourishing times, did not profane, according to their own expression, the *holiness* of the table; but rather adorned it with ingenious and elegant conversation: they proposed moral topics, of which Plutarch has preserved a collection.

Ancient philosophers remark, that heroes rarely assembled convivially without bringing affairs of consequence into discourse, or deliberating upon those that regarded either present events or future contingencies.

The Scythians, while at meat, used to make the strings of their bows resound, lest their warlike virtues might be enfeebled or lost in this season of pleasure.

When Rome was corrupted with luxury, singers, dancers, musicians, stage-players, and people that told pleasant tales, were brought into the hall to amuse the guests.

Plutarch informs us, that Cæsar, after his triumphs, treated the Roman people at 22,000 tables: and by calculation it would seem that there were at these tables upwards of 200,000 persons.

At the end of the feast the Romans drunk out of a large cup as often as there were letters in the name of their mistresses.

*Pelloutier, Hist. Celt. l. ii. c. 12. p. 463.*

Feasting seems to have been the chief delight of the Germans, Gauls, Britons, and all the other Celtic nations; in which they indulged themselves to the utmost, as often as they had an opportunity. "Among these nations (says an author who had carefully studied their manners) there is no public assembly, either for civil or religious purposes, duly held; no birthday, marriage, or funeral, properly celebrated; no treaty of peace or alliance rightly cemented, without a great feast." It was by frequent entertainments of this kind that the great men or chieftains gained the affections and rewarded the services of their followers; and those who made the greatest feasts were sure to be most popular, and to have the greatest retinue. These feasts (in which plenty was more regarded than elegance) lasted commonly several days, and the guests seldom retired until they had consumed all the provisions and exhausted all the liquors. Athenæus describes an entertainment that was given by Arcamnes, a very wealthy prince in Gaul, which continued a whole year without interruption, and at which all the people of Gaul, and even all strangers who passed through that country, were made welcome. At these feasts they sometimes consulted about the most important affairs of state, and formed resolutions relating to peace and war; imagining that men spoke their real sentiments with the greatest freedom, and were apt to form the boldest designs, when their spirits were exhilarated with the pleasures of the table. The conversation at these entertaiments very frequently turned on the great exploits which the guests themselves or their ancestors had performed in war; which sometimes occasioned quarrels and even bloodshed. It was at a feast that the two illustrious British princes, Cairbar and Oscar, quarrelled about their own bravery, and that of their ancestors, and fell by mutual wounds, (*Ossian*, vol. ii. p. 8, &c.).

As to the drink used at those feasts, particularly in Britain, it seems probable, that before the introduction of agriculture into the island, mead, or honey diluted with water, was the only strong liquor known to its inhabitants, as it was to many other ancient nations in the same circumstances. This continued to be a favourite beverage among the ancient Britons and their posterity long after they had become acquainted with other liquors. The mead-maker was the eleventh person in dignity in the courts of the ancient princes of Wales, and took place of the physician. The following ancient law of that principality shows how much this liquor was esteemed by the British princes.—"There are three things in the court which must be communicated to the king before they are made known to any other person: 1. Every sentence of the judge; 2. Every new song; and, 3. Every cask of mead." This was perhaps the liquor which is called by Ossian the joy and strength of shells, with which his heroes were so much delighted.—After the introduction of agriculture, ale or bear became the most general drink of all the British nations who practised that art, as it had long been of all the Celtic people on the continent (see Ale). If the Phœnicians or Greeks imported any wine into Britain, it was only in very small quantities; that most generous liquor being very little known in this island before it was conquered by the Romans. The drinking vessels of the Gauls, Britons, and other Celtic nations, were, for the most part, made of the horns of oxen and other animals; but those of the Caledonians consisted of large shells, which are still used by some of their posterity in the Highlands of Scotland.

The dishes in which the meat was served up were either of wood or earthen ware, or a kind of baskets made of osiers. These last were most used by the Britons, as they very much excelled in the art of making them both for their own use and for exportation. The guests sat in a circle upon the ground, with a little hay, grass, or the skin of some animal under them. A low table or stool was set before each person, with the portion of meat allotted to him upon it. In this distribution, they never neglected to set the largest and best pieces before those who were most distinguished for their rank, their exploits, or their riches. Every guest took the meat set before him in his hands, and tearing it with his teeth, fed upon it in the best manner he could. If any one found difficulty in separating any part of his meat with his hands and teeth, he made use of a large knife, that lay in a particular place for the benefit of the whole company. Servants, or young boys and girls, the children of the family, stood behind the guests, ready to help them to drink or any thing they wanted.

As the ancient Britons greatly excelled and very much delighted in music, all their feasts were accompanied with the joys of song, and the music of harps. In the words of Ossian †, "whenever the feast of shells is prepared, the songs of bards arise. The voice of sprightly mirth is heard. The trembling harps of joy are strung. They sing the battles of heroes, or the heaving breasts of love." Some of the poems of that illustrious British bard appear to have been composed in order to be sung by the hundred bards of Fingal ‡ at the feast of Selma. Many of the songs of the bards which were sung and played at the feasts of the ancient Britons, were of a grave and solemn strain, celebrating the brave actions of the guests, or of the heroes of other times; but these were sometimes intermixed with more sprightly and cheerful airs, to which the youth of both sexes danced, for the entertainment of the company.

ol. ii. ). . i. 9.

*id.* i. 7. 169.

If has been often observed by authors, that there is no nation in the world comes near the English in the magnificence of their feasts. Those made at our coronations, instalments, consecrations, &c. transcend the belief of all foreigners; and yet it is doubted whether those now in use are comparable to those of our forefathers.

William the Conqueror, after he was peaceably settled on the throne of England, sent agents into different countries, to collect the most admired and rare dishes for his table; by which means, says John of Salisbury, this island, which is naturally productive of plenty and variety of provisions, was overflowed with every thing that could inflame a luxurious appetite. The same writer tells us, that he was present at an entertainment which lasted from three o'clock in the afternoon to midnight; at which delicacies were served up, which had been brought from Constantinople, Babylon, Alexandria, Palestine, Tripoli, Syria, and Phœnicia. These delicacies, we may presume, were very expensive. Thomas Becket, if we may believe his historian, Fitz-Stephen, gave 5l. equivalent to 75l. at present, for one dish of eels. The sumptuous entertainments which the kings of England, and of other countries, gave to their nobles and prelates, at the festivals of Christmas, Easter, and Whitsuntide, in which they spent a great part of their revenues, contributed very much to diffuse a taste for profuse and expensive banqueting. It was natural for a proud and wealthy baron to imitate in his own castle the entertainments he had seen in the palace of his prince. Many of the clergy too, both seculars and regulars, being very rich, kept excellent tables. The monks of St Swithins, at Winchester, made a formal complaint to Henry II. against their abbot, for taking away three of the 13 dishes they used to have every day at dinner. The monks of Canterbury were still more luxurious: for they had at least 17 dishes every day, besides a dessert; and these dishes were dressed with spices and sauces; which excited the appetite as well as pleased the taste.

Great men had some kinds of provisions at their tables that are not now to be found in Britain. When Henry II. entertained his own court, the great officers of his army, with all the kings and great men of Ireland, in Dublin, at the feast of Christmas A. D. 1171, the Irish princes and chieftains were quite astonished at the profusion and variety of provisions which they beheld, and were with difficulty prevailed upon by Henry to eat the flesh of cranes, a kind of food to which they had not been accustomed. In the remaining monuments of this period, we meet with the names of several dishes, as dellegrout, maupigyrnun, karumpie, &c. the composition of which is now unknown.

The coronation feast of Edward III. cost 2835l. 18s. 2d. equivalent to about 40,000l. of our money. At the installation of Ralph abbot of St Augustine, Canterbury, A. D. 1309, 6000 guests were entertained with a dinner, consisting of 3000 dishes, which cost 287l. 5s. equal in efficacy to 4300l. in our times. "It would require a long treatise (says Matthew Paris) to describe the astonishing splendour, magnificence, and festivity with which the nuptials of Richard earl of Cornwall, and Cincia daughter of Reimund earl of Provence, were celebrated at London, A. D. 1243. To give the reader some idea of it, in a few words, above 30,000 dishes were served up at the marriage dinner." The nuptials of Alexander III. of Scotland, and the princess Margaret of England, were solemnized at York, A. D. 1251, with still greater pomp and profusion. "If I attempted (says the same historian) to display all the grandeur of this solemnity,—the numbers of the noble and illustrious guests,—the richness and variety of the dresses,—the sumptuousness of the feasts,—the multitudes of the minstrels, mimicks, and others whose business it was to amuse and divert the company, those of my readers who were not present would imagine that I was imposing upon their credulity." The following particular will enable them to form a judgment of the whole. The archbishop of York made the king of England a present of 60 fat oxen, which made only one article of provision for the marriage feast, and were all consumed at that entertainment.

The marriage feast of Henry IV. and his queen Jane of Navarre, consisted of six courses; three of flesh and fowls, and three of fish. All these courses were accompanied and adorned with *suttleties*, as they were called. These *suttleties* were figures in pastry, of men, women, beasts, birds, &c. placed on the table to be admired, but not touched. Each figure had a label affixed to it; containing some wise or witty saying, suited to the occasion of the feast, which was the reason they were called *suttleties*. The installation feast of George Neville, archbishop of York and chancellor of England, exceeded all others in splendour and expence, and in the number and quality of the guests. The reader may form some idea of this enormous feast from the following list of provisions prepared for it. In wheat, quarters, 300; in ale, tuns, 300; in wine, tuns, 100; in ipocrasse, pipes, 1; in oxen, 104; in wild bulls, 6; in muttons, 1000; in veals, 304; in porkes, 304; in swanns, 400; in geese, 2000; in cappons, 1000; in pigs, 2000; in plovers, 400; in quailes, 1200; in fowls, called rees, 2400; in peacocks, 104; in mallards and teals, 4000; in cranes, 204; in kids, 204; in chickens, 2000; in pigeons, 2000; in connies, 4000; in bittors, 204; in heronshaws, 400; in pheasants, 200; in partridges, 500; in woodcocks, 400; in curliews, 100; in egrits, 1000; in staggs, bucks, and roes, 500 and more; in pasties of of venison, cold, 4000; in parted dishes of jellies, 1000; in plain dishes of jellies, 3000; in cold tarts, baked, 4000; in cold custards, baked, 3000; in hot pasties of venison, 1500; in hot custards, 2000; in pikes and breams, 308; in porpoises and seals, 12; spices, sugared delicates, and waters, plenty. No turkeys are mentioned in this enormous bill of fare, because they were not then known in England. Cranes, heronshaws, porpoises, and seals, are seldom seen at modern entertainments.

One of the most expensive singularities attending the royal feasts in these days consisted in what they called *intermeats*. These were representations of battles, sieges, &c. introduced between the courses for the amusement of the guests. The French excelled in exhibitions of this kind. At a dinner given by Charles V. of France to the emperor Charles IV. A. D. 1378, the following intermeat was exhibited: A ship with masts, sails, and rigging, was seen first: she had for colours the arms of the city of Jerusalem: Godfrey de Bouillon appeared upon deck, accompanied by several knights armed cap-a-pee: the ship advanced into the middle of the hall, without the machine which moved it being perceptible. Then the city of Jerusalem appeared, with all its towers lined with Saracens. The ship approached the city; the Christians landed, and began the assault; the besieged made a good defence: several scaling ladders were thrown down; but at length the city was taken. Intermeats at ordinary banquets consisted of certain delicate dishes introduced between the courses, and designed rather for gratifying the taste than for satisfying hunger.

At those feasts, besides the ordinary drinks, ale and cyder, there were great quantities of wines of various kinds. Of these last, the following lines of a poet who wrote in the fourth century, contain an ample enumeration.

> Ye shall have rumney and malespine,
> Both ypocrasse and vernage wyne;
> Mountresse and wyne of Greke,
> Both algrade and despice eke,
> Antioche and bastarde,
> Pyment also, and garnarde,
> Wyne of Greke and Muscadell,
> Both clare, pyment, and Rochell.

Some of these liquors, as ypocrasse, pyment, and claret, were compounded of wine, honey, and spices of different kinds, and in different proportions.

**FEATHER**, in *Physiology*, a general name for the covering of birds; it being common to all the animals of this class to have their whole body, or at least the greatest part of it, covered with feathers or plumage. See ORNITHOLOGY *Index*.

Feathers make a considerable article in commerce, particularly those of the ostrich, heron, swan, peacock, goose, &c. for plumes, ornaments of the head, filling of beds, writing pens, &c.

Geese are plucked in some parts of Great Britain five times in the year; and in cold seasons many of them die by this barbarous custom. Those feathers that are brought from Somersetshire are esteemed the best, and those from Ireland the worst.

Eider down* is imported from Denmark; the ducks that supply it being inhabitants of Hudson's Bay, Greenland, Iceland, and Norway. Our own islands west of Scotland breed numbers of these birds, which turn out a profitable branch of trade to the poor inhabitants. Hudson's Bay also furnishes very fine feathers, supposed to be of the goose kind. The down of the swan is brought from Dantzic. The same place also sends us great quantities of the feathers of the cock and hen. The London poulterers sell a great quantity of the feathers of those birds, and of ducks and turkeys: those of ducks being a weaker feather, are inferior to those of the goose; and turkeys feathers are the worst of any. The best method of curing feathers is to lay them in a room, in an exposure to the sun; and when dried to put them in bags, and beat them well with poles to get the dirt off.

**FEBRIFUGE**, an appellation given to such medicines as mitigate or remove a fever.

**FEBRUARY**, in *Chronology*, the second month of Numa's year, and under the protection of the god Neptune. This month is not found in the kalendar of Romulus, but was added to the year by Numa. It had its name from *Februa*, *Februaca*, or *Februalis*, all names of Juno, who presided over the purifications of women; and in this month the Lupercalia were held in honour of Juno, and women were purified by the priests of Pan Lyceus at that festival. See LUPERCALIA.

February, in a common year, consists only of 28 days; but in the bissextile year it has 29, on account of the intercalary day added that year.

**FECIALES**, or FŒCIALES, an order of priests or officers, consisting of 20 persons, among the ancient Romans, appointed to proclaim war, negotiate peace, &c.

Festus derives the word from *ferio*, "I strike;" as *ferire fœdus* signifies "to conclude a treaty;" and accordingly, instead of *feciales*, he would have it written *feriales*. Others derive it from *fœdus*, which was anciently written *fedus*; or from *fides*, "faith." Others from *facio*, *feci*, "I make," &c. because they made war and peace. Vossius chooses to derive it from *fatu*, of the verb *fari*, "to speak": in which sense the *feciales* should be the same with *oratores*; which sentiment is also confirmed by the authority of Varro, who says they were called indifferently *feciales* and *oratores*.

The feciales were a sort of heralds, who, when the Romans had any dispute with their neighbours, were sent first to demand the thing intended to be usurped, or require satisfaction for the injury alleged to be done. If an answer was not returned by them that was satisfactory to the people and the senate, they were despatched again to declare war, and the like in treating for peace; the feciales being the only persons appointed to negotiate between the senate, &c. and the enemy.

Plutarch in the life of Numa, and Halicarnasseus (lib. ii.), observes, that they were first instituted by that prince. The latter adds, that they were first chosen out of the best families in Rome; that their office, which was reputed a sort of sacerdotium, or priesthood, only ended with their life; that their persons were sacred and inviolable, as those of other priests; that they were even charged to see the republic did not declare war unjustly; that they were to receive the complaints

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* See the article *Down*.

and remonstrances of nations who pretended to have been any way injured by the Romans; that if those complaints were found just, they were to seize the criminals, and deliver them up to those they had offended; that they were invested with the rights and privileges of ambassadors; that they concluded treaties of peace and alliance, and took care they were executed; and, lastly, abolished them, if they were found not to be equitable. Livy, lib. i. cap. 24. ascribes their institution to Ancus Martius, in the year of Rome 114.—Varro assures us, that in his time most of these functions of the feciales were set aside; though Plutarch observes, that they had still some authority in his time.

The feciales were crowned with *verbena*, "vervain," when they went to declare war. Their head was covered with a veil, over which the crown was applied. In this equipage they proceeded to the frontiers of the new enemy's country, and threw a bloody dart or javelin into the ground within the same. In Livy and other ancient authors we have the formula used in such declarations.

FECUNDITY, the same with FERTILITY.

FEE, in *Law*, signifies a complete feudal property. Hence, where the bare liferent of any feudal subject is meant to be conveyed to A, and the absolute property to B, that meaning is expressed thus; "to A in liferent, and to B in fee." See LAW, N° lxix. clxiv.

Fees are commonly divided into *absolute*, otherwise called fees-simple; and *limited*, one species of which we usually call fee-tail.

I. Tenant in fee-simple (or as he is frequently styled, *tenant in fee*), is he that hath lands, tenements, or hereditaments, to hold to him and his heirs for ever; generally, absolutely and simply; without mentioning what heirs, but referring that to his own pleasure, or to the disposition of the law. The true meaning of the word *fee (feodum)* is the same with that of *feud* or *fief**, and in its original sense it is taken in contradistinction to *allodium;* which latter the writers on this subject define to be every man's own land, which he possesseth merely in his own right, without owing any rent or service to any superior. This is property in its highest degree; and the owner thereof hath *absolutum et directum dominium*, and therefore is said to be seized thereof absolutely *in dominico suo*, in his own demesne. But *feodum* or *fee*, is that which is held of some superior, on condition of rendering him service; in which superior the ultimate property of the land resides. And therefore Sir Henry Spelman defines a feud or fee to be, The right which the vassal or tenant hath in lands to use the same and take the profits thereof to him and his heirs, rendering to the lord his due services; the mere allodial property of the soil always remaining in the lord. This allodial property no subject in Britain has; it being a received and now undeniable principle in the law, that all the lands are holden mediately or immediately of the king. The king therefore only hath *absolutum et directum dominium;* but all subjects lands are in the nature of *feodum* or *fee*, whether derived to them by descent from their ancestors, or purchased for a valuable consideration; for they cannot come to any man by either of those ways, unless accompanied with those feodal clogs which were laid upon the first feudatory when it was originally granted. A subject therefore hath only the usufruct, and not the absolute property, of the soil; or, as Sir Edward Coke expresses it, he hath *dominium utile*, but not *dominium directum*. And hence it is, that, in the most solemn acts of law, we express the strongest and highest estate that any subject can have, by these words, "he is seised thereof *in his demesne*, as of fee." It is a man's demesne, *dominium*, or property, since it belongs to him and his heirs for ever: yet this *dominium*, property, or demesne, is strictly not absolute or allodial, but qualified or feodal: it is of his demesne, *as of fee;* that is, it is not purely and simply his own, since it is held of a superior lord, in whom the ultimate property resides.

Fee.

This is the primary sense and acceptation of the word *fee*. But (as Sir Martin Wright very justly observes) the doctrine, "that all lands are *holden*," having been for so many ages a fixed and undeniable axiom, the English lawyers do very rarely (of late years especially) use the word *fee* in this its primary original sense, in contradistinction to *allodium* or absolute property, with which they have no concern; but generally use it to express the continuance or quantity of estate. A *fee* therefore, in general, signifies an estate of inheritance; being the highest and most extensive interest that a man can have in a feud: and when the term is used simply, without any other adjunct, or has the adjunct of *simple* annexed to it (as, a fee, or a fee-simple), it is used in contradistinction to a fee-conditional at the common law, or a fee-tail by the statute; importing an absolute inheritance, clear of any condition, limitation, or restrictions to particular heirs, but descendible to the heirs-general, whether male or female, lineal, or collateral. And in no other sense than this is the king said to be seised in fee, he being the feudatory of no man.

Taking therefore *fee* in this its secondary sense, as a state of inheritance, it is applicable to, and may be had in, any kind of hereditaments either corporeal or incorporeal. But there is this distinction between the two species of hereditaments; that of a corporeal inheritance a man shall be said to be seised *in his demesne, as of fee;* of an incorporeal one he shall only be said to be seised *as of fee*, and not *in his demesne*. For as incorporeal hereditaments are in their nature collateral to, and issue out of, lands and houses, their owner hath no property, *dominium*, or demesne, in the *thing* itself, but hath only something derived out of it; resembling the *servitutes*, or services, of the civil law. The *dominium*, or property, is frequently in one man, while the appendage or service is in another. Thus Gaius may be seised *as of fee*, of a way going over the land, of which Titius is seised *in his demesne as of fee*.

The fee-simple or inheritance of lands and tenements is generally vested and resides in some person or other; though divers inferior estates may be carved out of it. As if one grants a lease for 21 years, or for one or two lives, the fee-simple remains vested in him and his heirs; and after the determination of those years or lives, the land reverts to the granter or his heirs, who shall hold it again in fee-simple. Yet sometimes the fee may be in *abeyance*, that is (as the word signifies) in expectation, remembrance, and contemplation in law; there being no person *in esse*, in whom it can vest and abide, though the law considers it as always potentially existing, and ready to vest whenever a proper owner appears. Thus, in a grant to John for life, and afterwards to the heirs of Richard, the inheritance is plainly neither granted to John nor Richard, nor can it vest in the heirs of Richard till his death, *nam nemo est hæres viventis:* it remains therefore in waiting, or abeyance, during the life of Richard. This is likewise always the case of a parson of a church, who hath only an estate therein for the term of his life; and the inheritance remains in abeyance. And not only the fee, but the freehold also, may be in abeyance; as, when a parson dies, the freehold of his glebe is in abeyance until a successor be named, and then it vests in the successor.

The word *heirs* is necessary in the grant or donation, in order to make a fee or inheritance. For if land be given to a man for ever, or to him and his assigns for ever, this vests in him but an estate for life. This very great nicety about the insertion of the word *heirs* in all feoffments and grants, in order to vest a fee, is plainly a relick of the feodal strictness: by which it was required, that the form of the donation should be punctually pursued: or that, as Craig expresses it in the words of Baldus, *donationes sint stricti juris, ne quis plus donâsse præsumatur quam in donatione expresserit.* And therefore, as the personal abilities of the donee were originally supposed to be the only inducements to the gift, the donee's estate in the land extended only to his own person, and subsisted no longer than his life; unless the donor, by an express provision in the grant, gave it a longer continuance, and extended it also to his heirs. But this rule is now softened by many exceptions.

For, 1. It does not extend to devises by will; in which, as they were introduced at the time when the feodal rigour was apace wearing out, a more liberal construction is allowed: and therefore by a devise to a man for ever, or to one and his assigns for ever, or to one in fee-simple, the devisee hath an estate of inheritance; for the intention of the devisor is sufficiently plain from the words of perpetuity annexed, though he hath omitted the legal words of inheritance. But if the devise be to a man and his assigns, without annexing words of perpetuity, there the devisee shall take only an estate for life; for it does not appear that the devisor intended any more. 2. Neither does this rule extend to fines or recoveries, considered as a species of conveyance; for thereby an estate in fee passes by act and operation of law without the word *heirs;* as it does also for particular reasons, by certain other methods of conveyance, which have relation to a former grant or estate, wherein the word *heirs* was expressed. 3. In creations of nobility by writ, the peer so created hath an inheritance in his title, without expressing the word *heirs;* for they are implied in the creation, unless it be otherwise specially provided: but in creations by patent, which are *stricti juris,* the word *heirs* must be inserted, otherwise there is no inheritance. 4. In grants of lands to sole corporations and their successors, the word *successors* supplies the place of *heirs;* for as heirs take from the ancestor, so doth the successor from the predecessor. Nay, in a grant to a bishop, or other sole spiritual corporation, in *frankalmoign,* the word *frankalmoign* supplies the place of *successors* (as the word *successors* supplies the place of *heirs*) *ex vi termini;* and in all these cases a fee-simple vests in such sole corporation. But, in a grant of lands to a corporation aggregate, the word *successors* is not necessary, though usually inserted: for, albeit such simple grant be strictly only an estate for life, yet as that corporation never dies, such estate for life is perpetual, or equivalent to a fee-simple, and therefore the law allows it to be one. Lastly, In the case of the king, a fee-simple will vest in him, without the words *heirs or successors* in the grant; partly from prerogative royal, and partly from a reason similar to the last, because the king, in judgment of law, never dies. But the general rule is, that the word *heirs* is necessary to create an estate of inheritance.

II. We are next to consider limited fees, or such estates of inheritance as are clogged and confined with conditions or qualifications of any sort. And these we may divide into two sorts: 1. *Qualified* or *base* fees; and, 2. Fees *conditional,* so called at the common law; and afterwards fees-*tail,* in consequence of the statute *de donis.*

1. A BASE or qualified fee, is such a one as has a qualification subjoined thereto, and which must be determined whenever the qualification annexed to it is at an end. As, in the case of a grant to A and his heirs, tenants in the manor of Dale; in this instance, whenever the heirs of A cease to be tenants of that manor, the grant is entirely defeated. So, when Henry VI. granted to John Talbot, lord of the manor of Kingston Lisle in Berks, that he and his heirs, lords of the said manor, should be peers of the realm, by the title of *Barons of Lisle;* here John Talbot had a base or qualified fee in that dignity; and the instant he or his heirs quitted the seigniory of this manor, the dignity was at an end. This estate is a fee, because by possibility it may endure for ever in a man and his heirs; yet as that duration depends upon the concurrence of collateral circumstances, which qualify and debase the purity of the donation, it is therefore a qualified or base fee.

2. As to fees-*conditional,* or fee-tail, see the article TAIL.

FEE also signifies a certain allowance to physicians, barristers, attorneys, and other officers, as a reward for their pains and labour.

If a person refuse to pay an officer his due fees, the court will grant an attachment against him, to be committed till the fees are paid; and an attorney may bring an action of the case for his fees against the client that retained him in his cause.

FEE also denotes a settled perquisite of public officers, payable by those who employ them.

The fees due to the officers of the custom-house are expressly mentioned in a schedule, or table, which is hung up in public view in the said office, and in all other places where the said fees are to be paid or received. And if any officer shall offend, by acting contrary to the regulations therein contained, he shall forfeit his office and place, and be for ever after incapable of any office in the custom-house.

The other public offices have likewise their settled fees, for the several branches of business transacted in them.

FEE-*Farm,* a kind of tenure without homage, fealty, or other service, except that mentioned in the feoffment;

ment; which is usually the full rent, or at least a fourth part of it.

The nature of this tenure is, that if the rent be behind, and unpaid for two years, then the feoffer and his heirs may have an action for the recovery of the lands.

FEELERS, in *Natural History*, a name used by some for the horns of INSECTS.

FEELING, one of the five external senses, by which we obtain the ideas of solid, hard, soft, rough, hot, cold, wet, dry, and other tangible qualities. See ANATOMY *Index*.

FEET. See FOOT.

*FEET-Bearer*, the name of an officer in the courts of the ancient Anglo-Saxon and Welsh kings. He was a young gentleman whose duty it was to sit on the floor, with his back towards the fire, and hold the king's feet in his bosom all the time he sat at table, to keep them warm and comfortable †: a piece of state and luxury unknown in modern times.

FEINT, in fencing, a show of making a thrust at one part, in order to deceive the enemy, that you may really strike him in another.

A simple feint is a mere motion of the wrist, without stirring the foot.

FELAPTON, in *Logic*, one of the six first modes of the third figure of syllogisms; whereof the first proposition is an universal negative, the second an universal affirmative, and the third a particular negative.

FELIBIEN, ANDRE, was born at Chartres in 1619, and went secretary under the Marquis de Fontenay Mareuil ambassador to the court of Rome in 1647. On his return, M. Colbert procured him the place of historiographer to the king, superintendant of his buildings, and of the arts and manufactures in France. He became afterwards deputy comptroller general of the bridges and dykes in that kingdom; and died in 1695. He wrote several pieces relating to the fine arts: the principal of which is his "Dialogues on the Lives and Works of the most eminent Painters."

FELICITAS, (FELICITY, or *Happiness*), was deified by the ancient Pagans. Lucullus built a temple to her. She had another erected by Lepidus. The Greeks paid divine worship to *Macaria*, daughter of Hercules, the same with *Felicitas*. This deity is often pictured upon medals, and generally with a cornucopiæ in one hand, and a caduceus in the other. The inscriptions are, *Felicitas Temporum*, *Felicitas Augusti*, *Felicitas Publica*, &c.

FELIS, a genus of quadrupeds belonging to the order of feræ, and class mammalia. See MAMMALIA *Index*.

FELLING *of* TIMBER.—Many circumstances are well known and constantly observed in the felling of timber for building, which, though to a hasty observer they might appear trifling, yet prove, on experience, to be of the utmost consequence. One thing observed by M. de Buffon, which very greatly increases the solidity and strength of timber, is, that the trees intended to be felled for service should first be stripped of their bark, and suffered to stand and die upon the spot before the cutting. The sappy part or blea of the oak becomes by this means as hard and firm as the heart; and the real strength and density of the wood has been proved, by many experiments, to be greatly increased by it: nor is this a practice of any detriment to the proprietor, since the remaining stumps of these trees send up their young shoots as vigorously as if they had been cut down in their natural condition.

When any tree is to be cut down for timber, the first thing to be taken care of is a skilful disbranching of such limbs as may endanger it in its fall: many trees are utterly spoiled for want of a previous care of this kind. In arms of timber that are very great, it is always necessary to chop or sink in them close to the bole, and then meeting it with downright strokes, it will be severed from the tree without splitting. In felling the tree, take care always to cut it as close to the ground as possible, unless it is intended to be grubbed up: and the doing this is of advantage both to the timber and to the wood: for timber is never so much valued, if it be known to grow out of old stocks.

FELLOWSHIP, COMPANY, or *Distributive Proportion*, in *Arithmetic*. See ARITHMETIC.

FELO DE SE, in *Law*, a person that lays deliberately violent hands on himself, and is the occasion of his untimely death, whether by hanging, drowning, stabbing, shooting, or any other way.

FELON, in *Law*, a person guilty of felony. See FELONY.

FELONY, in the general acceptation of the law, comprises every species of crime, which occasions at common law the forfeiture of lands or goods. This most frequently happens in those crimes for which a capital punishment either is or was to be inflicted: for those felonies that are called *clergyable*, or to which the benefit of clergy extends, were anciently punished with death in all lay or unlearned offenders; though now, by the statute law, that punishment is for the first offence universally remitted. Treason itself, says Sir Edward Coke, was anciently comprised under the name of *felony*; and in confirmation of this we may observe, that the statute of treasons, 25 Edw. III. c. 2. speaking of some dubious crimes, directs a reference to parliament; that it may be there adjudged, "whether they be treason or *other* felony." All treasons, therefore, strictly speaking, are felonies; though all felonies are not treason. And to this also we may add, that all offences, now capital, are in some degree or other felony; but this is likewise the case with some other offences, which are not punished with death; as suicide, where the party is already dead; homicide by chance-medley, or in self-defence; and petit-larceny, or pilfering; all which are (strictly speaking) felonies, as they subject the committers of them to forfeitures. So that, upon the whole, the only adequate definition of felony seems to be that which is before laid down; viz. an offence which occasions a total forfeiture of either lands or goods, or both, at the common law; and to which capital or other punishment may be superadded, according to the degree of guilt.

To explain this matter a little farther: The word *felony*, or *felonia*, is of undoubted feodal original, being frequently to be met with in the books of feuds, &c. but the derivation of it has much puzzled the juridical lexicographers, Pratæus, Calvinus, and the rest: some deriving it from the Greek, φηλος, "an impostor or deceiver;" others from the Latin, *fallo*, *fefelli*, to countenance

nance which they would have it called *fellonia*. See Edward Coke, as his manner is, has given us a still stranger etymology; that it is *crimen animo felleo perpetratum*, "with a bitter or gallish inclination." But all of them agree in the description, that it is such a crime as works a forfeiture of all the offender's lands or goods. And this gives great probability to Sir Henry Spelman's Teutonic or German derivation of it: in which language, indeed, as the word is clearly of feodal original, we ought rather to look for its signification, than among the Greeks and Romans. *Fe-lon* then, according to him, is derived from two northern words: FEE, which signifies (we well know) the fief, feud, or beneficiary estate; and LON, which signifies price or value. Felony is therefore the same as *pretium feudi*, the consideration for which a man gives up his fief; as we say in common speech, such an act is as much as your life or estate is worth. In this sense it will clearly signify the feodal forfeiture, or act by which an estate is forfeited, or escheats to the lord.

To confirm this, we may observe, that it is in this sense of forfeiture to the lord, that the foedal writers constantly use it. For all those acts, whether of a criminal nature or not, which at this day are generally forfeitures of copyhold estates, are styled *feloniæ* in the feodal law: "*scilicet, per quas feudum amittitur.*" As "*si domino deservire noluerit;—si per annum et diem cessaverit in petenda investitura;—si dominum ejuravit*, i. e. *negavit se a domino feudum habere;—si a domino in jus eum vacante, ter citatus non comparuerit:*"—all these, with many others, are still causes of forfeiture in our copyhold estates, and were denominated *felonies* by the feodal constitutions. So likewise injuries of a more substantial or criminal nature were denominated *felonies*, that is, forfeitures: as assaulting or beating the lord; vitiating his wife or daughter, "*si dominum cucurbitaverit*, i. e. *cum uxore ejus concubuerit;* all these are esteemed felonies, and the latter is expressly so denominated, "*si fecerit feloniam, dominum forte cucurbitando.*" And as these contempts or smaller offences, were felonies or acts of forfeiture, of course greater crimes, as murder and robbery, fell under the same denomination. On the other hand, the lord might be guilty of felony, or forfeit his seignory to the vassal, by the same act as the vassal would have forfeited his feud to the lord. "*Si dominus commisit feloniam, per quam vassallus amitteret feudum si eam commiserit in dominum, feudi proprietatem etiam dominus perdere debet.*" One instance given of this sort of felony in the lord is beating the servant of his vassal, so as that he loses his service; which seems merely in the nature of a civil injury, so far as it respects the vassal. And all these felonies were to be determined, "*per laudamentum sive judicium parium suorum,*" in the lord's court; as with us forfeitures of copyhold lands are presentable by the homage in the court-baron.

Felony, and the act of forfeiture to the lord, being thus synonymous terms in the feodal law, we may easily trace the reason why, upon the introduction of that law into England, those crimes which induced such forfeiture or escheat of lands (and, by a small deflection from the original sense, such as induced the forfeiture of goods also) were denominated *felonies*. Thus it was that suicide, robbery, and rape, were felonies; that is, the consequence of such crimes was forfeiture; till by long use we began to signify by the term of *felony*, the actual crime committed, and not the penal consequence. And upon this system only can we account for the cause, why treason in ancient times was held to be a species of felony; viz. because it induced a forfeiture.

Hence it follows, that equal punishment does by no means enter into the true idea and definition of *felony*. Felony may be without inflicting capital punishment, as in the cases instanced of self-murder, excusable homicide, and petit-larceny: and it is possible that capital punishments may be inflicted, and yet the offence be no felony; as in case of heresy by the common law, which, though capital, never worked any forfeiture of lands or goods, an inseparable incident to felony. And of the same nature was the punishment of standing mute, without pleading to an indictment; which at the common law was capital, but without any forfeiture, therefore such standing mute was no felony. In short, the true criterion of felony is forfeiture: for, as Sir Edward Coke justly observes, in all felonies which are punishable with death, the offender loses all his lands in fee-simple, and also his goods and chattels; in such as are not punishable, his goods and chattels only.

The idea of felony is indeed so generally connected with that of capital punishment, that we find it hard to separate them; and to this usage the interpretations of the law do now conform. And therefore, if a statute makes any new offence felony, the law implies that it shall be punished with death, viz. by hanging, as well as with forfeiture: unless the offender prays the benefit of clergy; which all felons are entitled once to have, unless the same is expressly taken away by statute.

Felonies by statute are very numerous; and as this work will not admit of a proper enumeration, we must refer to the table of the quarto edition of the Statutes, where they are set forth in alphabetical order.

FELT, in *Commerce*, a sort of stuff deriving all its consistence merely from being fulled, or wrought with lees and size, without either spinning or weaving. Felt is made either of wool alone or of wool and hair.

FELTING, the method of working up hair or wool into a species of cloth, independent of either spinning or weaving. Felting in Britain is not much practised, excepting in the manufacturing of hats; and as the generality even of those who are employed in making them, are unacquainted with the principles on which they act, a few observations on the method of felting, may, to such, be both useful and agreeable.

If wool, the hair of a rabbit, hare, beaver, or human hair, be examined with a microscope of the greatest magnifying power, the surface of each hair appears perfectly smooth, or if any inequalities are observed, they do not appear so much to arise from an irregular surface, as from some peculiar difference in the colour and transparency of the substances examined; for if their image be viewed by a solar microscope, it terminates in even lines, without the smallest vestige of any roughness. Yet nothing is more evident than that the surfaces of hairs are not perfectly smooth, but either composed of lamellæ covering each other from the root to the point, resembling the scales of fishes; or, what some have deemed more probable, of zones placed over each other, similar to the structure of horns; and to this texture hair, wool, &c. owe their disposition for what is denominated felting.

Let a person take hold of a hair by the root with one hand, and draw it between two fingers of the other, from the root towards the point, he will scarcely perceive any friction, or hear any sound; but should he hold the hair by the point, and draw it between his fingers from the point towards the root, he will feel a sensible opposition or resistance which could not be felt before. A sort of tremulous motion is likewise produced, which can be distinguished by the ear. From this simple experiment it is obvious that the texture of the surface of a hair is not the same from the point to the root, as it is from the root to the point. If a hair is taken hold of by the fore-finger and thumb, and rubbed in a longitudinal direction, a progressive motion is the result, which is invariably towards the root. This is wholly independent of the texture or nature of the skin of the fingers; for if the hair be turned, and the point of it placed where the root formerly was, the movement becomes contrary, or, in other words, it is still directed towards the root.

It is found a very difficult task to unite a knot made in the middle of a hair, on account of its extreme thinness; but if the hair is placed in the bend of the hand, the knot being in a line with the little finger, and if the hair is grasped by closing the hand, and the fist struck several times against the knee, the knot is thereby opened, because the asperities of one end of the hair are in a contrary direction to those of the other, by which means each end of it recedes a little. By the introduction of a pin into the eye thus formed at the knot, it is easily untied. Although these observations have a direct reference to long hair; yet they are equally applicable to wool, furs, and almost every species of animal hair. The surface of all these consists of hard *lamellæ*, placed upon each other like tiles, in the direction from the root to the point.

By attending to these remarks, it is easy to see why the contact of woollen stuffs is rough to the skin. The asperities on the surface of the fibres of wool produce a disagreeable sensation, by fixing themselves in the skin, which can only be endured by being accustomed to feel it frequently. The injury done to wounds by the application of wool, is not the result of any chemical property, but is entirely occasioned by the asperities of its surface.

A hatter separates the hairs from each other, by striking the wool with the string of his bow, causing them to spring up in the air, which fall on the table in every possible direction, forming a layer of a particular thickness, which is covered by the workmen with a cloth, pressing it with his hands, and moving the hairs backwards and forwards in different directions. In this manner the hairs are brought against each other, and their points of contact considerably multiplied, and the agitation gives each hair a progressive motion towards the root, in consequence of which the hairs become twisted together. As the mass becomes compact, the pressure ought to be increased, in order to keep up the progressive motion and twisting of the hairs, which is then performed with greater difficulty.

The hair designed for the manufacturing of hats is always cut off with a sharp instrument, and not pulled out by the roots, because the bulb of the hair which would come out with it in the latter case, would render the end which was fixed in the skin very obtuse, and nearly destroy its disposition to unite with the adjacent hairs. But in addition to the tendency of hairs to move progressively towards the root, they should not be straight like needles, for in this case they could not produce any compactness in the stuff. The fibres of wool having naturally a crooked form, that substance is well adapted to the operation of felting. The hair of beavers, rabbits, hares, &c. being straight, it cannot be employed in felting by itself, till it has been subjected to a previous preparation, viz. rubbing and combing on the skin, the brush being dipped in a solution of mercury in nitric acid. This substance, by acting only on one side of the hair, gives them the disposition to felting which is natural to wool.

When it is not intended that the hairs shall enter into the body of the mass, but serve only as an external coating, which is sometimes given to the outer surface of hats, the operation with the nitric acid need not be performed. They must be uniformly spread upon the surface to which the coating is to be applied, and being covered with a cloth, it is pressed with the hands, and agitated for some time. They receive a particular direction afterwards by means of a brush, and are enabled to keep it by having a hot iron passed over them. Woollen cloth is thickened by fulling, on the same principles that wool and hair become capable of felting.

*FELT-Spar*, *FELD-Spar*, or *FEL-Spar*, a mineral substance. See MINERALOGY *Index*.

FELTRIA, in *Ancient Geography*, a town on the borders of Rhætia towards Italy. Now *Felitri*, in the territory of Venice, on the Piava. E. Long. 12. 16. N. Lat. 46. 0.

FELUCCA, in sea affairs, a little vessel rowed with six oars, frequent in the Mediterranean; which has this peculiarity, that its helm may be applied either in the head or stern, as occasion requires.

FEMALE, (FOEMINA), a term peculiar to animals, signifying that sex which conceives and generates its young within itself. See SEX and GENERATION.

FEMALE is also applied, figuratively, to things without life, from the resemblance they bear to the females of animals. Thus we say a

*FEMALE Screw*. See SCREW.
*FEMALE Flower*. See *Fœmineus* FLOS.
*FEMALE Plant*. See *Fœminea* PLANTA.

FEMME COVERT, in *Law*, a married woman. See COVERTURE.

*FEMME Sole*, an unmarried woman, whose debts, contracted before marriage, become those of her husband after it.

A femme sole merchant, is where a woman, in London, uses a trade alone, without her husband; on which account she shall be charged without him.

FEMININE, in *Grammar*, one of the genders of nouns. See GENDER.

The feminine gender is that which denotes the nouns or name to belong to a female. In the Latin, the feminine gender is formed of the masculine, by altering its termination; particularly by changing *us* into *a*.

Thus,

Thus, of the masculine *bonus equus*, "a good horse," is formed the feminine *bona equa*, "a good mare;" so, of *parvus homo*, "a little man," is formed *parva fœmina*, "a little woman," &c.

In French, the feminine gender is expressed, not by a different termination, but by a different article: thus, *le* is joined to a male, and *la* to a female.

In English, we are generally more strict, and express the difference of sex, not by different terminations, nor by different particles, but different words; as boar and sow, boy and girl, brother and sister, &c. —though sometimes the feminine is formed by varying the termination of the male into *ess;* as in abbot, abbess, &c.

FEMUR, OS FEMORIS, the thigh bone. See ANATOMY *Index*.

FEN, a place overflowed with water, or abounding with bogs. See BOG and DRAINING, in AGRICULTURE *Index*.

Fens are either made up of a congeries of bogs; or consist of a multitude of pools or lakes, with dry spots of land intermixed, like so many little islands.

Several statutes have been made for the draining of fens, chiefly in Kent, Cambridgeshire, Bedfordshire, and Lincolnshire; and by a late act, 11 Geo. II. commissioners shall be appointed for the effectually draining and preserving of the fens in the isle of Ely, who are authorized to make drains, dams, and proper works thereon; and they may charge the landholders therein with a yearly acre-tax, and in default of payment, sell the defender's lands.

The wet grounds called *fens*, in Lincolnshire and elsewhere in England, bring many advantages to the inhabitants of those counties. Fowl and fish are very plentiful in them. The pike and eels are large and easily caught, but they are usually coarse. The duck, mallard, and teal, are in such plenty as is scarce to be conceived. They are taken by DECOYS in prodigious flocks at a time. They send these fowl from Lincolnshire to London, twice a-week, on horseback, from Michaelmas to Lady-day; and one decoy will furnish 20 dozen, or more, twice a-week, for the whole season in this manner. The decoy-men contract with the people, who bring them to London at a certain rate, and they are obliged to take off their hands the whole number that is catched. Two teal are usually reckoned equal to one duck; and six ducks and twelve teal are accounted a dozen of wild fowl; and the usual market price is about 9s. for such a dozen. About midsummer, during the moulting season, a great number also are destroyed by the people in the neighbourhood. The poor birds at this season are neither able to swim nor fly well; and the people going in with boats among the reeds where they lie, knock them down with long poles. A little before Michaelmas, vast flights of these birds arrive at the decoys from other places; they soon grow fat in them, and continue there a prey to the masters or owners, as long as the decoys are unfrozen; but, when they are iced over, they fly away again, and go to the neighbouring seas for food.

The fens also abound in a sort of herbage that is very nourishing to cattle. Sheep and horses always grow fat upon it. The fens are common, and the owners of cattle mark them that they may be known. It is remarkable, that, though all is open, the cattle used to one particular spot of ground seldom leave it, but the owner may always find them in or near the same place. The fens have many large and deep drains. In these the pike and eel grow to a vast size: and they are full of geese which feed on the grass; but these eat rank and muddy, and may even be smelt as soon as a person comes into the room where they are roasting. But the people have another very great advantage from these birds besides the eating of them, namely, their feathers and quills; and the produce of these is so great, that the customhouse books in the town of Boston show, that there are frequently sent away in one year 300 bags of feathers, each containing a hundred and a half weight. Each pound of feathers brings in the owner twopence; and it may be thought strange by people unacquainted with these things, but it is a certain truth, that the owners pull them five or six times a year for the feathers, and three times for the quills. Each pulling comes to about a pound, and many people have 1000 geese at a time, or more. They are kept at no charge, except in deep snowy weather, when they are obliged to feed them with corn.

Oats also grow very well in many of the fen countries, and in good seasons bring great increase and advantage to the owners. There is also another vegetable of great profit to them. This is the *rapum silvestre;* the seed of which they call *cole-seed;* and they make an oil from it of great use in trade. They grind the seed between two large stones, the one standing perpendicularly on the other. The stones are made of a sort of black marble, and are brought from Germany. They sometimes turn them by sails, and sometimes by the drains which carry off the water from the fen lands.

The fens lying low, and being of a vast extent, are very subject to be overflowed by waters from the neighbouring high countries; and though great care and expence is used to keep them dry, they are often like a sea; and the sheep are obliged to be carried off in boats, and the people to live in their upper rooms, and to be supplied with provisions also with boats.

FENCE, in *Gardening* and *Husbandry*, a hedge, wall, ditch, bank, or other enclosure, made round gardens, fields, woods, &c.

In hot climates, where they have not occasion for walls to ripen their fruit, their gardens lie open, where they can have a water fence, and prospects; or else they bound their gardens with groves, in which are fountains, walks, &c. which are much more pleasing to the sight than a dead wall: but, in colder countries, we are obliged to have walls to shelter and ripen our fruit, although they take away much from the pleasant prospect of the garden. Brick walls are accounted the best and warmest for fruit: and these walls, being built pannelwise, with pillars at equal distances, will save a great deal of charge, in that the walls may be built thinner than if they were made plane without these pannels, for then it would be necessary to build them thicker everywhere; and, besides, these pannels make the walls look the handsomer. Stone walls, however, on account of their durability, are to be preferred to those of brick, especially those of square hewn stones. Those that are made of rough stones, though

though they are very dry and warm, yet, by reason of their unevenness, are inconvenient to nail up trees to, except pieces of timber be laid in them here and there for that purpose.

But, in large gardens, it is better to have the prospect open to the pleasure garden; which should be surrounded with a fosse, that from the garden the adjacent country may be viewed. But this must depend on the situation of the place: for, if the prospect from the garden is not good, it had better be shut out from the sight than be open. As also, when a garden lies near a populous town, and the adjoining grounds are open to the inhabitants; if the garden is open, there will be no walking there in good weather, without being exposed to the view of all passengers, which is very disagreeable.

Where the fosses are made round a garden which is situated in a park, they are extremely proper; because hereby the prospect of the park will be obtained in the garden, which renders those gardens much more agreeable than those that are confined.—In the making these fosses there have been many inventions; but, upon the whole, none seem preferable to those which have an upright wall next the garden, which, (where the soil will admit of a deep trench) should be five or six feet high; and, from the foot of this wall, the ground on the outside should rise with a gradual easy slope, to the distance of 18 or 20 feet; and where it can be allowed, if it slopes much farther it will be easier, and less perceptible as a ditch, to the eye, when viewed at a distance; but, if the ground is naturally wet, so as not to admit a deep fosse, then, in order to make a fence against cattle, if the wall be four feet high, and slight posts of three feet high are placed just behind the wall, with a small chain carried on from post to post, no cattle or deer will ever attempt to jump against it; therefore it will be a secure fence against them; and if these are painted green, they will not be discerned at a distance, and at the same time the chain will secure persons walking in the garden from tumbling over.

In places where there are no good prospects to be obtained from a garden, it is common to make the enclosure of park paling; which, if well performed, will last many years, and has a much better appearance than a wall; and this pale may be hid from the sight within, by plantations of shrubs and evergreens; or there may be a quick hedge planted within the pale, which may be trained up, so as to be an excellent fence by the time the pales begin to decay.

Fences round parks are generally of paling; which, if well made of winter-fallen oak, will last many years. But a principal thing to be observed, in making these pales, is not to make them too heavy: for, when they are so, their own weight will cause them to decay: therefore the pales should be cleft thin; and the rails should be cut triangular, to prevent the wet lodging upon them; and the posts should be good, and not placed too far asunder. If these things are observed, one of these pales will last, with a little care, upwards of 40 years very well. The common way of making these fences is, to have every other pale nine or ten inches above the intermediate ones; so that the fence may be six feet and a half high, which is enough for fallow deer; but where there are red deer, the fence should be one foot higher, otherwise they will leap over.

Fence-Month, Fencing.

Some enclose their parks with brick walls; and in countries, where stone is cheap, the walls are built with this material; some with, and others without, mortar.

A kitchen garden, if rightly contrived, will contain walling enough to afford a supply of such fruits as require the assistance of walls, for any family; and this garden, being situated on one side, and quite out of sight of the house, may be surrounded with walls which will screen the kitchen garden from the sight of persons in the pleasure garden; and, being locked up, the fruit will be much better preserved than it can be in the public garden; and the having too great a quantity of walling is often the occasion that so many ill managed trees are frequently to be seen in large gardens.

The height of garden walls should be 12 feet, which is a moderate proportion; and, if the soil be good, it may in time be well furnished with bearing wood in every part, especially that part planted with pears, notwithstanding of the branches being trained horizontally from the bottom of the walls.

With regard to the different kinds of fences, see Agriculture *Index*.

*Fence-Month*, the month wherein deer begin to fawn, during which it is unlawful to hunt in the forest.

It commences 15 days before Midsummer, and ends 15 days after it. This month, by ancient foresters, is called *defence-month*.

FENCING, the art of making a proper use of the sword, as well for attacking an enemy as for defending one's self.

This art is acquired by practising with foils, called in Latin *rudes;* whence fencing is also denominated *gladiatura rudiaria*.—It is one of the exercises learnt in the academies (see Exercise and Academy); and is an accomplishment both agreeable and useful:—Agreeable, as it affords gentlemen a noble and distinguished amusement:—Useful, as it forms their body; and furnishes them with the faculty of defence, whether it be of their honour or their life, when the one or the other is attacked by those turbulent and dangerous persons whose correction is of service to society in general.

Pyrard assures us, that the art of fencing is so highly esteemed in the East Indies, that none but princes and noblemen are allowed to teach it. They wear a badge or cognizance on their right arms, called in their language *esaru;* which is put on with great ceremony, like the badges of our orders of knighthood, by the kings themselves.

Fencing is divided into two parts, *simple* and *compound*.

*Simple* is that performed directly and nimbly, on the same line; and is either offensive or defensive.—The principal object of the first, is whatever may be attempted, in pushing or making passes from this or that point, to the most uncovered part of the enemy. The second consists in parrying and repelling the thrusts aimed by the enemy.

The *compound* includes all the possible arts and inventions to deceive the enemy, and make him leave that part we have a design on bare and unguarded, upon finding we cannot come at it by force, nor by the agility of the simple play. The principal means hereof are, on the offensive side, feints, appeals, clashings, and entanglings of swords, half thrusts, &c. and, on the defensive, to push in parrying. Of all which a detail would be here useless, as they are only to be understood and acquired from personal instructions conjoined with practice.

**FENELON**, Francis de Salignac de la Motte, was of an ancient and illustrious family, and born at the castle of Fenelon in Perigord in 1651. In 1689, he was appointed tutor to the dukes of Burgundy and Anjou; and in 1655 was consecrated archbishop of Cambray. After this preferment, a storm arose against him, that obliged him to leave the court for ever, occasioned by his performance entitled, An Explication of the Maxims of the Saints concerning the Interior Life; in which he was supposed to favour the extravagant notions of Madame Guyon, and the principles of Quietism. A controversy on this occasion was for some time carried on between him and M. Bossuet, bishop of Meaux: which terminated in an appeal to the pope; when his holiness condemned the archbishop's book, by a brief dated March 12. 1699. Some friends indeed pretend, that there was more of court policy than religious zeal in this affair: but be this as it may, the archbishop submitted patiently to this determination; and, retiring to his diocese of Cambray, acquitted himself punctually in all the duties of his station, and led a most exemplary life. The work that gained him the greatest reputation, and which will render his memory immortal, is his Adventures of Telemachus; the style of which is natural, the fictions well contrived, the moral sublime, and the political maxims tending all to the happiness of mankind. Hence it is thought, as the printing of this work was stopped at Paris, that the prelate's heresy was in politics instead of religion; and though his disgrace was prior to this work, he had, while he was tutor to the young princes, taught them the same principles asserted und exemplified in Telemachus. Fenelon died in 1715; and a collection of all his religious works was afterwards printed at Rotterdam, under the care of the marquis de Fenelon his grand-nephew, when ambassador to the States-General.

**FENNEL.** See Anethum, Botany *Index*.

**FENTON**, Sir Geoffroy, privy counsellor and secretary in Ireland during the reigns of Queen Elizabeth and King James I. is well known for his translation of Guicciardini's History of the Wars of Italy, dedicated to Queen Elizabeth in 1579. He died at Dublin in 1608; after having married his daughter to Mr Boyle, afterward the great earl of Corke.

Fenton, *Elijah*, descended from an ancient family, was born at Shelton near Newcastle, but in what year is uncertain. He was the youngest of 12 children, and was intended for the ministry; but embracing principles contrary to the government, while at Cambridge, he became disqualified for entering into holy orders. After he quitted the university, he was secretary to the earl of Orrery; but seems to have spent the most of his life amongst his friends and relations, and used to pay an annual visit to his elder brother who enjoyed an estate of 1000l. a-year. He was a man of great tenderness and humanity, enjoyed the fairest reputation, and was much esteemed by Mr Pope; who, when he died in 1730, paid him the tribute of a very elegant epitaph. He published a volume of poems in the year 1717; and in 1723 was acted his tragedy of Mariamne, built upon her story collected from Josephus in the third volume of the Spectator.

**FENUGREEK.** See Trigonella, Botany *Index*.

**FEOD**, or Feud, is defined to be a right which a vassal hath in lands or some immoveable thing of his lord's, to use the same, and take the profits thereof hereditarily, rendering unto the lord such feodal duties and services as belong to military tenure, &c. and the property of the soil always remaining to the lord.

**FEODAL**, of or belonging to a Feud or Fee.

*Feodal System*, the constitution of Fiefs or Feuds. About 12 centuries ago, this system was so universally received in Europe, that Sir Henry Spelman calls it *the law of nations in our western world.* Hence it deserves our attention in a particular manner: a knowledge of the different feuds being indispensably requisite for a proper understanding either of the civil government of our own country, or of the laws by which its landed property is regulated.

Origin of feuds.

The military policy of the Celtic or northern nations, known by the names of *Goths*, *Vandals*, *Franks*, *Hunns*, and *Lombards*, furnished the original constitution or system of feuds. These people pouring out in vast multitudes from the same *officina gentium* or "storehouse of nations," overran all the European countries on the declension of the Roman empire. They brought the feudal system along with them from the countries out of which they emigrated; and, supposing it to be the most proper method of securing their new conquests, they introduced it into their more southerly colonies.

According to this system, the victorious general allotted considerable tracts of land to his principal officers; while they, in like manner, divided their possessions among the inferior officers, and even those common soldiers who were thought to be the most deserving. Allotments of this kind were named *feoda*, *fiefs*, *fees*, or *feuds*, from a combination of words, in the language of these barbarians, signifying a reward or stipend bestowed on certain conditions (A). The condition upon which these rewards were given was, that the possessors should faithfully serve the person from whom they were received, both at home and abroad, in the military way. To this they engaged themselves by a *juramentum fidelitatis*, or oath of fealty †: in the event of a breach of which, either by not performing the service

† See the article Feodal Tenure.

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(A) We were informed by Pontopiddan, that odh in these northern languages is the same with *proprietas*, and all with *totum* in the Latin. Hence among the northern nations, he tells us, that odhall signifies *right*; and hence we may conjecture that the udal right in Finland is derived ‡. By transposing these two northern syllables,

‡ See Macdowall's Institut. part 2.

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service agreed upon, by deserting their lord in time of battle, &c. the lands were to return to their original possessor.

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Thus the possessors of feodal allotments became interested in the defence of them; and not only the receivers but those who gave them, were equally and mutually bound to defend their possessions, none of them being able to pretend any right but that of conquest. For this purpose government and subordination were absolutely necessary; it being impossible to conduct any system of defence where every thing was tumultuous and irregular. Every person, therefore, who was a feudatory, i. e. who had received lands, was bound to do every thing in his power to defend the lord of his fee; while, on the other hand, the latter was no less subordinate to his immediate superior; and so on to the prince himself. In like manner a reciprocal bond of defence existed down from the prince to the lowest feodists.

Such were the foundations on which the feodal system was properly established; and the natural consequence was, a military subjection throughout the whole community. The prince could always collect an army of feudatories ready to defend not only the kingdom in general, but the particular possessions of each person; and the propriety of this constitution was soon apparent in the strength which these newly erected kingdoms acquired, and the valour with which their conquests were defended.

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Besides these feodal grants, however, which were held only on the terms of military service above mentioned, there were others called *allodial*, which were given upon more enlarged principles. To these every free man had a title; and could not only claim his territory as well as the rest, but dispose of it at his pleasure (B); and this freedom was denominated *allodiality*. These allodials, however, were not exempted from military service. A part of their freedom consisted in liberty to go to the wars; for this, in the barbarous times we speak of, was the only way to acquire any degree of renown. Only the slaves were destined to follow the arts of peace; while every free person was not only at liberty to defend his country, but under an obligation to do it in case of any urgent necessity.

Feodal System.

4
Feodal and national militia.

Thus there was a feodal and a national militia. The free people only were allowed to possess property; the *feodal vassals* constituted the army, properly so called; while the national militia was composed of the allodial proprietors. This allodiality, however, was not confined to landed property, but included likewise moveable estates or money; so that proprietors of the latter kind were obliged also in times of danger to bear arms and appear in the field.

5
Different situations of the feodal and of the allodial proprietor.

Between the feodal and allodial proprietors, however, there was this farther difference, that the latter had no concern with any private quarrels which might take place among the lords themselves; so that they were never obliged to appear in the field unless when called forth by the sovereign against the enemies of the nation at large. This circumstance we might suppose to be an advantage, but it ultimately operated otherwise; becoming the means of changing the allodial right into a feodal tenure. For some time the holders of fiefs had an eminent advantage over the allodial proprietors. This was owing to the imperfection of government in those days; so that the nobles had it in their power to revenge their own quarrels, while the weak were equally exposed to the insults of both parties. The lord and his vassals therefore were always formidable; but the allodial

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syllables, we form the word ALLODH; whence we have the etymology of the *allodium* or *absolute* property, claimed by the holders of fiefs or feuds; and combining ODH, signifying "property," with the word *fee*, signifying "a conditional stipend or reward," we have the word FEODH, signifying "a property given by way of stipend or reward upon a certain condition."

(B) The author of A View of Society in Europe, has traced the remote sources of the feodal laws in an elegant and spirited manner (book i. chap. ii. sect. i.). Tacitus informs us, that the individuals of each of the German nations cultivated by turns a tract of land proportionable to their number, for the use of the whole; after which each individual received such an allotment of the cultivated tract as his dignity seemed to require. These nations had not altered their political principles at the time they overran the Roman empire; and hence the provinces of it were then divided after the same manner. The most considerable allotment was bestowed on the king, as being the most dignified person in the community, and this allotment was styled his *domain;* while the shares of citizens and warriors, which were likewise in proportion to the merit or dignity of each, constituted what was called *allodiality*. But as it often happened that all the land was not exhausted by these partitions, what remained was considered as the property of the community, and in the barbaric codes was called the *lands of the fisc*. In such German nations as had thus obtained a settlement, it was necessary that there should be a more close connexion betwixt the sovereign and the chiefs, as well as between the chiefs and the people, than in others. This was effected by means of the lands of the *fisc;* for of these the sovereign took possession, dealing them out to the chiefs under the burden of appearing in arms whenever he should please to call; while the chiefs in like manner dealt out lands to those called their *retainers*, who were also obliged to supply them with military assistance in cases of necessity. Hence a political system was founded, which had a prodigious effect on society in all those countries where it prevailed. The intention and tendency of this system was to render the nation independent both at home and abroad; for, while the people were all armed in their common defence, individuals were also properly guarded against the attacks of despotism. The power of the chiefs, who formed a regular nobility, was a counterpoise to that of the sovereign; while the number of the retainers and vassals, constituting the greatness and power of the nobility, was a proper barrier against aristocratical oppression; for a chief who oppressed his vassals evidently acted against his own interest.

allodial proprietors had scarce any means of defending themselves. The reason of this was, in the first place, that the law did not allow them to commit any hostilities; and in the next, they were too distant and unconnected to form any proper league for mutual defence; and hence proceeded the necessity already hinted at, of converting allodial property into feudal tenure. This was indeed owing in a great measure to the absurdity and violence of the times, by which gifts of property, burdened with service, and which might return to the person who granted them, were rendered superior in value to the absolute and unconditional possession of a subject. Other considerations, however, besides that just mentioned, contributed to produce the same effect. As in those dark ages no right existed but what had its origin in conquest, it thence followed, that the greatest conqueror or warrior was the most honourable person. The king, in whom the whole exploits of the community centered, as being their head, was the most honourable person: all others derived from him that portion of honour which they enjoyed, and which was most nicely adjusted in proportion as they approached him. Allodial proprietors, therefore, having no pretensions of this kind, were treated with contempt as a kind of poltroons. From this disagreeable situation they wished to free themselves, by converting their allodial property into feodal tenures; while the princes, supposing it their interest to extend those tenures as much as possible, discouraged the allodial possessions. As the feodists supported the importance of the nation and dignity of the monarch, it was not thought proper to allow the allodial proprietors any greater compensations than what were given to vassals in similar cases. Thus they were exposed to continual mortifications in the courts of justice; they were neglected by the king; denied sufficient protection from the laws; exposed not only to continual insults; but to have their property on all occasions destroyed by the great: so that they were without resource except from the feodal tenures, and were obliged even to solicit the privileges which were bestowed in other cases on vassals. In these unhappy circumstances, they were glad to yield up their lands to any superior whom they thought most agreeable, and to receive them back from him as a feudal gift. Thus the landed property was everywhere changed into feudal tenures, and fiefs became universal (c).

6
Conversion of allodium into tenure.

For some time the feodal system was not only useful in itself, but honourable in its principles; but this continued no longer than while the importers of it into Europe adhered to their original simple and noble maxims. During that period, the lord exercised his bounty

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(c) It has been an object of inquiry to the learned, in what nation of barbarians fiefs had their origin? But it is probable, that they took place in all these nations nearly about the same time, on the same principles; and were continued by reason of a similarity of manners, conquests, &c. so that we cannot ascribe the prevalence of them to imitation.

In France, we find mention made of fiefs as early as the age of Childebert. They were introduced into Italy by the Lombards; amongst whom the customs and laws relating to fiefs seem very early to have made rapid advances [*]. They were introduced into Spain before the invasion of the Moors and Saracens in the year 710. Lands were granted for service and attachment among the Goths; among whom also the person who received the gift was the retainer of him who granted it. If he refused his service, the grant was forfeited, and he was said to receive it *in patrocinio;* he also swore fealty to his lord; and on this footing the national militia was regulated [†]. There can be very little doubt that the feodal law was known in England in the Saxon times, as is mentioned in the text [‡]. In Scotland, however, the history of fiefs is still more uncertain than anywhere else; which has been ascribed partly to the mutilated state of the Scottish records, and partly to the want of able antiquaries in the nation. But, according to a late writer [§], allodiality and feudality have existed ever since the foundation of the Scottish monarchy, and have most probably arisen from a similarity of the manners and customs in Scotland to those of other nations. It has indeed been supposed that these customs were introduced from some foreign model by Malcolm II. According to some, they were introduced directly from England; and the policy of Malcolm in establishing them has been highly extolled: but, according to our author there is no foundation for any notion of that kind. Both the opinions just mentioned either directly assert or imply, that the feudal maxims were introduced into this country upon the principle of imitation; but it is very improbable that they could be imported from one people to another, on account of their excessive contrariety to the common usages and precepts of government among mankind. It must undoubtedly have been very absurd, if not altogether impracticable, to transplant the feudal tenures when the grants of land were precarious, or depending entirely on the will of the prince, to a country which had never known superiority or vassalage. This would have required an alteration of all the orders of society from the king to the peasant; while the whole chain of customs, as well as the jurisdiction of the kingdom, both high and low, must have sustained a corresponding alteration, in order to conform them to the new system. It is likewise obvious, that no conquest could be made on purpose to obtain a settlement by any nation who had already received the knowledge of fiefs. The establishment of them implied, that the people had already a fixed and settled residence; and accordingly history does not furnish us with an account of a nation among whom fiefs were known, who ever migrated from the country they already possessed, to seek for one in which they might settle. Feudal institutions must have originated wherever they have been observed to flourish.—Scotland was formerly a feudal kingdom, and we know pretty nearly the time when the fiefs were hereditary there; but in that form they could not be introduced by the sovereign; and there was not any nation among whom fiefs were already known who conquered, or made an establishment by conquest, in Scotland. Fiefs therefore must have *gradually* advanced to such a state of perfection. The progress they made may be likewise easily

[*] *Giannone Hist. of Naples*, book iv. sect. 3.

[†] *LL. Wisigoth*, lib. v. tit. 3. lib. iv tit. 7. l. xx.

[‡] See also *Whitaker's Hist. of Manchester.*

[§] *Stuart's Observat. on the Law and Constitution of Scotland.*

bounty to the vassal, which the latter repaid by acts of gratitude; so that the intercourse betwixt them was of the most tender and affectionate kind; and this gave rise to what are called the *feodal incidents*.

7
**The feodal incidents.**

The expectants of fiefs were educated in the hall of the superior, while the tenures were precarious or only for life: and even when they became hereditary, the lord took care of the son and estate of his deceased vassal; not only protecting his person, but taking charge of his education, and directing the management of his affairs. He took pleasure in observing his approach to maturity; and when he came of age, never failed to deliver to him the lands, with the care of which he had been entrusted, and which he had been careful to improve. This was called the *incident of wardship*.

The incident of *relief* was founded upon the gratitude of the vassal; who, upon entering on his fief, brought a present to his lord, as an acknowledgement of his care of him during the early part of his life, and in order to conciliate his future regard.

The incident of *marriage* proceeded also upon the principle of gratitude on the part of the vassal. The latter, conscious of the favours he had received, did not choose to ally himself with a family inimical to his chief; while the superior himself, ambitious to aggrandize and augment the importance of his family, sought how to find the most advantageous match for his vassal.

Sometimes the superior himself was reduced in his circumstances by war or other accident: but from whatever cause his distress proceeded, even though it had arisen from his own extravagance or prodigality, or when only destitute of means to support his ambition or grandeur, his vassals were bound to support and relieve him according to their circumstances; and this was called the *incident of aid*.

The incident of *escheat* took place on the part of the vassal, when, through cowardice, treachery, or any remarkable misbehaviour, he rendered himself unworthy of his fief. In that case, the taking it from him, and giving it to one more worthy, was called an *escheat*.

8
**Happiness of the feodal association.**

While the lords and vassals thus vied with one another in mutual acts of friendship and benevolence, universal happiness, liberty, and activity, were diffused through the society. The vassals behaved courteously towards the retainers, who were immediately below them; while they again were courted by the lords as constituting their importance and strength; the lords, lastly, giving a like importance and dignity to the sovereign himself. Thus a regular, powerful, and compact system of government took place; an unanimity and attention pervaded the various departments of state; so that, while the subjects were free, the nation at large was formidable.

During this happy state of affairs, the members of the national assembly in every country in Europe appeared there in arms, whether they came personally or by their representatives. Such particularly was the case under the Anglo-Saxon government; and the happiness they at that time enjoyed made the oppression and tyranny of the Normans appear the more intolerable.

9
**Its declension.**

In process of time, however, the state of society began to suffer a remarkable alteration. The high and disinterested notions, from which the happiness above mentioned took its origin, declined: the romantic ideas of chivalry † ceased; and much more interested notions of property came in their stead. The separation of the interests of the lords from their vassals was the first step towards the destruction of the feodal system.

10
**The perversion of its incidents.**

Thus the *incidents*, which, as has just now been mentioned, promoted their happiness, did the very reverse. Property being now looked upon as a distinction superior to personal merit, naturally introduced the most mercenary views. In consequence of these the infant *ward*, the care of whom was wont to be considered as a sacred and honorary trust, was now only looked upon as a mean of procuring emolument to the superior. The latter now regarded the profits of his vassals as so many diminutions of his own wealth. Instead of taking care to improve the estate of his ward as formerly, he impoverished it; not only neglecting the education of the heir, but offering insults to himself; insomuch that the relations of the unfortunate vassal were frequently obliged to ransom from the avaricious superior both his person and effects. By merchandise of this kind the coffers of princes were filled, and wardships let out to strangers, who might exercise their rapacity with greater freedom. When the vassal at last attained the years of maturity, he came to the possession of his land without any of that joy and festivity which usually took place on the occasion. He received an inheritance wasted and destroyed, while new grievances daily presented themselves to augment the horrors of his situation.

11
**Oppressed situation of the vassals.**

All the *incidents*, which in former times were so many expressions of gratitude on the part of the vassal, were now changed into taxes which might be exacted at the pleasure of the lord. Before the vassal was invested in his land, the superior exacted from him a certain sum or other gift, to be measured only by his own rapacity; and in case of delay or inability to pay this demand, the superior continued in possession of the estate. Such scandalous oppression could not but produce the greatest discontent and clamour. Applications were made to the law without success; nor were even the laws regarded which were fabricated on purpose for their relief. The incident of *marriage* now proved a source of the most dreadful oppression. The lord assumed a right of marrying his vassal to whom he pleased; and he not only exerted this right himself, but would sell it to a stranger, or allow the vassal to buy it himself; while the penalty annexed to a marriage without

† See *Chivalry* and *Knights*.

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easily pointed out. At first they were precarious, or at the pleasure of the lord; afterwards they were granted for life; then for a course of years longer than the natural life of a man; and, lastly, they became hereditary, which was their most perfect stage. This progress has been observed in every country where feodal tenures exist; and the same must have been known in Scotland, though, in considering it, we are necessarily carried back to periods of remote antiquity; for as fiefs were hereditary as early as the time of Malcolm II. they must have been in their precarious state several centuries before.

out the consent of the superior involved no less punishment than the loss of the estate itself, or some grievous infliction as for a crime of the first magnitude. The case was still worse with the female ward; whose beauty and accomplishments became a source of gain to the superior, or were sacrificed to please his whim or caprice; so that her relations were frequently obliged to buy from him the privilege of marrying her to the person she or they thought most proper. In like manner the *aid*, which was formerly a voluntary gift from the vassal in cases of distress happening to his lord, now became an unavoidable tax. An aid formerly was demanded when the eldest daughter of the superior was married, when his eldest son was knighted, or when the superior himself was taken prisoner in battle. These were the only legal causes of making a demand of this kind; but in the subsequent times of degeneracy, the most frivolous pretences were every day made use of by the prince to oppress the lords, and by the lords to oppress their vassals; demanding subsidies at pleasure, which their inferiors were always obliged to comply with. Lastly, The *escheat*, which in former times took place only in cases of cowardice, treachery, or some other heinous crime, was now inflicted on the most trifling occasions. If the vassal happened to be too long in attending the court of his superior to take the oath of fealty; if he committed any action which could in the least be construed an infringement of the oath; if he neglected to give his lord warning of any misfortune which he might suppose was about to befal him; revealed any thing concerning him; made love to his sister or daughter, &c.; or even if he should grant a tenure of land to another person in form different from that in which he held his own; all these, nay others still more ridiculous, were judged sufficient reasons for the superior to seize on the estate of the vassal, and involve him and his family in ruin.

12
Consequent degeneracy of the feodal militia.

Notwithstanding these oppressions, however, the vassal was still obliged to submit to his lord; to own him as his superior; and even, in appearance, to pay him the same respect as formerly when the greatest unanimity and cordial affection subsisted between them. Still he was obliged to perform the same military service; because a failure in that respect would have subjected him to a forfeiture of lands according to the original agreement. A vast difference, however, now took place in the valour and activity which inspired the army. The vassals, forced into the field with desponding hearts, were indifferent as to the success of the cause in which they were engaged, and frequently obstructed instead of forwarding the operations of the field. Hence the sovereign found himself embarrassed; and, though nominally at the head of a martial and powerful people, was frequently unable to effect any thing, by reason of the mutual hatred and dissension which everywhere prevailed.

13
Expedient for its recovery.

14
Invention of knight-service.

Thus the feodal states of Europe became unnaturally weak: a remedy was necessary; and it is remarkable that the same remedy was applied all over the continent. This was, in short, the making fiefs hereditary, which till now had only been granted for a long term of years; and, in return, burdening the lands with a certain number of soldiers, which were not to be refused under any pretence whatever. Hence was derived the tenure of *knight-service*. A certain portion of land, burdened with the service of one soldier or knight, was called a *knight's-fee*; and thus an estate, furnishing any number of soldiers, was said to contain as many knight's fees; so that now the manors, baronies, &c. became powerful according to the number of soldiers they were bound to furnish. In the grants from the crown, the nobility were obliged to furnish a certain number of soldiers for the service of the sovereign; and in those from the nobility to their vassals, the like service was required. Even the commons who had grants from the crown furnished a certain proportion of knights. The force of the nation was called into action by grants *in capite*, or from the sovereign and nobility. A numerous and powerful army was instantly assembled, and at once ready for action. Of this army the king was the general, the nobility the officers, and the vassals soldiers; the whole being exactly arranged, and capable of entering upon any expedition without the least delay.

Thus a remedy was found in some measure for the weakness of the feodal sovereigns: but though the knights tenure could accomplish this, it could not bring back the former affection and cordiality which subsisted between the various ranks of people. On the contrary, by uniting them more firmly to one another by legal ties, it rendered matters rather worse. The oppression originating from the operation of the feodal *incidents*, still continued with unremitting violence. The grants of knights tenure were attended with the same oaths of homage and fealty; the same incidents of relief, wardship, marriage, aid, and escheat, with the feodal tenures. The princes promised to abate somewhat of their rigour in demanding the feodal perquisites, but did not keep their word. Laws were occasionally promulgated, and for some time had an effect; but palliatives soon became ineffectual, and a new state of weakness began to commence.

15
Two eras in the history of fiefs.

The two remarkable eras in the feodal history are, the time before the invention of knight-service (D), and that during which it continued. Fiefs were in a state of fluctuation from the destruction of the Roman empire till the ninth century; but they were rendered perpetual in France about the year 877, and were generally become so in every country of Europe about the beginning of the tenth. Du Cange, *voce Militia*, gives us an example of a knight fee in the year 880. By the year 987, when Hugh Capet was raised to the throne of France, knight service was become general all over Europe, and was introduced into England after having made its appearance in other countries (E). In England, however, there have been several doubts and inquiries

16
Doubts concerning the introduction of the feodal laws into England.

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(D) For the difference between the knights produced by this service and the more ancient ones, or knights of honour, see the article KNIGHT.

(E) Dr Stuart informs us, that it appears from the records of Malcolm IV. in 1153, that knights-service was quiries among the learned concerning the introduction of the feodal laws. Many are of opinion, that they were first introduced by William the Conqueror; and, consequently, that they were entirely unknown to the Anglo-Saxons: but others think, that they existed among the latter in the same form under which they were continued by the Normans. Dr Stuart is of opinion that the Saxons who settled in England could not be strangers to fiefs. He supposes the conformity of manners, which undoubtedly prevailed between the Saxons and other barbarians, a sufficient proof that the hereditary grant of land, as well as the fluctuating state of feodal tenures which preceded it, were known to the former. Collateral proofs are derived from the spirit and tenure of the Anglo-Saxon laws, but especially from the grants of hereditary estates on condition of military service (F). The condition of fiefs under the Anglo-Saxons was very different from what it was afterwards. In their times we find no mention made of these oppressions of which so much notice has already been taken; and this may be easily accounted for from the alteration of the feodal spirit in different ages. During the time that a warm and generous affection subsisted between the feodal superiors and vassals, the incidents were marks of generosity on the one part, and gratitude on the other; but as soon as a variance had taken place, by reason of the interested disposition which the introduction of luxury produced, the same incidents became sources of the most flagrant oppression. This was remarkably the case in the time of William the Conqueror; and during the reign of King John, matters were come to such a crisis, that the people everywhere complained loudly, and demanded the restoration of the laws of Edward the Confessor (G). "What these laws of Edward the Confessor were (says Mr Hume), which the English every reign during a century and a half desired so passionately to have restored, is much disputed by antiquarians; and our ignorance of them seems one of the greatest defects of the ancient English history." Dr Stuart has offered an explanation; but this is in fact no more than a conjecture, that "by the laws or customs of the Confessor, that condition of felicity was expressed which had been enjoyed during the fortunate state of the feodal association. The cordiality, equality, and independence, which then prevailed among all ranks in society, continued to be remembered in less prosperous times, and occasioned an ardent desire for the revival of those laws and usages which were the sources of so much happiness."

17
Insufficient solution of them by Dr Stuart.

18
Distinction concerning fiefs in the Anglo-Saxon and the Anglo-Norman times.

Besides the great distinction (of which an account has already been given) between the state of fiefs under the Anglo-Saxons and under the Normans, they were no less distinguished by the introduction of knight-service. Hitherto the refinement of the English had been obstructed by the invasion of the Danes, and the insular situation of the kingdom; but after the Norman conquest the fiefs were made perpetual. Still, however, the knight-fee and knight-service were altogether unknown. William, the sixth prince who enjoyed the duchy of Normandy, was well acquainted with every thing relating to fiefs; for that duchy had experienced all the variety incidental to them from the time of its being granted to Rollo by Charles the Simple in the year 912, to the year 1066, when William was put in possession of England by the battle of Hastings.

On his accession to the throne, a number of forfeitures took place among those who had followed the fortune of Harold. Their estates were to be disposed of at the pleasure of the conqueror; and it was natural to suppose that he would follow the method practised in

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was known in Scotland, and that it was not a novelty at that time. The same author thinks it even probable that it was known in the time of David I.

(F) The use of entails was known to the Anglo-Saxons; and this practice, as well as the succession to allodial estates, must have contributed very much to establish hereditary fiefs. This opinion seems also to be confirmed by the accounts we have of the great power of many of the nobility among the Anglo-Saxons, and the natural tendency that fiefs must have, in the course of things, to become perpetual, though analogical arguments cannot entirely be depended upon in this case. There is indeed positive evidence that the territory which anciently constituted the kingdom of Merckand belonged to Ethelred as an hereditary fief and earldom. The grant was given him by Alfred when he married his daughter Ethelfleda: and it is likewise attested by Camden, that in the time of Ethelred the earldom of Leicester was an inheritance, and the regular succession of its earls is still known. We are informed also by creditable historians, that Beraicia and Deireland were feodal and inheritable earldoms among the Saxons. The same was true of the county of Cumberland when possessed by the Scottish monarchs. This last appears from the Saxon Chronicle: in which the grant was conveyed by Edmund king of England to Malcolm of Scotland in the following terms: "Edmundus rex totam Cumberland prædavit, et contrivit, et *commendavit* eam Malcolmo regi Scotiæ; hoc pacto, quod *in auxilio* sibi foret terra et mari." From the use of the word *commendavit*, indeed, Spelman takes occasion to say, that a feodal homage was not intended: but the contrary may be proved by the original Saxon from which the foregoing is a Latin translation; and the word, according to several learned critics, signifies feodal homage with the most strict propriety. Thus Du Cange informs us, that *commendare se alicui* was the general expression for *faire l'hommage a un suserain.*

(G) The laws which are now extant under the name of Edward, are generally allowed to be of doubtful authenticity; nor are they, even supposing them to be genuine, of any use in answering the present question. They determine indeed the existence of fiefs among the Anglo-Saxons: and Dr Stuart is of opinion, that the compilation which goes under the name of this prince, though posterior to the date it bears, nevertheless merits greater attention than has usually been bestowed upon it. M. Houard, a foreign lawyer, is the latest writer who has made it his study; but he is better acquainted with the Norman than the Anglo-Saxon customs.

**19 Introduction of knight-service into England.**

in his own country. Hence the origin of knight service in England. A grant of land, to any person whatever, was estimated at a certain number of knights fees; and each of these required the service of a knight. The grants of lands were even renewed to the old tenants under this tenure; so that by degrees the whole military people in the kingdom acquiesced in it. To accomplish this, DOMESDAY *Book* is supposed to have been compiled, which contained an exact account of all the landed property of the kingdom.—Hence it is to be concluded, not that William introduced fiefs into England, as some have imagined, but that he brought them to their ultimate state of perfection by the introduction of knight-service. This is evident from the laws enacted during his reign. In these it is not only mentioned that knight-service was enacted, but that it was done expressly with the consent of the common council of the nation; which at that time was equivalent to an act of parliament (H).

**20 Idea of the feodal militia.**

The invention of knight-service proved generally agreeable: for, as only a few of the Anglo-Saxon fiefs were hereditary, the advancement of the rest to perpetuity, under the tenure of knight-service, must have been accounted an acquisition of some importance; as not only augmenting the grandeur and dignity of the sovereign, but securing the independence of the subject, and improving his property. In the happy state of the feodal association, there was indeed no necessity for the knight's fee; but when the discordance and oppression so often mentioned began to take place, it became then necessary to point out particularly every duty of the vassal, as well as of the lord; and this was fully done by the invention of knight-service. The nobles possessed duchies, baronies, and earldoms; which extensive possessions were divided into as many fees, each of them to furnish a knight for the service of the king, or of the superior; so that every feudal state could command a numerous army and militia to support and defend it in case of any emergency. The knights were also bound to assemble in complete armour whenever the superior thought proper to call, and to hold themselves in readiness for action whenever the king or superior found it convenient to take the field: so that thus the militia might be marched at the shortest notice to defend or support the honour of the nation.

The knights were usually armed with a helmet, sword, lance, and shield; and each was besides obliged to keep a horse. This last requisite was owing to the contempt into which the infantry had fallen through the prevalence of tournaments and luxuries of various kinds, though it was by means of the infantry that the barbarians had originally distinguished themselves in their wars with the Romans, and became able to cope with these celebrated warriors. All proprietors of fees or tenants by knight-service fought on foot: the cavalry were distinguished by the name of *battle*; and the success of every encounter was supposed to depend on them alone. They only were completely armed; the infantry, being furnished by the villages under the jurisdiction of the barons, had at first only bows and slings; though afterwards they were found worthy of much greater attention.

**21 Its inefficacy and corruption.**

While the feodal association remained in perfection, the superior could at any time command the military service of his vassals; but in the subsequent degeneracy, this service could neither be depended upon when wanted, nor was it of the same advantage when obtained as formerly. The invention of knight-service tended in a great degree to remedy this inconvenience. Those who were possessed of knights fees were now obliged to remain 40 days in the field at their own expence; and this without exception, from the great crown vassals to the smallest feudatories; but if longer service was required, the prince was obliged to pay his troops. In those times, however, when the fate of nations was frequently decided by a single battle, a continuance in the field for 40 days was sufficient for ordinary occasions.

**22 Rise of standing armies, &c.**

Thus matters seemed once more to be restored nearly to their former state. It was now, as much as ever, the interest of the nation to act with unanimity in its defence, not only against foreign enemies, but against the tyranny of the prince over his subjects, or of one part of the subjects over the other. New inconveniences, however, soon began to take place, owing to the gradual improvements in life and the refinement of manners. From the first institution of military service, a fine had been accepted instead of actual appearance in the field. In the times of barbarity, however, when men accounted rapine and bloodshed their only glory, there were but few who made an offer of this compensation; but as wealth and luxury increased, and the manners of people became softer, a general unwillingness of following the army into the field became also prevalent. A new tenure, called *escuage*, was therefore introduced, by which the vassal was only obliged to pay his superior a sum of money annually, instead of attending him into the field *. Hence originated taxes and their misapplication; for as the king was lord paramount of the whole kingdom, it thence happened that the whole escuage money collected throughout the nation centred in him. The princes then, instead of recruiting their armies, frequently filled their coffers with the money, or dissipated it otherwise, hiring mercenaries to defend their territories when threatened with any danger. These being composed of the dregs of the people, and disbanded at the end

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* See the particular consequences of this under the article *Knight-Service*.

(H) The following law of William the Conqueror not only makes express mention of the knight's fee and service, but alludes to a former law of William and his parliament, by which this tenure was actually established. "Statuimus etiam et firmiter præcipimus, ut omnes comites, et barones, et milites, et servientes, et universi liberi homines totius regni nostri prædicti, habeant et teneant se semper bene in *armis* et in *equis*, ut decet et oportet, et quod sint semper prompti et bene parati ad *servitium suum integrum* nobis explendum, et peragendum, cum semper opus adfuerit, secundum quod NOBIS debent de *feodis et tenementis suis* de jure facere, et sicut illis statuimus per *commune consilium* totius regni nostri prædicti, et dedimus et concessimus in feodo jure hæreditario." *LL. Guill.* c. 58.

end of every campaign, filled all Europe with a disorderly banditti, who frequently proved very dangerous to society. To avoid such inconveniences, standing armies were introduced, and taxations began to be raised in every European kingdom. New inconveniences arose. The sovereigns in most of these kingdoms, having acquired the right of taxation, as well as the command of the military power, became completely despotic: but in England the sovereign was deprived of this right by Magna Charta, which was extorted from him, as related under the article ENGLAND, N° [153]; so that, though allowed to command his armies, he could only pay them by the voluntary contributions of the people, or their submitting to such taxations as were virtually imposed by themselves.

FEOFFMENT, in *Law*, (from the verb *feoffare* or *infeudare*, "to give one a feud"); the gift or grant of any corporeal hereditament to another. He that so gives, or enfeoffs, is called the *feoffer*, and the person enfeoffed is denominated the *feoffee*.

This is plainly derived from, or is indeed itself the very mode of, the ancient feodal donation; for though it may be performed by the word "enfeoff," or "grant," yet the aptest word of feoffment is *do* or *dedi*. And it is still directed and governed by the same feodal rules; insomuch that the principal rule relating to the extent and effect of the feodal grant, *tenor est qui legem dat feudo*, is in other words become the maxim of our law with relation to feoffments *modus legem dat donationi*. And therefore, as in pure feodal donations, the lord, from whom the feud moved, must expressly limit and declare the continuance or quantity of estate which he meant to confer, *ne quis plus donasse præsumatur, quam in donatione expresserit*; so if one grants by feoffment lands or tenements to another, and limits or expresses no estate, the grantee (due ceremonies of law being performed) hath barely an estate for life. For, as the personal abilities of the feoffee were originally presumed to be the immediate or principal inducements to the feoffment, the feoffee's estate ought to be confined to his person, and subsist only for his life; unless the feoffer, by express provision in the creation and constitution of the estate, hath given it a longer continuance. These express provisions are indeed generally made; for this was for ages the only conveyance, whereby our ancestors were wont to create an estate in fee-simple, by giving the land to the feoffee, to hold to him and his heirs for ever; though it serves equally well to convey any other estate of freehold.

But by the mere words of the deed the feoffment is by no means perfected: there remains a very material ceremony to be performed, called *livery of seisin*, without which the feoffee has but a mere estate at will. See SEISIN.

FERÆ, an order of quadrupeds, belonging to the class *Mammalia*. See MAMMALIA *Index*.

FERALIA, in antiquity, a festival observed among the Romans on February 21st, or, according to Ovid, on the 17th of that month, in honour of the manes of their deceased friends and relations.

Varro derives the word from *inferi*, or from *fero*; on account of a repast carried to the sepulchres of such as the last offices were that day rendered to. Festus derives it from *ferio*, on account of the victims sacrificed. Vossius observes, that the Romans called death *fera*, "cruel," and that the word *feralia* might arise thence. —Macrobius, Saturn. lib. i. cap. 13. refers the origin of the ceremony to Numa Pompilius. Ovid, in his Fasti, goes back as far as Æneas for its institution. He adds, that on the same day a sacrifice was performed to the goddess Muta, or Dumb; and that the persons who officiated were an old woman attended with a number of young girls.

During the continuance of this festival, which lasted eleven days, presents were made at the graves of the deceased, marriages were forbidden, and the temples of the gods shut up. While the ceremonies continued, they imagined that the ghosts suffered no punishments in hell, but that their tormentors allowed them to wander round their tombs, and feast upon the meats which their surviving friends had prepared for them.— For a more particular account of the offerings and sacrifices and feasts for the dead, see INFERIÆ and SILICERNIUM.

Sometimes at the feralia public feasts were given to the people, at the tombs of the rich and great, by their heirs or particular friends.

FER DE FOURCHETTE in *Heraldry*, a cross having at each end a forked iron, like that formerly used by soldiers to rest their muskets on. It differs from the cross-fourche, the ends of which turn forked; whereas this has that sort of fork fixed upon the square end. See HERALDRY.

*Fer de Moulin*, *Milrinde*, *Inke de Moulin*, in *Heraldry*, is a bearing supposed to represent the iron ink, or ink of a mill, which sustains the moving millstone.

FERDINAND V. king of Spain, called *the Catholic*, which title was continued to his successors. He married Isabella of Castile, by which that kingdom was united to the Spanish crown. This illustrious couple laid the foundation of the future glory and power of Spain. The conquest of Granada, and the discoveries of Christopher Columbus, made this reign a celebrated era in the history of Spain. He died in 1516, aged 63. See (*History of*) SPAIN.

FERENTARII, in Roman antiquity, were auxiliary troops, lightly armed; their weapons being a sword, bow, arrows, and a sling.

FERENTINUM, in *Ancient Geography*, a town of the Hernici in Latium, which the Romans, after subduing that nation, allowed to be governed by its own laws. Now *Feretino*, an episcopal city in the Campagna di Roma. E. Long. 14. 5. N. Lat. 41. 45.

FERENTUM or FORENTUM, in *Ancient Geography*, a town of Apulia in Italy. Now *Forenza*, in the Basilicata of Naples.

FERETRIUS, a surname of Jupiter, *à ferendo*, because he had assisted the Romans: or *à feriendo*, because he had conquered their enemies under Romulus. He had a temple at Rome built by Romulus. It was there that the spoils called *opima* were always carried.

FERETRUM, among the Romans, the bier used in carrying out the bodies of the dead, which duty was performed by the nearest male relations of the deceased: thus, sons carried out their parents, brothers their sisters, &c.

FERG, or FERGUE, FRANCIS PAUL, a charming landscape-painter, was born at Vienna in 1689, and there learned the first principles of his art. He successively

cessively practised under Hans Graf, Orient, and Thiele. This last, who was painter to the court of Saxony, invited him to Dresden to insert small figures in his landscapes. Ferg thence went into Lower Saxony, and painted for the duke of Brunswick and for the gallery of Salzdahl. From Germany he went to London, where he might have lived in the highest esteem and affluence, if, by an indiscreet marriage, he had not been so effectually depressed, that he was ever after involved in difficulties. The necessities which arose from his domestic troubles compelled him to diminish the prices of his paintings in order to procure an immediate support; and as those necessities increased, his pictures were still more sunk in their price, though not in their intrinsic value. By a series of misfortunes he was overrun with debts, and to avoid the pursuit of his creditors, he was constrained to secrete himself in different parts of London. He died suddenly in the street one night as he was returning from some friends, about the year 1738, before he had attained his 50th year; and left four children. This pleasing artist, Mr Walpole observes, had formed a manner of his own from various Flemish painters, though resembling Poelemburg most in the enamelled softness and mellowness of his colouring; but his figures are greatly superior; every part of them is sufficiently finished, every action expressive. He painted small landscapes, fairs, and rural meetings, with the most agreeable truth; his horses and cattle are not inferior to Wouvermans; and his buildings and distances seem to owe their respective softness to the intervening air, not to the pencil. More faithful to nature than Denner, he knew how to omit exactness, when the result of the whole demands a less precision in parts. The greatest part of his works are in London and Germany; and the price they now bear is the best proof of their real merit. He also etched well with aquafortis; and his prints of that kind are generally esteemed by the curious.

**FERGUS**, the name of three kings of Scotland. See (*History of*) SCOTLAND.

**FERGUSON**, JAMES, an eminent experimental philosopher and mechanic, was born in Scotland, of very poor parents. At an early age his extraordinary genius began to exert itself. He first learned to read by overhearing his father teach his elder brother: and he had made this acquisition before any one suspected it. He soon discovered a peculiar taste for mechanics, which first arose on seeing his father use a lever. He pursued this study a considerable length, even while very young; and made a watch in woodwork, from having once seen one. As he had no instructor, nor any help from books, every thing he learned had all the merit of an original discovery; and such, with infinite joy, he believed it to be. As soon as his age would permit he went to service; in which he met with hardships which rendered his constitution feeble through life. Whilst he was servant to a farmer (whose goodness he acknowledges in the modest and humble account of himself which he prefixed to his last publication), he frequently contemplated the stars; and began the study of astronomy, by laying down, from his own observations only, a celestial globe. His kind master, observing these marks of his ingenuity, procured him the countenance and assistance of his superiors. By their help and instructions, he went on gaining farther knowledge, and was sent to Edinburgh. There he began to take portraits; an employment by which he supported himself and family for several years, both in Scotland and England, whilst he was pursuing more serious studies. In London he first published some curious astronomical tables and calculations; and afterwards gave public lectures in experimental philosophy, which he repeated (by subscription) in most of the principal towns in England, with the highest marks of general approbation. He was elected a fellow of the Royal Society, without paying for admission (an honour scarcely ever conferred on a native); and had a pension of 50l. per ann. given him, unsolicited, by our gracious king, at his accession, who had heard lectures from him, and frequently sent for and conversed with him on curious topics. He also received several presents from his majesty, the patron of real merit. To what a degree of consideration Mr Ferguson mounted by the strength of his natural genius, almost every one knows. He was universally considered as at the head of astronomy and mechanics in this nation of philosophers. And he might justly be stiled self-taught, or rather heaven-taught; for in his whole life he had not above half a-year's instruction at school. He was a man of the clearest judgment and the most unwearied application to study; benevolent, meek, and innocent in his manners as a child; humble, courteous, and communicative; instead of pedantry, philosophy seemed to produce in him only diffidence and urbanity,—a love for mankind and for his Maker. His whole life was an example of resignation and Christian piety. He might be said to be an enthusiast in his love of God, if religion, founded on such substantial and enlightened grounds as his was, could be styled enthusiasm. He died in 1776.

FERGUSON, *Robert*, a Scottish poet, who acquired a considerable share of celebrity at a very early period of life, was born at Edinburgh on the 5th of September 1750, of which we are assured from unquestionable authority, although some have placed it in 1751. His father's name was William, who, as well as the son, likewise paid court to the muses: but he wisely relinquished the study of poetry for the more certain emoluments of trade and commerce, being employed in different mercantile houses both in Edinburgh and Aberdeen. He was an accountant in the Linen Hall when he died, but never acquired any thing like an independent fortune.

The subject of the present sketch was of a weak and delicate constitution during infancy,—indeed to such a degree, that small hopes were entertained of his ever reaching the years of manhood. Yet such were the care and attention of his parents, that he was able to attend an English school by the time he was six years of age, when his progress was considered as very extraordinary. It was no less rapid at the high school of Edinburgh, which he attended four years, acquiring a competent knowledge of the Latin tongue with very little labour or exertion. From that he went to the grammar school of Dundee, and in two years after to the university of St Andrews, which place his father preferred to Edinburgh, because a gentleman of the name of Ferguson had left two bursaries for the education of two boys of the same name.

His health was never impaired at any time by severe study; yet he kept alive at the university the opinion which had been entertained of him while at school, and he was decidedly the first mathematician of the same standing. He was patronized by Dr Wilkie, professor of natural philosophy, who was perhaps as much attached to him for his poetical as his mathematical talents, the doctor himself being a poet, and author of the Epigoniad. This kindness was repaid by Ferguson, on the death of Dr Wilkie, by a beautiful eclogue to his memory, written in the Scottish dialect. A little before he left the university, Ferguson had conceived the idea of writing a tragedy on the death of Sir William Wallace, for which he had collected materials; but as he afterwards met with a work on the same subject, he abandoned the design, after he had completed two acts. His own reason for doing so he thus expressed: "Whatever I publish shall be original, and this tragedy might be considered as a copy."

He returned to Edinburgh when he had finished his studies, without having fixed on any particular employment; for although he was destined for the church by his father, on his death he paid little attention to the expostulations of his mother. He declined also the study of physic, assigning this as a reason, that when he read the description of diseases, he believed that he felt the symptoms of them all in himself. He was then induced to attempt the study of the law, in which, as was natural to expect, he made no proficiency. He seems to have turned a wishful eye to some sinecure place, to obtain which he paid a visit to an uncle who resided at Aberdeen, a man of literature and opulence, hoping that through his influence he might be settled in some place suited to his merit. In this rational hope he was completely disappointed; for although his uncle shewed him every mark of attachment, his fondness decayed by degrees, and in six months he desired him in an abrupt manner to leave his house, without attempting to procure for him any kind of living. It would perhaps be rash and uncandid to reprobate this conduct of his uncle, whose penetration probably beheld, if not the actual commission, at least the germinating seeds of these too fashionable vices and follies into which he afterwards plunged. We only give this as a conjecture of our own; but it seems to derive considerable countenance from the contrast between the manner in which his uncle received him, and the nature of their separation. Be this as it may, the conduct of his uncle operated powerfully on the mind of Ferguson, which, with the fatigue of his journey back to Edinburgh, brought on him a severe illness, on his recovery from which he composed two elegies; one on the decay of friendship, and the other against repining at fortune; both which were suggested by this adventure at Aberdeen. The disappointment of his hopes, and the effect it produced on his mind, are very evident from the following stanzas.

But, ah! these youthful sportive hours are fled,
The scenes of jocund mirth are now no more;
No healing slumbers 'tend my humble bed,
No friends condole the sorrows of the poor.

And what avail the thoughts of former joy?
What comfort bring they in the adverse hour?
Can they the canker-worm of care destroy,
Or brighten fortune's discontented lour?

So great were his necessities at this period, that he copied papers in the commissary clerk's office for so much per sheet, which employment he soon left in disgust. So boundless was his wit, which was only equalled by his good nature, modesty, and goodness of heart, that all who knew him received him with affection: but his powers of song and talents for mimicry often led him into the company of the dissipated, whose example could not fail of doing him essential injury, but who had neither the power nor inclination to provide for him through life. The irregularities into which he was thus frequently led, often awakened upon him the dictates of conscience; and the conversation of a minister who understood his manner of life, made a deep impression on his mind. In short, his remorse soon after assumed the appearance of absolute despair. His sprightliness entirely forsook him: but he gradually recovered from his despondency, and his health was fully restored. Soon after he cut his head so dreadfully in consequence of a fall, that from the loss of blood he became delirious, in which condition he remained for some months, till the want of sleep and perpetual talking put a period to his existence on the 16th of October 1774. He was buried in the Canongate churchyard. Over his grave his admirer Robert Burns has since erected a monument. Had he joined prudence to his bright genius and good heart, he would have no doubt risen to distinguished eminence in the literary world. His poems in the Scottish dialect have been universally admired by his countrymen; and when we reflect that they were composed in a round of dissipation, they must be considered as unequivocal evidences of his genius and taste.

FERGUSON, *Adam*, LL.D. a late Scottish philosopher and historian. See SUPPLEMENT.

FERIÆ, in Roman antiquity, holidays, or days upon which they abstained from work. Proclamation was generally made by the herald, by command of the *Rex Sacrorum* or *Flamines*, that all should abstain from business; and whoever transgressed the order was severely fined.—The feriæ were of two kinds, public and private.

The public feriæ were fourfold. 1. *Stativæ*, which were kept as public feasts by the whole city upon certain immoveable days appointed by their kalendar;—such were the *Compitalia*, *Carmentalia*, *Lupercalia*, *&c.* 2. *Feriæ Conceptivæ*, which were moveable feasts, the days for the celebration of which were fixed by the magistrates or priests; of this sort were the *Feriæ Latinæ*, *Paganalia*, *Compitalia*, &c. which happened every year, but the days for keeping them were left to the discretion of the magistrates or priests. 3. *Feriæ Imperativæ*, which were fixed and instituted by the mere command of consuls, prætors, dictators, upon the gaining of some victory or other fortunate event. 4. *Nundinæ*. See the articles NUNDINÆ, AGONALIA, CARMENTALIA, &c.

The *private* feriæ were holidays observed by particular persons or families on several accounts, as birthdays, funerals, &c. The feriæ belonged to, and were one division of the *dies festi*. See FESTI.

*FERIÆ Latinæ*, a festival at which a white bull was sacrificed, and the Latin and Roman towns provided each a set quantity of meat, wine, and fruits; and during the celebration, the Romans and Latins swore eternal friendship to each other, taking home a piece of the victim to every town. The festival was instituted by Tarquinius Superbus when he overcame the Tuscans and made a league with the Latins, proposing to build a common temple to Jupiter Latialis, at which both nations might meet and offer sacrifices for their common safety. At first the solemnity lasted but one day, but it was at different times extended to ten. It was held on the Alban mount, and celebrated with chariot races at the Capitol, where the victor was treated with a large draught of wormwood drink.

**FERIA**, in the Romish breviary, is applied to the several days of the week; thus Monday is the *feria secunda*, Tuesday the *feria tertia;* though these days are not working days, but holidays. The occasion of this was, that the first Christians were used to keep the Easter week holy, calling Sunday the *prima feria*, &c. whence the term *feria* was given to the days of every week. But besides these, they have extraordinary feriæ, viz. the three last days of Passion week, the two following Easter day, and the second feriæ of Rogation.

**FERIANA**, the ancient city of Thala in Africa, taken and destroyed by Metellus in the war with Jugurtha. It was visited by Mr Bruce in his late travels through Africa, who expected to have found many magnificent ruins in the place, but was disappointed. The only remarkable objects he met with were the baths, which are excessively warm. These are without the town, and flow from a fountain named *El Tarmid.* Notwithstanding the excessive heat of its water, the fountain is not destitute of fishes. They are of the shape of a gudgeon, about four inches in length; and he supposed that there might have been about five or six dozen of them in the pool. On trying the water with a thermometer, he found the heat so great, that he was surprised the fish were not boiled in it. That fish should exist in this degree of heat, is very surprising; but it seems no less wonderful that Mr Bruce, while standing naked in such water, should leisurely make observations on its heat, without suspecting that he himself would be boiled by continuing there. We have to regret that the accidental wetting of the leaf on which he wrote down his remarks has deprived the public of the knowledge of the precise degree to which the thermometer is raised by this water. The fish are said to go down the stream to some distance during the day, and to return to the spring or warmest part at night.

**FERMANAGH**, a county of Ireland, in the province of Ulster; bounded by Cavan on the south, Tir-Oen on the north and north-east, by Tyrconnel on the north-west, Leitrim on the south-west, and Monaghan on the west. It is 38 miles long, and 24 broad. A great part of it is taken up with bogs; and the great lake called *Lough-Earne*, which is near 20 miles in length and in some places 14 in breadth, diversified with upwards of 300 islands, most of them well wooded, inhabited, and covered with cattle. It abounds also with great variety of fish, such as huge pike, large bream, roach, eels, trout, and salmon. The water of the lake in some places is said to have a particular softness and sliminess, that bleaches linen much sooner than could be done by other water. In one part of the country are marble rocks 50 or 60 feet high. This county sends three members to parliament, viz. two for the shire, and one for Inniskillen the capital. See FERMANAGH, SUPPLEMENT.

**FERMAT**, PETER DE, an eminent French mathematician. See SUPPLEMENT.

**FERMENT**, any body which being applied to another, produces fermentation.

Ferments are either matters already in the act of fermentation, or that soon run into this act. Of the first kind are the flowers of wine, yeast, fermenting beer, or fermenting wine, &c. and of the second are the new expressed vegetable juices of summer fruit.

Among distillers, ferments are all those bodies which, when added to the liquor, only correct some fault, therein, and, by removing some obstacle to fermentation, forward it by secondary means: as also such as, being added in time of fermentation, make the liquor yield a larger proportion of spirit, and give it a finer flavour.

**FERMENTATION**, may be defined a sensible internal motion of the constituent particles of a moist, fluid, mixed or compound body; by the continuance of which motion, these particles are gradually removed from their former situation or combination, and again, after some visible separation is made, joined together in a different order and arrangement, so that a new compound is formed, having qualities very sensibly different from those of the original fluid.

Fermentation, properly so called, is confined to the vegetable and animal kingdoms; for the effervescences between acids and alkalies, however much they may resemble the fermentation of vinous liquors, are nevertheless exceedingly different. It is divided into three kinds; or rather, there are three different stages of it, viz. the vinous, the acetous, and the putrefactive. To these has been added a fourth, the *panary*, or the fermentation of bread. Of the first, vegetables alone are susceptible; the flesh of young animals is in some slight degree susceptible of the second (A); but animal substances are particularly susceptible of the third, which vegetables do not so easily fall into without previously undergoing the first and second. The produce of the first stage is wine, or some other vinous liquor; of the second, vinegar; and of the third, ammonia or volatile alkali.

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(A) Under the article CHINA, N° 115. a fact is mentioned which seems to shew that animal substances are likewise capable of the vinous fermentation; viz. that the Chinese make use of a certain liquor called *lamb wine*, and likewise that they use a kind of spirit distilled from *sheep's flesh.* This is related on the credit of M. Grosier: but as he does not mention the particulars of the process, we are at liberty to suppose that the flesh of these animals has been mixed with rice, or some other ingredients naturally capable of producing a vinous liquor; so that instead of contributing any thing to the fermentation in question, they may in reality be detrimental, and furnish only that strong and disagreeable smell complained of in the liquid.

kali. For the explanation of this process, according to the principles of modern chemistry, see CHEMISTRY *Index*; and for the more general details of the process, see BREWING, MALTING, and VINEGAR-*making*.

FERN, FILIX. See FILICES, BOTANY *Index*.

Fern is very common in dry and barren places. It is one of the worst weeds for lands, and very hard to destroy where it has any thing of a deep soil to root in. In some grounds, the roots of it are found to the depth of eight feet. One of the most effectual ways to destroy it is often mowing the grass; and if the field is ploughed up, plentifully dunging thereof is very good: but the most certain remedy for it is urine. However, fern, cut while the sap is in it, and left to rot upon the ground, is a very great improver of land.

In some places of the north, the inhabitants mow it green; and, burning it to ashes, make those ashes up into balls, with a little water. They then dry them in the sun, and make use of them to clean their linen with; looking upon it to be near as good as soap for that purpose.

*Male FERN.* See POLYPODIUM, BOTANY *Index*.

*Female FERN.* See PTERIS, BOTANY *Index*.

FERNANDO, or FERNANDES, an island in the Pacific ocean. See *JUAN Fernandes*.

FERNELIUS, JOHN, physician to Henry II. king of France, was born in Picardy, in the latter end of the 15th or the beginning of the 16th century. Being sent to Paris to study rhetoric and philosophy, he applied himself in a most intense manner. All other pleasure was insipid to him. He cared neither for play nor for walking, nor for entertainments, nor even for conversation. He read Cicero, Plato, and Aristotle. The reading of Cicero procured him this advantage, that the lectures he read on philosophical subjects were as eloquent as those of the other masters were barbarous at that time. He also applied himself very earnestly to the mathematics. This continual study drew upon him a long fit of sickness, which obliged him to leave Paris. On his recovery, he returned thither with a design to study physic; but before he applied himself entirely to it, he taught philosophy in the college of St Barbara. After this, he spent four years in the study of physic; and taking a doctor's degree, confined himself to his closet, in order to read the best authors, and to improve himself in the mathematics; that is, as far as the business of his profession would suffer him. Never was a man more diligent than Fernel. He used to rise at four o'clock in the morning, and studied till it was time either to read lectures or to visit patients. He then examined the urine that was brought him; for this was the method of those times, with regard to the poor people, who did not send for the physician. Coming home to dine, he shut himself up among his books till they called him down to table. Rising from table, he returned to his study, which he did not leave without necessary occasions. Coming home at night, he did just as at noon: he staid among his books till they called him to supper; returned to them the moment he had supped; and did not leave them till 11 o'clock, when he went to bed. In the course of these studies he contrived mathematical instruments, and was at great charges in making them. But his wife murmuring at the expence, he dismissed his instrument-makers, and applied himself in good earnest to practise physic. But as visiting patients did not employ his whole time, he read public lectures upon Hippocrates and Galen. This soon gained him a great reputation through France and in foreign countries. His business increasing, he left off reading lectures; but as nothing could make him cease to study in private, he spent all the hours he could spare in composing a work of physic, entitled *Physiologia*, which was soon after published. He was prevailed with to read lectures upon this new work, which he did for three years: and undertaking another work which he published, *De venæ sectione*, he laid himself under the necessity of reading lectures some years longer, in order to explain this new book to the youth. While he was thus employed, he was sent for to court, in order to try whether he could cure a lady, whose recovery was despaired of. He was so happy as to cure her; which was the first cause of that esteem which Henry II. who was then but dauphin, and was in love with that lady, conceived for him. This prince offered him, even then, the place of first physician to him; but Fernel, who infinitely preferred his studies to the hurry of a court, would not accept the employment. When Henry came to the throne, he renewed his entreaties: but Fernel represented that the honour which was offered him was due, for several reasons, and as an hereditary right, to the late king's physician; and that, as for himself, he wanted some time to make experiments concerning several discoveries he had made relating to physic. The king admitted this: but as soon as Francis I's. physician died, Fernel was obliged to go and fill his place at Henry II.'s court. And here just the contrary of what he dreaded came to pass; for he enjoyed more rest and more leisure at court than he had done at Paris; and he might have considered the court as an agreeable retirement, had it not been for the journey which the new civil war obliged the king to take. He died in 1558, leaving behind him a great many works, besides what have been mentioned; as, *De abditis rerum causis*, seven books on Pathology, a book on Remedies, &c. They have been printed several times, with his life prefixed, written by William Plantius his disciple.

FERONIA, the Pagan goddess of woods and orchards. This deity took her name from the town Feronia, situated at the foot of Mount Soracte in Italy, where was a wood and temple consecrated to her. That town and wood are mentioned by Virgil, in the catalogue of Turnus's forces. Strabo relates, that those who sacrificed to this goddess, walked barefoot upon burning coals, without being hurt. She was the guardian deity of freed men, who receive their cap of liberty at her temple.

FERRARA, a city of Italy, in the territory of the pope, capital of a duchy of the same name. It is seated in an agreeable and fertile plain; watered by the river Po, which is a defence on one side; and on the other is encompassed by a strong wall and deep broad ditches full of water, as well as by a good citadel, finished by Pope Paul. In the middle of the city is a magnificent castle, which was formerly the palace of the dukes, and is now not the least ornament of Ferrara. It is quite surrounded with water; and the arsenal, which is near it, deserves the observation of travellers. Over against the palace is the duke's garden; with a park, called

*Belvidere* on account of its beauty. Behind the garden there is a palace, built with white marble, called the *palace of diamonds*, because all the stones are cut diamond fashion. Ferrara had formerly a considerable trade; but it is now much deserted. It is said to contain 24,000 inhabitants. The fortifications are now neglected, and the ancient university is dwindled into a wretched college of the Jesuits. However, in 1755, it was advanced to an archbishopric by Pope Clement XII. The country about it is so marshy, that a shower or two of rain renders the roads almost impassable. It is 24 miles north-east of Bologna, 38 north-west of Ravenna, 70 north-by-west of Florence, and 190 north of Rome. Murat's army was defeated here in 1815 by the Austrians. E. Long. 12. 14. N. Lat. 44. 36.

Ferrara, the duchy of; a province in the pope's territory, bounded on the north by the Austrian territories, on the west by the duchies of Mantua and Mirandola, on the south by the Bolognese and by Romagna, of which it was formerly a part, and on the east by the gulf of Venice. It is 50 miles in length, and 43 in breadth along the coast; but grows narrower and narrower towards the Mantuan. This country is almost surrounded by the branches of the Po, which often overflow the country, and form the great morass of Comachio, which has a bad effect on the air. It is thin of people, and indifferently cultivated, though fit for corn, pulse, and hemp. The Po and the lake of Comachio yield a large quantity of fish. Ferrara is the capital town; besides which there are Arano, Comachio, Magnavacca, Belriguardo, Cento, Buendeno, and Ficherola. This duchy was formerly possessed by the house of Este. But the pope took possession of it in 1598. The part of it beyond the Po was annexed to Lombardy in 1815.

FERRARIA, a genus of plants, belonging to the gynandria class; and in the natural method ranking under the sixth order, *Ensatæ*. See Botany *Index*.

FERRARS, George, a lawyer, poet, historian, and accomplished gentleman, was descended from an ancient family in Hertfordshire, and born about the year 1510, in a village near St Alban's. He was educated at Oxford, and thence removed to Lincoln's Inn; where applying with uncommon diligence to the study of the law, he was soon distinguished for his elocution at the bar. Cromwell, earl of Essex, the great minister of Henry VIII. introduced him to the king, who employed him as his menial servant, and in 1535, gave him a grant of the manor of Flamstead, in his native county. This is supposed to have been a profitable estate; nevertheless, Mr Ferrars being a gay courtier, and probably an expensive man, about seven years after was taken to execution by a sheriff's officer for a debt of 200 merks, and lodged in the compter. Being at this time member for Plymouth, the house of commons immediately interfered, and he soon obtained his liberty. He continued in favour with the king to the end of his reign, and in that of Edward VI. he attended the lord protector Somerset as a commissioner of the army in his expedition to Scotland in 1548. In the same reign, the young king being then at Greenwich, Mr Ferrars was proclaimed *lord of misrule*, that is, prince of sports and pastimes; which office he discharged during 12 days, in Christmas holidays, to the entire satisfaction of the court. This is all we know of Mr Ferrars; except that he died in 1579, at Flamstead in Hertfordshire, and was buried in the parish church. He is not less celebrated for his valour in the field, than for his other accomplishments as a gentleman and a scholar. He wrote, 1. History of the Reign of Queen Mary; published in Grafton's chronicle, 1569, fol. 2. Six tragedies, or dramatic poems; published in a book called the *Mirror for Magistrates*, first printed in 1559, afterwards in 1587, and again in 1610.

FERRET. See Mustela, Mammalia *Index*.

Ferrets, among glassmakers, the iron with which the workmen try the melted metal, to see if it be fit to work.—It is also used for those irons which make the rings at the mouth of the bottles.

FERRETTO, in glass-making, a substance which serves to colour glass.

This is made by a simple calcination of copper, but it serves for several colours: there are two ways of making it. The first is this. Take thin plates of copper, and lay them on a layer of powdered brimstone, in the bottom of a crucible; over these lay more brimstone, and over that another layer of the plates, and so on alternately till the pot is full. Cover the pot, lute it well, place it in a wind furnace, and make a strong fire about it for two hours. When it is taken out and cooled, the copper will be found so calcined, that it may be crumbled to pieces between the fingers like a friable earth. It will be of a reddish, and, in some parts, of a blackish colour. This must be powdered and sifted fine for use.

Another way of making ferretto is as follows. Make a number of stratifications of plates of copper and white vitriol alternately in a crucible; which place on the the floor of the glass furnace near the eye; and let it stand there three days; then take it out, and make a new stratification with more fresh vitriol; calcine again as before. Repeat this operation six times, and a most valuable ferretto will be obtained.

FERRO, (W. Long. 19. N. Lat. 28.), the most westerly of the Canary islands, near the African coast, where the first meridian was lately fixed in most maps; but now, the geographers of almost every kingdom make their respective capitals the first meridian, as we do London. It is a dry and barren spot, affording no water except what is supplied in a very surprising manner by a tree which grows in these islands, called the Fountain-*Tree*.

Ferro, *Faro*, or *Feroe Islands*; a cluster of little islands lying in the Northern ocean, between 61° 15′, and 62° 21′ N. Lat. and between 5° and 8° W. Long. They belong to Denmark. There are 17 which are habitable; each of which is a lofty mountain arising out of the waves, divided from the others by deep and rapid currents. Some of them are deeply indented with secure harbours; Providence seeming to have favoured mankind with the safest retreats in the most boisterous seas. All are very steep, and most of them faced with most tremendous precipices. The surface of the mountains consists of a shallow soil of remarkable fertility; for barley, the only corn sown here, yields above 20 for one; and the grass affords abundant pasturage for sheep. The exports are, salted mutton and tallow, goose quills, feathers, and eider down; and, by the industry of the inhabitants, knit woollen waistcoats, caps, and stockings. No trees beyond the size of juniper or stunted willows will grow here, nor are any wild quadrupeds to be met with except rats and mice, originally escaped from the shipping. Vast quantities of sea fowl frequent the rocks; and the taking of them furnishes a very perilous employment to the natives, as described under the article *Bird-Catching*.

The sea which surrounds these islands is extremely turbulent. The tides vary greatly on the western and eastern sides. On the first, where is received the uninterrupted flood of the ocean from the remote Greenland, the tide rises seven fathoms; on the eastern side it rises only three. Dreadful whirlwinds, called by the Danes *oes*, agitate the sea to a strange degree; catch up a vast quantity of water, so as to leave a great temporary chasm in the spot on which it falls, and carries away with it, to an amazing distance, any fishes which may happen to be within the reach of its fury. Thus great shoals of herrings have been found on the highest mountains of Feroe. It is equally resistless on land; tearing up trees, stones, and animals, and carrying them to very distant places.

Among the numerous whirlpools of these seas, that of Suderoe, near the island of the same name, is the most noted. It is occasioned by a crater 61 fathoms in depth in the centre, and from 50 to 55 on the sides. The water forms four fierce circumgirations. The point they begin at is on the side of a large bason, where commences a range of rocks running spirally and terminating at the verge of the crater. This range is extremely rugged, and covered with water from the depth of 12 to 8 fathoms only. It forms four equidistant wreaths with a channel from 35 to 20 fathoms in depth between each. On the outside beyond that depth, the sea suddenly sinks to 80 and 90. On the south border of the bason is a lofty rock, called *Sumboe Munk*, noted for the multitude of birds which frequent it. On one side, the water is only 3 or 4 fathoms deep; on the other 15. The danger at most times, especially in storms, is very great. Ships are irresistibly drawn in; the rudder loses its power; and the waves beat as high as the masts; so that an escape is almost miraculous; yet at the reflux, and in very still weather, the inhabitants will venture in boats for the sake of fishing.

Innumerable flocks of aquatic birds are continually to be seen perched on the extremities of the rocks, which make their nests in the clefts above the precipices; and vast numbers of them may be killed by the discharge of a single musket, and the rest will not stir, so little are they accustomed to be disturbed. One of the islands contains but a single habitation, which can be visited by the curate only in summer. In the southern parts of these islands coal-mines were discovered about the beginning of the eighteenth century, and trials of the coals were only made in 1777, when it was judged that working them would be of sufficient interest and consequence. The quarry was determined by a commissary to be about 12,000 feet long, 4000 broad on a medium, and five feet deep; but so great did the difficulty of working it appear, that the idea was abandoned. The coals were analyzed by the celebrated professor Kratzenstein of Copenhagen, who found that they were superior to those of England, as burning longer, and giving a more intense heat, but not so easily kindled. A trial of them has been made in Scotland, and they are allowed to be of a superior quality. It is a favourable circumstance to the exportation of the produce of those islands, that their harbours are never frozen, and navigation of consequence could meet with no interruption during the winter.

The measles and smallpox never attack the inhabitants but when they are brought there by strangers, when the ravages they make are almost as terrible as those of the pestilence; but for 70 years back they have not been subjected to this dreadful visitation. The air is temperate, and neither too hot in summer, nor extremely cold in winter. There are frequent mists on these islands, but they do not seem to be injurious to the health of the inhabitants. The wind often blows with such violence, that the people on horseback are obliged to dismount at its approach, which is announced by a whistling across the rocks; and persons on foot must throw themselves flat on their face, to avoid the dreadful consequences of the irresistible hurricane. So sudden is its approach at some times, that a burning candle might be carried in the open air but a few seconds before it. There is seldom any thunder on these islands; but when the phenomenon does happen, its awful and incessant roar among the rocks is truly alarming. Potatoes, the cultivation of which is rapidly advancing, thrive well, and the same is the case with radishes and turnips. Corn is not much cultivated, which would require excessive labour in a country so mountainous, and the spring fishery requires all the hands that can be spared. Trees cannot be made to grow upon them, and of consequence there is no wood.

The number of inhabitants amounted to 5209 in 1812, and they are in general well made, with fair complexions, and their whiteness is very seldom impaired by the influence of the sun. They are not deficient in understanding; and although phlegmatic, yet they are benevolent and hospitable, and are seldom known to quarrel. They are fond of brandy, and yet it is said that they are very rarely seen in a state of intoxication. They are frugal and upright, yet extremely credulous, and much addicted to superstitious practices. There are no schools among them, as parents educate their own children, and their knowledge of consequence is very circumscribed. They abound in skilful players at chess, but are wholly unacquainted with instruments of music, and dance to the sound of the voice. See Faroe, Supplement.

**FERROL**, a sea port town in Spain, in the province of Gallicia, seated on a bay of the Atlantic ocean. It has a good harbour, and is frequented by the Spanish fleet in time of war. W. Long. 8. 46. N. Lat. 43. 26.

**FERRUGINOUS**, any thing partaking of iron, or which contains particles of that metal.

**FERRUGO**, Rust, or oxide of iron. See Iron, *Oxide of*, Chemistry *Index*.

**FERRUM**, Iron. See Iron, Chemistry *Index*.

**FERRY**, a liberty by prescription, or by the king's grant, to have a boat for passage, on a frith or river, for carrying passengers, horses, &c. over the same for a reasonable toll.

**FERTILITY**, that quality which denominates a thing fruitful or prolific.

Nothing can produce fertility in either sex, but what promotes

promotes perhaps health; nothing but good blood, spirits, and perfect animal functions, that is, high health, can beget perfect fecundity; and therefore, all means and medicines, all nostrums and specifics, to procure fertility, different from those which procure good blood and spirits, are arrant quackery. Dr Cheyne says, that water-drinking males are very rarely infertile; and that, if any thing in nature can prevent infertility, and bring fine children, it is a milk and seed diet persevered in by both parents.

To increase the fertility of *vegetables*, says Lord Bacon, we must not only increase the vigour of the earth and of the plant, but also preserve what would otherwise be lost: whence he infers that there is much saved by setting, in comparison of sowing. It is reported, continues he, that if nitre be mixed with water to the thickness of honey, and after a vine is cut, the bud be anointed therewith, it will sprout within eight days. If the experiment be true, the cause may be in the opening of the bud, and contiguous parts, by the spirit of the nitre; for nitre is the life of vegetables.

How far this may be true, is not perhaps sufficiently shown, notwithstanding the experiments of Sir Kenelm Digby and M. Homberg. Consult Mr Evelyn's Sylvy, the Philosophical Transactions, the French Memoirs, and Dr Stahl's Philosophical Principles of Chemistry; but a proper set of accurate experiments seems still wanting in this view.

**FERULA**, a little wooden pallet or slice, reputed the schoolmaster's sceptre, wherewith he chastises the boys by striking them on the palms of the hand. The word is Latin, and has also been used to denote the prelate's crosier and staff. It is supposed to be formed of the Latin *ferire*, "to strike." Under the eastern empire, the ferula was the emperor's sceptre, as is seen on divers medals: it consists of a long stem or shank, and a flat square head. The use of the ferula is very ancient among the Greeks, who used to call their princes ναρθηκοφοροι, q. d. "ferula-bearers."

In the ancient eastern church, ferula or *narthex* signified a place separated from the church; wherein the penitents or the catechumens of the second order, called *auscultantes*, ακροωμενοι, were kept, as not being allowed to enter the church; whence the name of the place, the persons therein being under penance or discipline: *sub* ferula *erant ecclesiæ*.

**Ferula**, *Fennel-giant*, a genus of plants belonging to the pentandria class, and in the natural method ranking under the 45th order, *Umbellatæ*. See Botany *Index*. The drug assafœtida is obtained from a species of ferula.

**FESCENNIA**, or **Fescennium**, in *Ancient Geography*, a town of Etruria, above Falerii; where the Fescennine verses were first invented. Now *Galese*, in the Ecclesiastical State, near the Tiber.

**FESCENNINE verses**, in antiquity, were a kind of satirical verses, full of wanton and obscene expressions, sung or rehearsed by the company, with many indecent gestures and dances, at the solemnization of a marriage among the Romans; (Hor. lib. v. ep. i. 145.). The word is borrowed, according to Macrobius, from *facinum*, "a charm;" the people taking such songs to be proper to drive away witches, or prevent their effect; but its more probable origin is from Fescennium, a city of Campania, where such verses were first used.

**FESSE**, in *Heraldry*, one of the nine honourable ordinaries. See Heraldry.

*Fesse Point*, is the exact centre of the escutcheon. See Point.

*Fesse Ways*, or *in Fesse*, denotes any thing borne after the manner of a fesse; that is, in a rank across the middle of the shield.

*Party per Fesse*, implies a parting across the middle of the shield, from side to side, through the fesse point.

**FESTI dies**, in Roman antiquity, certain days in the year devoted to the honour of the gods.

Numa, when he distributed the year into 12 months, divided the same into the *dies festi*, *dies profesti*, and *dies intercisi*.

The *festi* were again divided into days of sacrifices, banquets, games, and feriæ. See Feriæ.

The *profesti* were those days allowed to men for the administration of their affairs, whether of a public or private nature: these are divided into fasti, comitiales, &c. See Fasti, Comitiales, &c.

The *intercisi* were days common both to gods and men, some parts of which were allotted to the service of the one, and some to that of the other.

**FESTINO**, in *Logic*, the third mood of the second figure of the syllogism, the first proposition whereof is an universal negative, the second a particular affirmative, and the third a particular negative; as in the following example:

FES No bad man can be happy.
TI Some rich men are bad men.
NO *Ergo*, Some rich men are not happy.

**FESTIVAL**, a time of feasting. See Feast.—The term is particularly applied to anniversary days of civil or religious joy.

**FESTOON**, in *Architecture* and *Sculpture*, &c. an ornament in form of a garland of flowers, fruits, and leaves, intermixed or twisted together.

It is in the form of a string or collar, somewhat bigger in the middle, where it falls down in an arch; being extended by the two ends, the extremities of which hang down perpendicularly.

Festoons are now chiefly used in friezes, and other vacant places which want to be filled up and adorned; being done in imitation of the long clusters of flowers, which the ancients placed on the doors of their temples and houses on festival occasions.

**FESTUCA**, **Fescue Grass**, a genus of plants belonging to the triandria class, and in the natural method ranking under the 34th order, *Gramina*. See Botany and Agriculture *Index*.

**FESTUS Pompeius**, a celebrated grammarian of antiquity, who abridged a work of Verrius Flaccus, *De Significatione Verborum;* but took such liberties in castration and criticising, as, Gerard Vossius observes, are not favourable to the reputation of his author. A complete edition of his Fragments was published by M. Dacier in 1681, for the use of the Dauphin. Scaliger says, that Festus is an author of great use to those who would attain the Latin tongue with accuracy.

**FETLOCK**, in the manege, a tuft of hair growing behind the pastern joint of many horses; for those of a low size have scarce any such tuft.

FETTI, Domenico, an eminent painter in the style of Julio Romano, was born at Rome in 1589, and educated under Ludovico Civoli of Florence. He painted but little for churches, but excelled in history: his pictures are much sought after, and are scarce.—He abandoned himself to disorderly courses; and put an end to his life by excesses, in the 35th year of his age.

FETUS. See Foetus.

FEUD, in our ancient customs is used for a capital quarrel or enmity, not to be satisfied but with the death of the enemy: and thence usually called *deadly feud*.—*Feud*, called also *feida*, and *faida*, in the original German, signifies *guerran*, i. e. *bellum*, "war." Lambert writes it *feeth*, and saith it signifies *capitalis inimicitia*, or "implacable hatred."

In Scotland, and the north of England, feud is particularly used for a combination of kindred, to revenge the death of any of their blood, against the killer and all his race, or any other great enemy.

Feud (*Feoda*), the same with *Fief*, or *Fee*. See *Feodal System*.

FEUDAL, or Feodal, of or belonging to a feud or fee. See Feodal.

FEUDATORY, or Feodatory, a tenant who formerly held his estate by feodal service. See *Feodal Tenure*.

FEU-duty, in *Scots Law*, is the annual rent or duty which a vassal, by the tenor of his right, becomes bound to pay his superior.

*Feu-Holding*, in *Scots Law*, is that particular tenure by which a vassal is taken bound to pay an annual rent or feu-duty to his superior.

FEVER. See Medicine *Index*.

The ancients deified the diseases, as well as the passions and affections of men. Virgil places them in the entrance into hell, Æn. vi. 273. Among these *Fever* had a temple on Mount Palatine, and two other parts of ancient Rome; and there is still extant an inscription to this goddess. FEBRI. DIVÆ. FEBRI. SANCTÆ. FEBRI. MAGNÆ. CAMILLA. AMATA. PRO. FILIO. MALE. AFFECTO.

Fever, in *Farriery*. See Farriery *Index*.

FEVERFEW. See Matricaria, Botany *Index*.

FEVERSHAM, a town of the county of Kent in England, situated on a branch of the river Thames, which is navigable for hoys. It was a royal demesne A. D. 811, and called in Kenulf's charter the *King's little Town*, though it is now a large one. It was inhabited by the Britons long before the invasion of Cæsar. In 903, King Athelstan held a great council here. King Stephen erected a stately abbey, 1147, whose abbots sat in parliament; and he was buried in it, together with Maud his queen, and Eustace his son; but of this building, two mean gate-houses are all that now remain. The town was first incorporated by the name of the barons of Feversham; afterwards by Henry VIII. with the title of the mayor and commonalty; and lastly, by that of the mayor and jurats and commonalty. It contained 3655 inhabitants in 1811, and consists chiefly of two long broad streets, with a market-house in the centre, built 1574. Its ancient church was rebuilt in 1754, at the expence of 2300l. but was originally built in Edward II's reign. There is a free grammar school in this place, built and endowed by Queen Elizabeth in 1582; also two charity schools. It is a member of the cinque-port of Dover, and has a manufactory of gunpowder. The London markets are supplied from hence with abundance of apples and cherries, and the best oysters for stewing. These last were at one time carried away in such quantities by the Dutch, that many men and boats were employed in the winter to dredge for them; and it is said they carried home as many as amounted to above 2000l. a-year. The fishermen admit none to take up their freedom but married men.

FEVILDEA, a genus of plants belonging to the diœcia class, and in the natural method ranking under the 54th order, *Cucurbitaceæ*. See Botany *Index*.

FEVRE, Tanegui le, of Caen in Normandy, born in 1615, was an excellent scholar in Greek and Roman learning. Cardinal de Richelieu gave him a pension of 2000 livres to inspect all the works published at the Louvre, and designed to have made him principal of a college he was about to erect at Richelieu. But the cardinal's death cut off his hopes; and Cardinal Mazarine having no great relish for learning, his pension was ill paid. Some time after the marquis de Francier, governor of Langres, took him along with him to his government, and there he embraced the Protestant religion; after which he was invited to Saumur, where he was chosen Greek professor. He there taught with extraordinary reputation. Young men were sent to him from all the provinces in the kingdom, and even from foreign countries, while divines and professors themselves gloried in attending his lectures. He was preparing to go to Heidelberg, whither he was invited by the prince Palatine, when he died, aged 57. He wrote, 1. Notes on Anacreon, Lucretius, Longinus, Phædrus, Justin, Terence, Virgil, Horace, &c. 2. A short account of the lives of the Greek poets. 3. Two volumes of letters: and many other works.

*Fevre, Claud le*, an eminent French painter, was born at Fountainbleau in 1633, and studied in the palace there, and then at Paris under Le Sueur and Le Brun; the latter of whom advised him to adhere to portraits, for which he had a particular talent, and in his style equalled the best masters of that country. He died in England in 1675, aged 42.

FEZ, the capital of a kingdom of the same name in Barbary, in Africa. It is described as a very large place, surrounded with high walls, within which there are hills and valleys, only the middle being level and flat. The river which runs through the city, is divided into two streams, from which canals are cut into every part of the town: so that the mosques, colleges, palaces, and the houses of great men, are amply supplied with water. They have generally square marble basons in the middle of the court of their houses, which are supplied with water by marble pipes that pass through the walls. They constantly run over, and the stream returns back into the street, and so into the river. The houses are built with brick or stone; and are adorned on the outside with fine mosaic work, or tiles like those of Holland. The wood work and ceilings are carved, painted and gilt. The roofs are flat; for they sleep on the tops of the houses in summer. Most of the houses are two stories high, and some three. There are piazzas and galleries running all round the court on the inside, so that you may go under cover, from one apartment to another. The pillars are of brick, covered with glazed tiles, or of marble, with arches between. The timber work is carved and painted with gay colours, and most of the rooms have marble cisterns of water. Some of the great men build towers over their houses several stories high, and spare no expence to render them beautiful; from hence they have a fine prospect all over the city.

There are in this city 700 mosques, great and small, 50 of which are magnificent, and supported with marble pillars and other ornaments. The floors are covered with mats, as well as the walls to the height of a man. Every mosque has a tower or minaret, like those in Turkey, with a gallery on the top, from whence they call the people to prayers. The principal mosque is near a mile and a half in circumference. The middle building is 150 yards in length, and 80 in breadth, with a tower proportionably high. Round this to the east, west, and north, there are great colonnades 30 or 40 yards long. There are 900 lamps lighted every night; and in the middle of the mosque are large branches, which are capable of holding 500 lamps each. Along the walls are seven pulpits, from which the doctors of the law teach the people. The business of the priest is only to read prayers, and distribute alms to the people; to support which, there are large revenues.

Besides the mosques, there are two colleges built in the Moorish manner, and adorned with marble and paintings. In one of them there are 100 rooms, besides a magnificent hall. In this there is a great marble vase full of water, adorned with marble pillars of various colours, and finely polished. The capitals are gilt, and the roof shines with gold, azure, and purple. The walls are adorned with Arabic verses in gold characters. The other colleges are not near so beautiful, or rather are all gone to ruin since the neglect of learning.

There are hospitals in the city, where formerly all strangers were maintained three days *gratis*. But the estates belonging to them have been confiscated for the emperor's use. There are above 100 public baths, many of which are stately buildings. People of the same trade or business live in streets by themselves.

Though the country about Fez is pleasant and fertile, and in many places abounding with corn and cattle, yet a great part of it lies waste and uncultivated, not so much for want of inhabitants as from the oppression of the governors; which makes the people choose to live at some distance from the high roads, where they cultivate just as much land as is necessary for their own subsistence.

Round the city there are fine marble tombs, monuments, and gardens full of all manner of fruit trees.

Such are the common accounts of this city. The following are given by M. Chenier, in his *Recherches Historiques sur les Maures*.

Fez was built in the end of the eighth century by Edris, a descendant of Mahomet and of Ali; whose father, in order to avoid the proscriptions of the caliph Abdalla, retired to the extremity of Africa, and was proclaimed sovereign by the Moors. Sidy Edris, having succeeded to the throne of his father, built the city of Fez in the year 793. He caused a mosque to be erected, in which his body was interred, and the city ever afterwards became an asylum for the Moors, and a place of devotion. In the first moments of fervour, which a new worship inspires, another mosque was built, called *carubin*, which is perhaps one of the largest and most beautiful edifices in Africa. Several others were successively built, besides colleges and hospitals; and the city was held in such veneration, that when the pilgrimage to Mecca was interrupted in the fourth century of the Hegira, the western Mahometans substituted that of Fez in its stead, while the eastern people went to Jerusalem.

When the Arabs had overspread Asia, Africa, and Europe, they brought to Fez the little knowledge they had acquired in the sciences and arts; and that capital conjoined, with the schools of religion, academies where philosophy was taught, together with medicine and astronomy. This last gradually degenerated; ignorance brought astrology into repute, and this quickly engendered the arts of magic and divination.

Fez soon became the common resort of all Africa. The Mahometans went thither for the purposes of devotion; the affluence of strangers introduced a taste for pleasure; libertinism quickly followed; and as its progress is most rapid in warm countries, Fez, which had been the nurse of sciences and arts, became a harbour for every kind of vice. The public baths, which health, cleanliness, and custom, had rendered necessary, and which were everywhere respected as sacred places, became scenes of debauchery; where men introduced themselves in the habits of women: youths in the same disguise, with a distaff in their hands, walked the streets at sunset in order to entice strangers to their inns, which were less a place of repose than a convenience for prostitution.

The usurpers who disputed the kingdom of Fez after the 16th century overlooked these abuses, and contented themselves with subjecting the masters of the inns to furnish a certain number of cooks for the army. It is to this laxity of discipline that Fez owed its first splendour. As the inhabitants are beautiful, the Africans flocked thither in crowds; the laws were overturned, morals despised, and vice itself turned into an engine of political resource. The same spirit, the same inclinations, the same depravity, still exist in the hearts of all the Moors. But libertinism is not now encouraged; it wears there, as in other places, the mask of hypocrisy; and dares not venture to show itself in the face of day.

The Mahometans of Andalusia, those of Granada and Cordova, migrated to Fez during the different revolutions that agitated Spain; they carried with them new customs and new arts, and perhaps some slight degree of civilization. The Spanish Moors carried from Cordova to Fez the art of staining goat and sheep skins with a red colour, which were then called Cordova leather, and now Morocco leather, from that city where the art is less perfect. They manufacture gauzes at Fez, silk stuffs, and girdles elegantly embroidered with gold and silk, which show how far their ingenuity might be carried if industry were more encouraged.

There is still some taste for study preserved at Fez, and the Arabic language is spoken there in greater purity than in any other part of the empire. The rich Moors send their children to the schools at Fez, where they are better instructed than they could be elsewhere.

Leo Africanus, in the 16th century, gave a magnificent description of this city, from which most of those that have been afterwards made are copied; but its situation, its schools, and the industry and great urbanity of its inhabitants, are the only circumstances that give it any preference to the other cities of the empire. There are some pretty convenient inns here, consisting of two or three stories. The houses have no elegance externally: the streets are ill paved, and so strait that two persons riding abreast can hardly pass. The shops are like stalls; and have no more room in them than is sufficient to serve for the owner, who is always seated with his wares around him, which he shows to the passengers. But though the Moors of Fez are more civilized than the rest, they are vain, superstitious, and intolerant; and an order must be obtained from the emperor before a Christian or a Jew can be allowed to enter the city.

The situation of Fez is exceeding singular. It lies in the bottom of a valley surrounded by little hills in the shape of a funnel; the declivities are divided into gardens planted with tall trees, orange shrubs, and all sorts of fruit trees; a river meanders along the declivity, and turns a number of mills, which disperse the water abundantly to all the gardens, and almost to every house. The descent to the city, which stands in the centre, is long; and the road lies through these gardens, which it traverses in a serpentine direction.

The gardens, seen from the city, form a most delightful amphitheatre. Formerly each garden had a house in which the inhabitants spent the summer. These houses were destroyed in the times of the civil wars, and in the revolutions to which Fez has been subject, and few individuals have restored them. Ali Bey estimates the population of Fez at 100,000; and Mr Jackson at 380,000. But the latter estimate, though founded on public documents, is most probably an exaggeration.

On the height above Fez, in a plain susceptible of rich cultivation, stands New Fez, finely situated, and enjoying excellent air, containing some old palaces, in which the children of the emperor live, and where he sometimes resides himself. New Fez is inhabited by some Moorish families, but by a greater number of Jews.

Fez is seated on the river Cebu. W. Long. 4. 25. N. Lat. 33. 58.

FEZZAN, a kingdom of Africa, about 300 miles long from north to south, and 200 broad from east to west. It is bounded on the east by the Harutsch and line of the deserts; by the country of the Tibboes on the south and south-east; by that of the Nomadic Tuaricks on the south-west; and the country which forms the western boundary is inhabited by Arabs. It contains 101 towns and villages, of which Mourzouk is the metropolis. The climate of this kingdom is neither temperate nor agreeable at any season whatever; for the heat of summer is almost intolerable, even to the inhabitants, especially when the wind blows from the south; and the prevalence of the north wind during winter makes the cold so intense, as not only to chill the natives, but those also who visit it from northern regions.

Fezzan.

Rain falls but seldom in this country, and in very small quantities. Thunder is also a rare phenomenon: Mr Horneman assures us that there was not a single storm from November 1798 to June 1799; and that on the last day of January 1799 there were some faint flashes of lightning, unaccompanied by any claps of thunder. Winds, however, blow very frequently, both from the north and south, whirling up the dust and sand in such a manner as to give the atmosphere a yellowish appearance. There is neither river nor rivulet of any consequence in the whole country, according to Mr Horneman, who informs us that the soil is a deep sand, beneath which is found calcareous rock or earth, and sometimes a stratum of an argillaceous substance.

Date trees may be considered as the natural production of Fezzan, in the western parts of which some senna grows, of a superior quality to that which is imported from the country of the Tibboes. Culinary plants, and almost every vegetable peculiar to the garden, are met with in abundance. Wheat and barley seem well adapted to the nature of the soil, as well as to the climate; yet corn is not raised in sufficient quantity for home consumpt, which is brought from those parts of Africa bordering on the northern parts of the kingdom. This is most probably owing to the native indolence of the people, the despotism of their government, and the difficulties inseparable from their peculiar mode of tillage.

They bestow little attention on the rearing of cattle, which are only found in the most fertile parts of the country, and even in these their numbers are but small. They are made use of to draw water from the wells, and are never killed but in cases of absolute necessity. The common domestic animal is the goat; and although sheep are reared in the southern parts of the country, the most abundant supply is furnished by the Arabs on the borders. They make coarse cloths of the wool, which constitute the apparel of the inhabitants in general. Their horses are not numerous, as they make most use of asses, either for carriage, draught, or burthen. Camels bear a most extravagant price, being only made use of by the higher ranks, or by opulent merchants; and the common food of all these animals is the fruit of the date tree.

Although the trade of Fezzan consists entirely of foreign articles, it is nevertheless considerable. Mourzouk is the great market and place of general resort for different caravans from Cairo, Bengasi, Tripoli, and other places, between the months of October and February. The caravans which come to Mourzouk from the west or south, deal in ostrich feathers, tiger skins, gold dust, and also in slaves of both sexes as articles of commerce. Tobacco and snuff, with other articles manufactured in Turkey, are brought to the capital by the merchants from Bengasi; and paper, fire-arms, sabres, knives, and woollen cloth, are conveyed to it from Tripoli.

Fezzan is governed by a sultan, a descendant of the family of the Shereefs; and according to the tradition of the country, his ancestors came from the western parts of Africa, invaded and made a conquest of it about 500 years ago. He reigns over his dominions with absolute power, but is at the same time tributary to the bashaw of Tripoli, who annually receives from him the sum of 4000 dollars by the hands of an officer appointed for that purpose. The sultan who was upon the throne when Mr Horneman in 1798 visited the country, assumed the title of "Sultan Muhammed ben Sultan Mansur," engraved on a seal which is applied to all public acts, and also to correspondence within his dominions; but he makes use of a smaller seal when he writes to the bashaw of Tripoli. The crown is hereditary; yet it descends not in all cases from father to son, for when the heir apparent dies, a nephew may succeed in preference to a second son, which is frequently the occasion of much bloodshed, when the right of succession comes to be warmly contested. The palace of the sultan is within the walls of the fortress of the capital, where he leads a life of retirement attended by his eunuchs. The harem is near the palace, into which he never enters, as the female whom he inclines to see is conducted to his apartment. The harem consists of the sultana and about 40 female slaves, which last he frequently disposes of, and replaces them by others, unless they bear him children, or become the objects of his ardent attachment, either by their personal beauty or other accomplishments.

Those who wish for an audience with the sultan, approach the throne, which is an old elbow chair raised a few steps from the ground, kiss his hand, and raise it so as to touch their forehead, and then kneel before him to give a statement of their business in common language, taking care, however, to intermix it with such exclamations as these: "God prolong thy life, God protect thy country," and to offer him some small present. The court of the sultan consists of a first and second minister, the general of his forces, a number of black and a few white slaves. Some of the black slaves who are purchased while boys, and educated according to their distinctions and talents, often acquire considerable influence with the sultan.

The dress of the sultan, when he appears in state, consists of a white frock of stuff, ornamented with gold and silver, and sometimes of satin interwoven with silver. The appearance of his turban is remarkable, which measures not less than three feet from the fore to the hinder part, and two feet in breadth. His revenue arises from certain taxes on all gardens and cultivated lands, and from fines and requisitions imposed in an arbitrary manner. The slaves who are employed in collecting these are often rigorous in the extreme, but it is often possible to procure their lenity by means of a bribe. The expenditure of this revenue is chiefly confined to the support of the sultan, his court and palace; for the cadi and department of justice, the religious order, and principal officers of government, are supported by the produce of date-tree woods and gardens.

The administration of justice is vested in the hands of a cadi, whose decisions are guided by the Mohammedan law, by antiquated customs, and established practice; but judgment in all criminal cases is purely arbitrary, or is referred to the sultan. The office of cadi has been hereditary in one family, ever since the conquest of the country by the ancestors of the present sultan; and when he dies, his place is filled by one who is the most eminent for learning, or who can best read and write, which is all the learning that he is ever possessed of.

It is difficult to ascertain any thing like an accurate statement of the population of Fezzan; but Mr Horneman conjectures that they may amount to about 75,000, all of them professing the religion of Mahomet. The complexion of the people varies considerably; those in the northern parts bearing in this respect a striking resemblance to the Arabians, while those in the southern districts are very much like the Tibboes and Tuaricks. Those who are strictly indigenous are of ordinary stature, and their limbs far from being muscular; of a deep brown colour, short black hair, with their face formed like the people of Europe, and their nose not so flat as that of the negro. Their walk, mien, and gesture, indicate a total want of energy, either of body or mind.

The women of this country are in general fond of dancing, and the wanton manners and public freedoms in which they are permitted to indulge, are frequently astonishing, even to Mahometans from other countries; and the men are very much addicted to the vice of drunkenness, using the juice of the date-tree, or a drink that is called *busa*, which is of an intoxicating nature.

Different species of the venereal disease prevail in this country, but that which is brought from Soudan is reckoned the most inveterate. The common lues venerea is called *franssi*, for the cure of which they make use of salts and colocynth as powerful cathartics, healing the sores with natron water or dissolved soda. They are sometimes afflicted with hæmorrhoids, the cure of which is no doubt rendered more difficult by the too liberal use of red pepper; and a fever and ague which are very pernicious to foreigners. They are entirely unacquainted with phlebotomy, yet they sometimes draw blood by means of cupping; and some are as much acquainted with surgery as to be able to cure a simple fracture.

Their houses are miserable structures, composed of stones or bricks mixed with clay, and dried in the sun, and the hands of the labourer are all the tools which are employed in building. When the walls are finished, they are covered over with mortar made of calcareous earth, which is also done with the hand. Their houses are extremely low, and there is no other entrance for the light but by the door. They are uncommonly abstemious in respect of diet. Indeed they can never abstain from butcher meat when it is placed before them; but this is not an article of food with the generality, and their expression for a rich man is, "*that he eats* bread and meat every day."

**FEWEL.** See Fuel.

**FIASCONE**, a town of Italy, in the territories of the pope, remarkable for its good wine. E. Long. 13. 12. N. Lat. 42. 20.

**FIAT**, in *Law*, a short order or warrant signed by a judge, for making out and allowing certain processes.

**FIBRARIÆ**, an old term applied to minerals of a fibrous structure.

**FIBRE**, in *Anatomy*, a perfectly simple body, or at least as simple as any thing in the human structure; being fine and slender like a thread, and serving to form other parts. Hence some fibres are hard, as the bony ones; and others soft, as those destined for the formation of all the other parts.

The fibres are divided also, according to their position and

and direction, into such as are straight, oblique, transverse, annular, and spiral; as they are arranged in these directions in different parts of the body.

**Fibre** is also used to denote the slender **Filaments** which compose other bodies, whether animal, vegetable, or mineral; but more especially the capillary roots of plants.

**FIBROSE**, or **Fibrous**, something consisting of fibres, as the roots of plants. See **Root**.

**FIBULA**, in *Anatomy*, the outer and smaller of the of the bones of the leg. See **Anatomy** *Index*.

**Fibula**, in *Surgery*, an instrument in use among the ancients for the closing of gaping wounds.—Celsus speaks of the fibula as to be used when the wound was so patent as not easily to admit of being sewed. (*Op.* lib. vii. cap. 25. *apud fin.*).

**Fibula**, in *Antiquity*, was a sort of button, buckle, or clasp, made use of by the Greeks and Romans for keeping close or tying up some part of their clothes. They are of various forms, and often adorned with precious stones. Men and women wore them in their hair and at their shoes. Players and musicians, by way of preserving the voices of children put under their care to learn their arts, used to keep close the prepuce with a fibula, lest they should have commerce with women.

**FICHTE, John Theophilus**, a late eminent German metaphysician. See **Supplement**.

**FICINUS, Marsilius**, a celebrated Italian, was born at Florence in 1433, and educated at the expence of Lawrence de Medicis. He attained a perfect knowledge of the Greek and Latin tongues, and became a great philosopher, a great physician, and a great divine. He was in the highest favour with Laurence and Cosmo de Medicis, who made him a canon of the cathedral church of Florence. He applied himself intensely to the study of philosophy; and while others were striving who should be the deepest read in Aristotle, who was then the philosopher in fashion, he devoted himself wholly to Plato. He was indeed the first who restored the Platonic philosophy in the west; for the better effecting of which, he translated into Latin the whole works of Plato. There goes a story, that his friend Marcus Musurus disliking the translation, he did it all over again. He next translated Plotinus; and afterwards the works, or part of them at least, of Proclus, Jamblicus, Porphyrius, and other celebrated Platonists.—In his younger years, Ficinus lived like a philosopher; and too much so, as is said, to the neglect of piety. However, Savonarola coming to Florence, Ficinus went with every body else to hear his sermons; and while he attended them for the sake of the preacher's eloquence, he imbibed a strong sense of religion, and devoted himself henceforward more especially to the duties of it. He died at Correggio in 1499; and as Boronius assures us upon the testimony of what he calls credible authors, appeared immediately after his death to his friend Michael Mercatus: to whom, it seems, he had promised to appear, in order to confirm what he had taught concerning the immortality of the soul. His writings, sacred and profane, which are very numerous, were collected and printed at Venice, in 1516, at Basil in 1561 and 1576, and at Paris 1641, in two vols folio. Twelve books of his Epistles, among which are many treatises, were printed separately in folio at Venice 1495, and at Nuremberg, 1497, in 4to.

**FICOIDES**, the specific name given to several plants as the mesembryanthemum, musa, and opuntia. See **Mesembryanthemum**, &c. **Botany** *Index*.

**FICTION.** See **Fable** and **Poetry**.

**FICUS**, the **Fig-tree**; a genus of plants, belonging to the polygamia class; and in the natural method ranking under the 53d order, *Scabridæ*. See **Botany** *Index*.

The ficus religiosa, or Banian tree, is a native of several parts of the East Indies. It has a woody stem, branching to a great height and vast extent, with heart-shaped entire leaves ending in acute points. Of this tree the following lines of Milton contain a description equally beautiful and just:

> ———There soon they chose
> The fig-tree: not that tree for fruit renown'd;
> But such as, at this day to Indians known
> In Malabar or Decan, spreads her arms,
> Branching so broad and long, that in the ground
> The bended twigs take root, and daughters grow
> About the mother tree, a pillar'd shade,
> High overarch'd, and echoing walks between;
> There oft the Indian herdsman, shunning heat,
> Shelters in cool, and tends his pasturing herds
> At loop-holes cut through thickest shade.
> *Par. Lost*, Book. ix. l. 1100.

The Banian tree, or Indian fig, is perhaps the most beautiful of Nature's productions in that genial climate, where she sports with the greatest profusion and variety. Some of these trees are of amazing size and great extent, as they are continually increasing, and, contrary to most other things in animal and vegetable life, they seem to be exempted from decay. Every branch from the main body throws out its own roots; at first, in small tender fibres, several yards from the ground: these continually grow thicker until they reach the surface; and then striking in, they increase to large trunks, and become parent trees, shooting out new branches from the top: these in time suspend their roots, which, swelling into trunks, produce other branches; thus continuing in a state of progression as long as the earth, the first parent of them all, contributes her sustenance. The Hindoos are particularly fond of the Banian tree; they look upon it as an emblem of the Deity, from its long duration, its outstretching arms, and overshadowing beneficence; they almost pay it divine honours, and

> Find a fane in every sacred grove.

Near these trees the most esteemed pagodas are generally erected; under their shade the Brahmins spend their lives in religious solitude; and the natives of all casts and tribes are fond of recreating in the cool recesses, beautiful walks, and lovely vistas of this umbrageous canopy, impervious to the hottest beams of a tropical sun.

A remarkable large tree of this kind grows on an island in the river Nerbudda, ten miles from the city of Baroche in the province of Guzerat; a flourishing settlement lately in possession of the East India Company, but ceded by the government of Bengal, at the treaty of peace concluded with the Mahrattas in 1783, to, to Mahdajee Scindia a Mahratta chief. It is distinguished by the name of Cubbeer Burr, which was given it in honour of a famous saint. It was once much larger than at present; but high floods have carried away the banks of the island where it grows, and with them such parts of the tree as had thus far extended their roots: yet what remains is about 2000 feet in circumference, measured round the principal stems; the overhanging branches, not yet struck down, cover a much larger space. The chief trunks of this single tree (which in size greatly exceed our English elms and oaks), amount to 350; the smaller stems, forming into stronger supporters, are more than 3000; and every one of these is casting out new branches, and hanging roots, in time to form trunks, and become the parents of a future progeny. Cubbeer Burr is famed throughout Hindostan for its great extent and surpassing beauty: the Indian armies generally encamp around it; and, at stated seasons, solemn jatarras, or Hindoo festivals, are held there, to which thousands of votaries repair from various parts of the Mogul empire.—It is said that 7000 persons find ample room to repose under its shade. The English gentlemen, on their hunting and shooting parties, used to form extensive encampments, and spend weeks together under this delightful pavilion, which is generally filled with green wood pigeons, doves, peacocks, and a variety of feathered songsters; crowded with families of monkeys performing their antic tricks; and shaded by bats of a large size, many of them measuring upwards of six feet from the extremity of one wing to the other. This tree not only affords shelter, but sustenance, to all its inhabitants, being covered amid its bright foliage with small figs of a rich scarlet, on which they regale with as much delight, as the lords of creation on their more costly fare in their parties.

**FIDD**, an iron pin used at sea to splice or fasten ropes together; it is made tapering and sharp at one end.

There are also fidds of wood, which are much larger than the iron ones.

The pin also in the heel of the topmast, which bears it upon the chess-tree, is called a *fidd.*

*Fidd-Hammer*, is used for a hammer, the handle of which is a fidd, or made tapering into that form.

**FIDDES, Richard**, a learned divine and polite writer, was born in 1671, and educated at Oxford. He was presented to the living of Halsham in Yorkshire, where he was so admired for the sweetness of his voice and the gracefulness of his delivery, that the people for several miles round flocked to his sermons. Coming to London in 1711, he was by the favour of Dean Swift, introduced to the earl of Oxford, who made him one of his chaplains, and the queen soon after appointed him chaplain to the garrison at Hull: but losing his patrons upon the change of the ministry, he lost his chaplainship; and being obliged to apply himself to writing, composed, 1. A body of Divinity; 2. The Life of Cardinal Wolsey; 3. A Treatise of Morality, &c. He died in 1725.

**FIDDLE.** See Violin.

*Fiddle-Wood.* See Citharexylon, Botany *Index.*

**FIDE-jussores** *Assidui.* See Assiduus.

*Fide-Jussor*, in the *Civil Law*, is a surety, or one that obliges himself in the same contract with a principal, for the greater security of the creditor or stipulator.

**FIDEI-commissum**, in Roman antiquity, an estate left in trust with any person, for the use of another. See Trustee.

**FIDENA**, or Fidenæ, in *Ancient Geography*, a town of the Sabines, five miles to the north of Rome, where traces of it are still to be seen. Fidenates, the people (Livy).

**FIDES, Faith** or **Fidelity**, one of the virtues deified by the Pagans. She had a temple near the Capitol, founded by Numa Pompilius; but no animals were offered, or blood spilt, in her sacrifices. During the performance of her rites, her priests appeared in white vestments, with their heads and hands covered with linen, to show that fidelity ought to be sacred.

**FIDIUS**, in Pagan worship, a god who presided over alliances and promises. This deity, which the Romans borrowed from the Sabines, was also called *Sanctus*, *Semon*, and *Semi-Pater*.

**FIELD**, in *Agriculture*, a piece of ground enclosed, whether for tillage or pasture.

Field, in *Heraldry*, is the whole surface of the shield or the continent, so called because it containeth those achievements anciently acquired in the field of battle. It is the ground on which the colours, bearing, metals, furs, charges, &c. are represented. Among the modern heralds, field is less frequently used in blazoning than shield or escutcheon. See Shield, &c.

*Field-Book*, in *Surveying*, a book in which the angles, stations, distances, &c. are set down.

*Field-Colours*, or *Camp-Colours*, in *War*, are small flags of about a foot and a half square, which are carried along with the quartermaster general, for marking out the ground for the squadrons and battalions.

*Field-Fare*, in *Ornithology*. See Turdus, Ornithology *Index*.

*Field-Officers*, in the art of war. See Officer.

*Field-Pieces*, small cannons, from three to twelve pounders, carried along with an army in the field.

*Field-Staff*, a weapon carried by the gunners, about the length of a halbert, with a spear at one end; having on each side ears screwed on, like the cock of a matchlock, where the gunners screw in lighted matches when they are upon command; and then the field-staffs are said to be armed.

*Field-Works*, in *Fortification*, are those thrown up by an army in besieging a fortress, or by the besieged to defend the place. Such are the fortifications of camps, highways, &c.

*Elysian Fields.* See Elysian.

**FIELDING, Henry**, a well-known writer of the present age, son of Lieutenant-general Fielding who served under the duke of Marlborough, was born in 1707. He had four sisters; of whom Sarah is well known, as writer of The Adventures of David Simple. On the death of his mother, his father married again; and Sir John Fielding, who succeeded him in the commission of the peace for Middlesex, is his brother by this marriage. Henry was sent to study at Leyden; but a failure in his remittances obliged him to return in two years, when his own propensity to gaiety and profusion drove him to write for the stage at 20 years of age. His first dramatic piece, Love in several Masques, which was well received, appeared in 1727; and all his plays and farces, to the amount of 18, were written before

before the year 1737, and many of them are still acted with applause. While he was thus employed, he married a young lady with 1500l. fortune, and inherited an estate of 200l. a-year from his mother; all which, though on the plan of retiring into the country, he contrived to dissipate in three years; and then applied himself to the study of the law for a maintenance. In losing his fortune, he acquired the gout; which, rendering it impossible for him to attend the bar, he with a shattered constitution had recourse to many extempore applications of his pen for immediate supplies; until, soon after the rebellion in 1745, he accepted the office of acting justice for Middlesex, an employment much more profitable than honourable in the public esteem. Reduced at length by the fatigues of this office, and by a complication of disorders, he, by the advice of his physicians, went to Lisbon, where he died in 1754. He wrote a great number of fugitive pamphlets and periodical essays; but is chiefly distinguished by his Adventures of Joseph Andrews, and History of Tom Jones. His works have been collected and published, with his life prefixed, by Mr Murphy.

**FIENUS**, Thomas, an ingenious and learned physician, born at Antwerp in 1566. He went into Italy to study physic under Mercurialis and Aldrovandus; and on his return distinguished himself so much in the university of Louvain, that he was there chosen professor of physic, and was afterwards made physician to the duke of Bavaria. He wrote several works, among which were, *De viribus imaginationis;* and *De formatione fœtus.* He died at Louvain in 1631.

**FIERI** facias, in *Law*, a writ that lies where a person has recovered judgment for debt or damages in the king's court against one, by which the sheriff is commanded to levy the debt and damages on the defendant's goods and chattels.

**FIFE**, in *Music*, is a sort of wind instrument, being a small pipe. See Pipe.

**FIFESHIRE**, a county of Scotland, lying between the friths of Tay and Forth; bounded on the north and north-east by the Frith of Tay, which divides it from Perth and Angus; on the south by the frith of Forth, which separates it from the Lothians; the German ocean bounds it on the east; and on the west it borders with the counties of Perth and Kinross, and a small corner of Clackmannan. It extends about 60 miles in length from Colross to Fifeness, and is about 18 in breadth; comprehending a superficies of nearly 504 square miles. The face of the country is agreeably diversified; towards the west it is mountainous, and a ridge of hills extends eastward almost its whole length, occupying the central district; towards the north and south the surface gradually descends to the friths, exhibiting the most beautiful and enlivening prospect of fertile and well cultivated fields. It is watered by several streams, none of which deserve the name of rivers, except the Eden and Leven; the former empties itself into the ocean at St Andrews, and the latter at the village of Leven: both these rivers abound with trout and salmon; and on no coast of Scotland is the white fishing more productive than on the Fife coast. From its situation, it appears to have been very early inhabited; the fishings, coal-mines, harbours, and other advantages for navigation, attracted settlers, and the coast was first peopled and best cultivated: this appears to have been the case, when King James VI. compared the county to a gray mantle with a gold fringe. The whole coast is covered with small burghs, which that monarch regarded with particular attention, and very early in his reign endeavoured to render them subservient to his wishes, of raising Scotland high in the world as a commercial nation; he granted them many privileges and immunities, and encouraged the inhabitants, by every means in his power, to prosecute the advantages which, by their local situation, they possessed; indeed the municipal privileges which they received from that monarch, though rendered unimportant by the union with England, will long remain a monument of his political sagacity and discernment. The county can boast of possessing several ancient seats of royalty: at Dunfermline, at Falkland, at Kinghorn, and at St Andrews, vestiges of royal splendour are still to be seen. It contains 13 royal boroughs, which possess parliamentary representation, and several which have lost that privilege from their being unable to defray the expence which attended the sending a commissioner to the Scottish parliament. To the county also belong the small island of May, on which there is a lighthouse, and Inchgarvie. Fifeshire is divided into 60 parishes, and contains, by the enumeration in 1811, 101,272 inhabitants, being nearly 208 to the square mile; a much greater proportion than is to be found in any other county in Scotland. It was anciently an earldom in the Macduff family, created by Malcolm III. for the services performed by the thane of Fife, in restoring him to the throne of Scotland, when usurped by Macbeth. That title having expired, it was lately revived in the Duffs of Braco, lateral descendants of the ancient family: the ruins of the residences of that powerful nobleman are still evident in many parts of the county. The whole of the south side lies upon coal, and many pits are wrought on every part of the coast: in many places is excellent limestone; and some marl is found in the county. Ironstone, of excellent quality, is found in the western and middle quarters, and much is forged in the county, or exported to the Carron works. Lead ore is found in the Eastern Lomond, one of the two conical hills which rise nearly in the middle of the county, and are seen at a great distance: in Kemback parish also, lead ore has been wrought. The county of Fife sends one member to parliament. Cupar is the county town.

The following account of the population of Fifeshire at two different periods, is taken from the *Statist. Hist. of Scotland.*

| | *Parishes.* | Population in 1755. | Population in 1790—98 |
|---|---|---|---|
| 1 | Abbotshall | 1348 | 2136 |
| | Abdie | 822 | 494 |
| | Aberdour | 1198 | 1280 |
| | Anstruther | 1100 | 1000 |
| 5 | Anstruther, Wester | 385 | 370 |
| | Auchterderran | 1143 | 1200 |
| | Auchtermuchty | 1308 | 1439 |
| | Auchtertool | 389 | 334 |
| | Ballingry | 464 | 220 |
| 10 | Balmerino | 565 | 703 |
| | Beath | 1099 | 450 |
| | Burntisland | 1390 | 1210 |

| | *Parishes.* | Population in 1755. | Population in 1790—98. |
|---|---|---|---|
| | Cameron | 1295 | 1165 |
| | Carnbee | 1293 | 1041 |
| 15 | Carnock | 583 | 970 |
| | Ceres | 2540 | 2320 |
| | Colessie | 989 | 949 |
| | Crail | 2173 | 1710 |
| | Creich | 375 | 306 |
| 20 | Cult | 449 | 534 |
| | Cupar | 2192 | 3702 |
| | Dairsie | 469 | 540 |
| | Dalgety | 761 | 869 |
| | Denbog | 255 | 235 |
| 25 | Denino | 598 | 383 |
| | Dunfermline | 8552 | 9550 |
| | Dysart | 2369 | 4862 |
| | Elie | 642 | 620 |
| | Falkland | 1795 | 2108 |
| 30 | Ferrie | 621 | 805 |
| | Flisk | 318 | 371 |
| | Forgan | 751 | 825 |
| | Inverkeithing | 1694 | 2210 |
| | Kemback | 420 | 588 |
| 35 | Kennoway | 1240 | 1500 |
| | Kettle | 1621 | 1759 |
| | Kilconquhar | 2131 | 2013 |
| | Kilmeney | 781 | 869 |
| | Kilrenny | 1348 | 1086 |
| 40 | Kinghorn | 2389 | 1768 |
| | Kinglassie | 998 | 1200 |
| | Kingsbarns | 871 | 807 |
| | Kirkaldy | 2296 | 2673 |
| | Largo | 1396 | 1913 |
| 45 | Lesly | 1130 | 1212 |
| | Leuchars | 1691 | 1620 |
| | Logie | 413 | 425 |
| | Markinch | 2188 | 2790 |
| | Monimail | 884 | 1101 |
| 50 | Moonsie | 249 | 171 |
| | Newburgh | 1347 | 1664 |
| | Newburn | 438 | 456 |
| | Pittenweem | 939 | 1157 |
| | St Andrew's and St Leonard's | 4913 | 4335 |
| 55 | St Monance | 780 | 832 |
| | Saline | 1285 | 950 |
| | Scoonie | 1528 | 1675 |
| | Strathmiglo | 1695 | 980 |
| | Torryburn | 1634 | 1600 |
| 60 | Wemyss | 3041 | 3025 |
| | Total | 81,570 | 87,250 |
| | Population in 1801, | 93,743 | |
| | in 1811, | 101,272 | |

See Fifeshire, Supplement.

*Fife-Rails*, in a ship, are those that are placed on banisters, on each side of the top of the poop, and so along with haunces or falls. They reach down to the quarter deck, and to the stair of the gangway.

FIFTH, in *Music*. See Interval.

FIG, or Fig-tree. See Ficus, Botany *Index*.

FIGWORT. See Scrophularia, Botany *Index*.

FIGURAL, Figurate, or *Figurative*, a term applied to whatever is expressed by obscure resemblances. The word is chiefly applied to the types and mysteries of the Mosaic law; as also to any expression which is not taken in its primary and literal sense.

*Figurate Numbers.* See *Numbers, Figurate.*

FIGURE, in *Physics*, expresses the surface or terminating extremities of any body.

Figures, in *Arithmetic*, are certain characters whereby we denote any number which may be expressed by any combination of the nine digits, &c. See Arithmetic.

Figure, among divines, is used for the mysteries represented under certain types.

Figure, in *Dancing*, denotes the several steps which the dancer makes in order and cadence, considered as they mark certain figures on the floor. See Dancing.

Figure, in *Painting* and *Designing*, denotes the lines and colours which form the representation of any animal, but more particularly of a human personage. See Painting.

Figure, in the manufactures, is applied to the various designs represented or wrought on velvets, damasks, taffeties, satins, and other stuffs and cloths.

The most usual figures for such designs are flowers imitated from the life; or grotesques, and compartiments of pure fancy. Representations of men, beasts, birds, and landscapes, have only been introduced since the taste for the Chinese stuffs, particularly those called *furees*, began to prevail among us. It is the woof of the stuff that forms the figures; the warp only serves for the ground. In working figured stuffs there is required a person to show the workman how far he must raise the threads of the warp, to represent the figure of the design with the woof, which is to be passed across between the threads thus raised. This some call *reading the design*.

For the figures on tapestry, brocade, &c. see Tapestry, &c.

For those given by the calenders, printers, &c. see Calender, &c.

Figure, in *Logic*, denotes a certain order and disposition of the middle term in any syllogism.

Figures are fourfold. 1. When the middle term is the subject of the major proposition, and the predicate of the minor, we have what is called the first figure. 2. When the middle term is the predicate of both the premises, the syllogism is said to be in the second figure. 3. If the middle term is the subject of the two premises, the syllogism is in the third figure: and lastly, by making it the predicate of the major, and subject of the minor, we obtain syllogisms in the fourth figure. Each of these figures has a determinate number of moods, including all the possible ways in which propositions differing in quantity or quality can be combined, according to any disposition of the middle term, in order to arrive at a just conclusion. See Logic.

Figure, in composition. See Oratory; also Allegory, Apostrophe, Hyperbole, Metaphor, Personification, &c.

*A Figure, the means or instrument conceived to be the agent.* When we survey a number of connected objects, that which makes the greatest figure employs chiefly our attention; and the emotion it raises, if lively, prompts us even to exceed nature in the conceptions we form of it. Take the following examples.

For Neleus' son Alcides' *rage* had slain.

A broken rock the *force* of Pirus threw.

In these instances, the rage of Hercules and the force of Pirus being the capital circumstances, are so far exalted as to be conceived the agents that produce the effects.

In the first of the following instances, hunger being the chief circumstance in the description, is itself imagined to be the patient.

Whose hunger has not tasted food these three days.
*Jane Shore.*

————————As when the *force*
Of subterranean wind transports a hill.
*Paradise Lost.*

————————As when the *potent rod*
Of Amram's son, in Egypt's evil day,
Wav'd round the coast, upcall'd a pitchy cloud
Of locusts. *Paradise Lost.*

*A* Figure, *which, among related objects, extends the properties of one to another.* This figure is not dignified with a proper name, because it has been overlooked by writers. *Giddy brink, jovial wine, daring wound,* are examples of this figure. Here are adjectives that cannot be made to signify any quality of the substantives to which they are joined; a *brink,* for example, cannot be termed *giddy* in a sense, either proper or figurative, that can signify any of its qualities or attributes. When we examine attentively the expression, we discover that a *brink* is termed *giddy* from producing that effect on those who stand on it: in the same manner, a wound is said to be *daring,* not with respect to itself, but with respect to the boldness of the person who inflicts it: and wine is said to be *jovial,* as inspiring mirth and jollity. Thus the attributes of one subject are extended to another with which it is connected; and the expression of such a thought must be considered as a figure, because the attribute is not applicable to the subject in any proper sense.

How are we to account for this figure, which we see lies in the thought, and to what principle shall we refer it? Have poets a privilege to alter the nature of things, and at pleasure to bestow attributes upon a subject to which they do not belong? It is observed †, that the mind passeth easily and sweetly along a train of connected objects; and where the objects are intimately connected, that it is disposed to carry along the good or bad properties of one to another; especially when it is in any degree inflamed with these properties. From this principle is derived the figure under consideration. Language, invented for the communication of thought, would be imperfect, if it were not expressive even of the slighter propensities and more delicate feelings: but language cannot remain so imperfect among a people who have received any polish; because language is regulated by internal feeling, and is gradually improved to express whatever passes in the mind. Thus, for example, when a sword in the hand of a coward is termed *a coward sword,* the expression is significative of an internal operation; for the mind, in passing from the agent to its instrument, is disposed to extend to the latter the properties of the former. Governed by the same principle, we say *listening* fear, by extending the attribute *listening* of the man who listens, to the passion with which he is moved. In the expression *bold deed,* or *audax facinus,* we extend to the effect what properly belongs to the cause. But not to waste time by making a commentary upon every expression of this kind, the best way to give a complete view of the subject, is to exhibit a table of the different relations that may give occasion to this figure. And in viewing the table it will be observed, that the figure can never have any grace but where the relations are of the most intimate kind.

† . of ism. part . 6.

1. An attribute of the cause expressed as an attribute of the effect.

Audax facinus.
Of yonder fleet a *bold* discovery make.
An impious mortal gave the *daring* wound.
————————To my *advent'rous* song,
That with no middle flight intends to soar.
*Paradise Lost.*

2. An attribute of the effect expressed as an attribute of the cause.

Quos periisse ambos *misero* censebam in mari.
Plautus.

No wonder, fallen such a *pernicious* height.
*Paradise Lost.*

3. An effect expressed as an attribute of the cause.

Jovial wine, Giddy brink, Drowsy night, Musing midnight, Panting height, Astonish'd thought, Mournful gloom.

Casting a dim *religious* light. Milton, *Comus.*

And the *merry* bells ring round,
And the *jocund* rebecks sound. Milton, *Allegro.*

4. An attribute of a subject bestowed upon one of its parts or members.

*Longing* arms.
It was the nightingale, and not the lark,
That pierc'd the *fearful* hollow of thine ear.
*Romeo and Juliet,* act. iii. sc. 7.

————————Oh, lay by
Those most ungentle looks and angry weapons:
Unless you mean my griefs and killing fears
Should stretch me out at your *relentless* feet.
*Fair Penitent,* act iii.

————————And ready now
To stoop with *wearied* wing and *willing* feet,
On the bare outside of this world.
*Paradise Lost,* book iii.

5. A quality of the agent given to the instrument with which it operates.

Why peep your *coward* swords half out their shells?

6. An attribute of the agent given to the subject upon which it operates.

*High-climbing* hill. Milton.

7. A quality of one subject given to another.

Icci, *beatis* nunc Arabum invides
Gazis. Horat. *Carm.* lib. i. ode 29.

When sapless age, and weak unable limbs,
Shall bring thy father to his *drooping* chair.
Shakespeare.

By art, the pilot through the boiling deep,
And howling tempest, steers the *fearless* ship.
*Iliad*, book xxiii. l. 385.

Then, nothing loth, th' enamour'd fair he led,
And sunk transported on the *conscious* bed.
*Odyssey*, book viii. l. 337.

A *stupid* moment motionless she stood.
*Summer*, l. 1336.

8. A circumstance connected with a subject, expressed as a quality of the subject.

*Breezy* summit.

'Tis ours the chance of *fighting* fields to try.
*Iliad*, book v. l. 301.

Oh! had I dy'd before that *well-fought* wall.
*Odyssey*, book v. l. 395.

From this table it appears, that the adorning a cause with an attribute of the effect, is not so agreeable as the opposite expression. The progress from cause to effect is natural and easy: the opposite progress resembles retrograde motion *; and therefore *panting height*, *astonish'd thought*, are strain'd and uncouth expressions, which a writer of taste will avoid.

* See PERCEPTION *and Ideas in a Train.*

It is not less strained, to apply to a subject in its present state, an epithet that may belong to it in some future state:

*Submersasque* obrue puppes. *Æneid*, book i. l. 73.

And mighty *ruins* fall. *Iliad*, book v. l. 411.

Impious sons their *mangled* fathers wound.

Another rule regards this figure, That the property of one subject ought not to be bestowed upon another with which the property is incongruous.

*K. Rich.*———How dare thy joints forget
To pay their *awful* duty to our presence?
*Richard II.* act iii. sc. 6.

The connexion between an awful superior and his submissive dependent is to intimate, that an attribute may readily be transferred from the one to the other: but awfulness cannot be so transferred, because it is inconsistent with submission.

*FIGURE of Speech*, as peculiarly distinguished from the above and from those first referred to]. Under the article *METAPHOR and Allegory*, a figure of speech is defined, "The using a word in a sense different from what is proper to it;" and the new or uncommon sense of the word is termed *the figurative sense.* The figurative sense must have a relation to that which is proper; and the more intimate the relation is, the figure is the more happy. How ornamental this figure is to language, will not be readily imagined by any one who hath not given peculiar attention; and therefore we shall endeavour to unfold its capital beauties and advantages. In the first place, a word used figuratively, or in a new sense, suggests at the same time the sense it commonly bears: and thus it has the effect to present two objects; one signified by the figurative sense, which may be termed *the principal object;* and one signified by the proper sense, which may be termed *accessory:* the principal makes a part of the thought; the accessory is merely ornamental. In this respect, a figure of speech is precisely similar to concordant sounds in music, which, without contributing to the melody, make it harmonious.

*Elem. of Criticism.*

To explain the matter by examples. *Youth*, by a figure of speech, is termed *the morning of life:* This expression signifies *youth*, the principal object which enters into the thought; it suggests, at the same time, the proper sense of *morning;* and this accessory object, being in itself beautiful, and connected by resemblance to the principal object, is not a little ornamental. *Imperious ocean*, is an example of a different kind, where an attribute is expressed figuratively: Together with *stormy*, the figurative meaning of the epithet *imperious*, there is suggested its proper meaning, viz. the stern authority of a despotic prince; and these two are strongly connected by resemblance. Upon this figurative power of words, Vida descants with elegance, *Poet.* lib. iii. l. 44.

In the next place, this figure possesses a signal power of aggrandizing an object, by the following means.—Words, which have no original beauty but what arises from their sound, acquire an adventitious beauty from their meaning: a word signifying any thing that is agreeable, becomes by that means agreeable; for the agreeableness of the object is communicated to its name. This acquired beauty, by the force of custom, adheres to the word, even when used figuratively; and the beauty received from the thing it properly signifies, is communicated to the thing which it is made to signify figuratively. Consider the foregoing expression *Imperious ocean*, how much more elevated it is than *Stormy ocean.*

Thirdly, This figure hath a happy effect by preventing the familiarity of proper names. The familiarity of a proper name is communicated to the thing it signifies by means of their intimate connexion; and the thing is thereby brought down in our feeling. This bad effect is prevented by using a figurative word instead of one that is proper: as, for example, when we express the sky by terming it *the blue vault of heaven;* for though no work of art can compare with the sky in grandeur, the expression however is relished, because it prevents the object from being brought down by the familiarity of its proper name. With respect to the degrading the familiarity of proper names, Vida has the following passage:

Hinc si dura mihi passus dicendus Ulysses,
Non illum vere memorabo nomine, sed qui
Et mores hominum multorum vidit, et urbes,
Naufragus eversæ post sæva incendia Trojæ.
*Poet.* lib. ii. l. 460.

Lastly, By this figure, language is enriched, and rendered more copious; in which respect, were there no other, a figure of speech is a happy invention. This property is finely touched by Vida; *Poet.* lib. iii. l. 90.

The beauties we have mentioned belong to every figure of speech. Several other beauties, peculiar to one or other sort, we shall have occasion to remark afterwards.

Not only subjects, but qualities, actions, effects, may be expressed figuratively. Thus, as to subjects, *gates of breath* for the lips, *the watery kingdom* for the ocean. As to qualities, *fierce* for stormy, in the expression *Fierce winter; Altus* for profundus, *Altus puteus, Altum mare;*

*more; breathing* for perspiring, *Breathing plants.* Again, as to actions, The sea *rages*, Time will *melt* her frozen thoughts, Time *kills* grief. An effect is put for the cause, as *lux* for the sun; and a cause for the effect, as *boum labores* for corn. The relation of resemblance is one plentiful source of figures of speech; and nothing is more common than to apply to one object the name of another that resembles it in any respect: Height, size, and worldly greatness, resemble not each other; but the emotions they produce resemble each other, and, prompted by this resemblance, we naturally express worldly greatness by height or size: One feels a certain uneasiness in seeing a great depth; and, hence depth is made to express any thing disagreeable by excess, as *depth* of grief, *depth* of despair: Again, Height of place, and time long past, produce similar feelings; and hence the expression, *Ut altius repetam!* Distance in time past, producing a strong feeling, is put for any strong feeling; *Nihil mihi antiquius nostra amicitia:* Shortness with relation to space, for shortness with relation to time; *Brevis esse laboro, obscurus fio:* Suffering a punishment resembles paying a debt; hence *pendere pœnas.* In the same manner, light may be put for glory, sunshine for prosperity, and weight for importance.

Many words, originally figurative, having, by long and constant use, lost their figurative power, are degraded to the inferior rank of proper terms. Thus the words that express the operations of the mind, have in all languages been originally figurative; the reason holds in all, that when these operations came first under consideration, there was no other way of describing them but by what they resembled: it was not practicable to give them proper names, as may be done to objects that can be ascertained by sight and touch. A *soft* nature, *jarring* tempers, *weight* of woe, *pompous* phrase, *beget* compassion, *assuage* grief, *break* a vow, *bend* the eye downward, *shower* down curses, *drowning* in tears, *wrapt* in joy, *warm'd* with eloquence, *loaded* with spoils, and a thousand other expressions of the like nature, have lost their figurative sense. Some terms there are that cannot be said to be altogether figurative or altogether proper: originally figurative, they are tending to simplicity, without having lost altogether their figurative power. Virgil's *Regina saucia cura*, is perhaps one of these expressions: with ordinary readers, *saucia* will be considered as expressing simply the effect of grief; but one of a lively imagination will exalt the phrase into a figure.

For epitomizing this subject, and at the same time for giving a clear view of it, Lord Kames † gives a list of the several relations upon which figures of speech are commonly founded. This list he divides into two tables; one of subjects expressed figuratively, and one of attributes.

m. *of* *ism*, 5.

### TAB. I. *Subjects expressed figuratively.*

1. A word proper to one subject employed figuratively to express a resembling subject.

There is no figure of speech so frequent, as what is derived from the relation of resembling. Youth, for example, is signified figuratively by the *morning* of life. The life of a man resembles a natural day in several particulars: the morning is the beginning of a day, youth the beginning of life; the morning is cheerful, so is youth, &c. By another resemblance, a bold warrior is termed the *thunderbolt* of war; a multitude of troubles, a *sea* of troubles.

This figure, above all others, affords pleasure to the mind by variety of beauties. Besides the beauties above mentioned, common to all sorts, it possesses in particular the beauty of a metaphor or a simile: a figure of speech built upon resemblance, suggests always a comparison between the principal subject and the accessory; whereby every good effect of a metaphor or simile may, in a short and lively manner, be produced by this figure of speech.

2. A word proper to the effect employed figuratively to express the cause.

*Lux* for the sun; *Shadow* for cloud. A helmet is signified by the expression *glittering terror;* a tree by *shadow* or *umbrage.* Hence the expression,

> Nec habet Pelion umbras. OVID.

> Where the dun umbrage hangs. *Spring*, l. 1023.

A wound is made to signify an arrow:

> Vulnere non pedibus te consequar. OVID.

There is a peculiar force and beauty in this figure: the word which signifies figuratively the principal subject, denotes it to be a cause by suggesting the effect.

3. A word proper to the cause employed figuratively to express the effect.

*Boumque labores* for corn. *Sorrow* or *grief* for tears.

> Again Ulysses veil'd his pensive head;
> Again unmann'd, a shower of *sorrow* shed.

> Streaming *grief* his faded cheek bedew'd.

*Blindness* for darkness:

> Cæcis erramus in undis. *Æneid.* iii. 200.

There is a peculiar energy in this figure, similar to that in the former: the figurative name denotes the subject to be an effect by suggesting its cause.

4. Two things being intimately connected, the proper name of the one employed figuratively to signify the other.

*Day* for light. *Night* for darkness; and hence, A sudden night. *Winter* for a storm at sea:

> Interea magno misceri murmure pontum,
> Emissamque Hyemem sensit Neptunus.
> *Æneid.* i. 128.

This last figure would be too bold for a British writer, as a storm at sea is not inseparably connected with winter in this climate.

5. A word proper to an attribute, employed figuratively to denote the subject.

*Youth* and *beauty* for those who are young and beautiful:

> Youth and beauty shall be laid in dust.

*Majesty* for the king:

> What art thou, that usurp'st this time of night,
> Together with that fair and warlike form
> In which the *Majesty* of buried Denmark
> Did sometimes march? *Hamlet*, act i. sc. 1.

———Or have ye chosen this place,
After the toils of battle to repose
Your weary'd *virtue*? *Paradise Lost.*

*Verdure* for a green field. *Summer*, l. 301.

Speaking of cranes,

The pigmy nations, wounds and death they bring,
And all the *war* descends upon the wing,
*Iliad*, book iii. l. 10.

Cool *age* advances venerably wise.
*Iliad*, book iii. l. 149.

The peculiar beauty of this figure arises from suggesting an attribute that embellishes the subject, or puts it in a stronger light.

6. A complex term employed figuratively to denote one of the component parts.

*Funus* for a dead body. *Burial* for a grave.

7. The name of one of the component parts instead of the complex term.

*Tæda* for a marriage. The *East* for a country situated east from us. *Jovis vestigia servat*, for imitating Jupiter in general.

8. A word signifying time or place, employed figuratively to denote what is connected with it.

*Clime* for a nation, or for a constitution of government: hence the expression, *Merciful clime*, *Fleecy winter*, for snow, *Seculum felix*.

9. A part for the whole.

The *pole* for the earth. The *head* for the person.

Triginta minas pro *capite* tuo dedi. Plautus.

*Tergum* for the man:

Fugiens tergum. Ovid.

*Vultus* for the man:

Jam fulgor armorum fugaces
Terret equos, equitumque vultus. Horat.

Quis desiderio sit pudor aut modus
Tam chari *capitis*? Horat.

Dumque virent *genua*? Horat.

Thy growing virtues justify'd my cares,
And promis'd comfort to my *silver hairs*.
*Iliad*, ix. l. 616.

———Forthwith from the pool he rears
His mighty *stature*. *Paradise Lost.*

The silent *heart* which grief assails. Parnel.

The peculiar beauty of this figure consists in marking that part which makes the greatest figure.

10. The name of the container, employed figuratively to signify what is contained.

*Grove* for the birds in it; Vocal *grove*. *Ships* for the seamen; Agonizing *ships*. *Mountains* for the sheep pasturing upon them; Bleating *mountains*. *Zacynthus*, *Ithaca*, &c. for the inhabitants; *Ex mœstis domibus*. Livy.

11. The name of the sustainer, employed figuratively to signify what is sustained.

*Altar* for the sacrifice. *Field* for the battle fought upon it; Well-fought *field*.

12. The name of the materials, employed figuratively to signify the things made of them.

*Ferrum* for *gladius*.

13. The names of the Heathen deities, employed figuratively to signify what they patronize.

*Jove* for the air, *Mars* for war, *Venus* for beauty, *Cupid* for love, *Ceres* for corn, *Neptune* for the sea, *Vulcan* for fire.

This figure bestows great elevation upon the subject; and therefore ought to be confined to the higher strains of poetry.

Tab. II. *Attributes expressed figuratively.*

1. When two attributes are connected, the name of the one may be employed figuratively to express the other.

Purity and virginity are attributes of the same person: hence the expression *Virgin* snow, for pure snow.

2. A word signifying properly an attribute of one subject, employed figuratively to express a resembling attribute of another subject.

*Tottering* state. *Imperious* ocean. *Angry* flood. *Raging* tempest. *Shallow* fears.

My sure divinity shall bear the shield,
And edge thy sword to *reap* the glorious field.
*Odyssey*, book xx. l. 61.

*Black omen*, for an omen that portends bad fortune.

*Ater* omen. Virgil.

The peculiar beauty of this figure arises from suggesting a comparison.

3. A word proper to the subject, employed to express one of its attributes.

*Mens* for *intellectus*. *Mens* for a resolution:

Istam, oro, exue, mentem.

4. When two subjects have a resemblance by a common quality, the name of the one subject may be employed figuratively to denote that quality in the other: *Summer* life for agreeable life.

5. The name of the instrument made to signify the power of employing it:

———Melpomene, cui liquidam pater
Vocem cum *cithara* dedit.

The ample field of figurative expression displayed in these tables, affords great scope for reasoning. Several of the observations relating to metaphor*, are applicable to figures of speech: these shall be slightly retouched, with some additions peculiarly adapted to the present subjects.

1. As the figure under consideration is built upon relation, we find from experience, and it must be obvious from reason, that the beauty of it depends on the intimacy of the relation between the figurative and proper sense of the word. A slight resemblance, in particular, will never make this figure agreeable: the expression, for example, *Drink down a secret*, for listening to a secret with attention, is harsh and uncouth, because there is scarce any resemblance between *listening* and *drinking*. The expression *weighty crack*, used by Ben Johnson for *loud crack*, is worse if possible; a loud sound has not the slightest resemblance to a piece of matter that is weighty.

Phemius! let acts of gods, and heroes old,
What ancient bards in hall and bow'r have told,
Attemper'd

---

* See Metaphor.

Attemper'd to the lyre, your voice employ,
Such the pleas'd *ear will drink* with silent joy.
*Odyssey*, book i. l. 433.

Strepitumque exterritus *hausit*.
*Æneid*, book vi. l. 559.

——————————Write, my queen,
And with mine eyes I'll *drink* the words you send.
*Cymbeline*, act i. sc. 2.

As thus th' effulgence tremulous I *drink*.
*Summer*, l. 1684.

Neque *audit* currus habenas.
*Georg.* book i. l. 514.

O prince! (Lycaon's valiant son reply'd),
As thine the steeds, be thine the task to guide.
The horses practis'd to their lord's command,
Shall *hear* the rein, and answer to thy hand.
*Iliad*, book v. l. 288.

The following figures of speech seem altogether wild and extravagant, the figurative and proper meaning having no connexion whatever. *Moving* softness, Freshness *breathes*, *Breathing* prospect, *Flowing* spring, *Dewy* light, *Lucid* coolness, and many others of this false coin, may be found in Thomson's *Seasons*.

2. The proper sense of the word ought to bear some proportion to the figurative sense, and not soar much above it, nor sink much below it. This rule, as well as the foregoing, is finely illustrated by Vida, *Poet.* book iii. l. 148.

3. In a figure of speech, every circumstance ought to be avoided that agrees with the proper sense only, not with the figurative sense: for it is the latter that expresses the thought, and the former serves for no other purpose but to make harmony:

Zacynthus green with ever-shady groves,
And Ithaca, presumptuous boast their loves;
Obtruding on my choice a second lord,
They press the Hymenean rite abhorr'd.
*Odyssey*, book xix. l. 152.

Zacynthus here standing figuratively for the inhabitants, the description of the island is quite out of place: it puzzles the reader, by making him doubt whether the word ought to be taken in its proper or figurative sense.

——————————Write, my queen,
And with mine eyes I'll drink the words you send,
Though ink be made of gall.
*Cymbeline*, act i. sc. 2.

The disgust one has to drink ink in reality, is not to the purpose where the subject is drinking ink figuratively.

4. To draw consequences from a figure of speech, as if the word were to be understood literally, is a gross absurdity; for it is confounding truth with fiction:

Be Moubray's sins so heavy in his bosom,
That they may break his foaming courser's back,
And throw the rider headlong in the lists,
A caitiff recreant to my cousin Hereford.
*Richard II.* act i. sc. 3.

Sin may be imagined heavy in a figurative sense: but weight in a proper sense belongs to the accessory only; and therefore to describe the effects of weight, is to desert the principal subject, and to convert the accessory into a principal:

*Cromwell.* How does your Grace?
*Wolsey.* Why well;
Never so truly happy, my good Cromwell.
I know myself now, and I feel within me
A peace above all earthly dignities,
A still and quiet conscience. The king has cur'd me,
I humbly thank his Grace: and, from these shoulders,
These ruin'd pillars, out of pity, taken
A load would sink a navy, too much honour.
*Henry VIII.* act iii. sc. 6.

Ulysses speaking of Hector—

I wonder now how yonder city stands,
When we have here the base and pillar by us.
*Troilus and Cressida*, act iv. sc. 9.

*Othello.* No; my heart is turned to stone: I strike it, and it hurts my hand. *Othello*, act iv. sc. 5.

Not less, even in this despicable now,
Than when my name fill'd Afric with affrights,
And froze your hearts beneath your torrid zone.
*Don Sebastian King of Portugal*, act i.

How long a space, since first I lov'd, it is!
To look into a glass I fear,
And am surpris'd with wonder, when I miss
Gray hairs and wrinkles there.
COWLEY, vol. i. p. 86.

I chose the flourishing'st tree in all the park,
With freshest boughs and fairest head;
I cut my love into its gentle bark,
And in three days behold 'tis dead;
My very written flames so violent be,
They've burnt and wither'd up the tree.
COWLEY, vol. i. p. 136.

Ah, mighty Love, that it were inward heat
Which made this precious limbeck sweat!
But what, alas! ah, what does it avail,
That she weeps tears so wond'rous cold,
As scarce the ass's hoof can hold,
So cold, that I admire they fall not hail!
COWLEY, vol. i. p. 132.

Such a play of words is pleasant in a ludicrous poem.

*Almeria.* O Alphonso, Alphonso!
Devouring seas have wash'd thee from my sight,
No time shall raze thee from my memory:
No, I will live to be thy monument:
The cruel ocean is no more thy tomb;
But in my heart thou art interr'd.
*Mourning Bride*, act i. sc. 1.

This would be very right, if there were any inconsistence in being interred in one place really, and in another place figuratively.

From considering that a word used in a figurative sense suggests at the same time its proper meaning, we discover a fifth rule, That we ought not to employ a word in a figurative sense, the proper sense of which is inconsistent or incongruous with the subject: for every inconsistency, and even incongruity, though in the expression only and not real, is unpleasant:

Interea,

Interea genitor Tyberini ad fluminis undam,
Vulnera *siccabat* lymphis————
*Æneid*, book x. l. 833.

Tres adeo incertos cæca caligine *soles*
Erramus pelago, totidem sine sidere noctes.
*Æneid*, book iii. l. 203.

The foregoing rule may be extended to form a sixth, That no epithet ought to be given to the figurative sense of a word that agrees not also with its proper sense:

————Dicat Opuntiæ
Frater Megillæ, quo *beatus*
Vulnere. Horat. *Carm.* lib. i. ode 27.

Parcus deorum cultor, et infrequens,
*Insanientis* dum sapientiæ
Consultos erro. Horat. *Carm.* lib. i. ode 54.

Seventhly, The crowding into one period or thought different figures of speech, is not less faulty than crowding metaphors in that manner: the mind is distracted in the quick transition from one image to another, and is puzzled instead of being pleased:

I am of ladies most deject and wretched,
That suck'd the honey of his music vows. *Hamlet.*

My bleeding bosom sickens at the sound.
*Odyssey*, book i. l. 439.

————Ah miser,
Quanta laboras in *Charybdi!*
Digne puer meliore *flamma.*
Quæ saga, quis te solvere Thessalis
Magus *venenis*, qua poterit Deus:
Vix illigatum tetriformi
Pegasus expediet *Chimera.*
Horat. *Carm.* lib. i. ode 27.

Eighthly, If crowded figures be bad, it is still worse to graft one figure upon another: For instance,

While his keen falchion drinks the warriors lives.
*Iliad*, book xi. l. 211.

A falchion drinking the warriors blood, is a figure built upon resemblance, which is passable. But then in the expression, *lives* is again put for *blood;* and by thus grafting one figure upon another, the expression is rendered obscure and unpleasant.

Ninthly, Intricate and involved figures, that can scarce be analyzed, or reduced to plain language, are least of all tolerable:

Votis incendimus aras. *Æneid*, book iii. l. 279.

————Onerentque canistris
Dona laboratæ Cereris. *Æneid*, book viii. l. 180.

Vulcan to the Cyclops:

Arma acri facienda viro: nunc viribus usus,
Nunc manibus rapidis, omni nunc arte magistra:
*Præcipitate* moras. *Æneid*, book viii. l. 441.

————Huic gladio, perque ærea scuta,
Per tunicam squalentem auro, latus *haurit* apertum.
*Æneid*, book x. l. 313.

Scriberis Vario fortis, et hostium
Victor, Mæonii carminis *alite.*
Horat. *Carm.* lib. i. ode 6.

Else shall our fates be number'd with the dead.
*Iliad*, book v. l. 294.

Commutual death the fate of war confounds.
*Iliad*, book viii. l. 85. and book xi. l. 117.

Speaking of Proteus.

Instant he wears, elusive of the rape,
The mimic force of every savage shape.
*Odyssey*, book iv. l. 563.

Rolling convulsive on the floor, is seen
The piteous object of a prostrate queen.
*Ibid.* book iv. l. 652.

The mingling tempest weaves its gloom.
*Autumn*, l. 337.

A various sweetness swells the gentle race.
*Ibid.* l. 640.

The distant waterfall swells in the breeze.
*Winter*, l. 738.

In the tenth place, When a subject is introduced by its proper name, it is absurd to attribute to it the properties of a different subject to which the word is sometimes applied in a figurative sense:

Hear me, Oh Neptune! thou whose arms are hurl'd
From shore to shore, and gird the solid world.
*Odyssey*, book ix. l. 617.

Neptune is here introduced personally, and not figuratively, for the ocean: the description, therefore, which is only applicable to the latter, is altogether improper.

It is not sufficient that a figure of speech be regularly constructed, and be free from blemish: it requires taste to discern when it is proper, when improper; and taste perhaps is our only guide. One, however, may gather from reflection and experience, that ornaments and graces suit not any of the dispiriting passions, nor are proper for expressing any thing grave and important. In familiar conversation, they are in some measure ridiculous: Prospero, in the *Tempest*, speaking to his daughter Miranda, says,

The fringed curtains of thine eyes advance,
And say what thou seest yond.

No exception can be taken to the justness of the figure; and circumstances may be imagined to make it proper; but it is certainly not proper in familiar conversation.

In the last place, Though figures of speech have a charming effect when accurately constructed and properly introduced, they ought, however, to be scattered with a sparing hand; nothing is more luscious, and nothing consequently more satiating, than redundant ornaments of any kind.

Figure is used, in *Theology*, for the mysteries represented or delivered obscurely to us under certain types, or actions in the Old Testament. Thus manna is held a figure or type of the eucharist; and the death of Abel, a figure of the suffering of Christ.

Many divines and critics contend, that all the actions, histories, ceremonies, &c. of the Old Testament, are only figures, types, and prophecies, of what was to happen under the New. The Jews are supposed to to have had the figures or shadows, and we the substance.

Figure is also applied in a like sense to profane matters; as the emblems, enigmas, fables, symbols, and hieroglyphics, of the ancients.

**FIGURED**, in general, something marked with figures.

The term *figured* is chiefly applied to stuffs, whereon the figures of flowers, and the like, are either wrought or stamped.

**Figured**, in *Music*, is applied either to simple notes or to harmony: to simple notes, as in these words *figured bass*, to express a bass whose notes carrying chords are subdivided into many other notes of lesser value: to harmony, when by supposition and in a diatonic procedure, other notes than those which form the chord are employed. See Supposition.

To *figure* is to pass several notes for one; to form runnings or variations; to add some notes to the air, in whatever manner it be done; in short, it is to give to harmonious sounds a figure of melody, by connecting them with other intermediate sounds.

**FILAGO**, a genus of plants, belonging to the syngenesia class; and in the natural method ranking under the 49th order, *Compositæ*. See Botany *Index*.

**FILAMENT**, in *Anatomy*, *Natural History*, &c. a term used in the same sense with fibre, for those fine threads whereof the flesh, nerves, skin, plants, roots, &c. are composed. See Fibre.

*Vegetable* **Filaments** form a substance of great use in the arts and manufactures; furnishing thread, cloth, cordage, &c.

For these purposes the filamentous parts of the *Cannabis* and *Linum*, or hemp and flax, are employed among us †. But different vegetables have been employed in different countries for the same uses. Putrefaction destroys the pulpy or fleshy matter, and leaves the tough filaments entire: By putrefying the leaf of a plant in water, we obtain the fine flexible fibres, which constituted the basis of the ribs and minute veins, and which now form as it were a skeleton of the leaf. Alkaline lixivia, in some degree, produce similar effects to putrefaction.

The Sieur de Flacourt, in his history of Madagascar, relates, that different kinds of cloth are prepared in that island from the filaments of the bark of certain trees boiled in strong lye; that some of these cloths are very fine, and approach to the softness of silk, but in durability come short of cotton; that others are coarser and stronger, and last thrice as long as cotton; and that of these the sails and cordage of his vessel were made. See also the article Bark.

The same author informs us, that the stalks of nettles are used for the like purposes in his own country, France. And Sir Hans Sloane relates, in one of his letters to Mr Ray, that he has been informed by several, that muslin and callico, and most of the Indian linens, are made of nettles.

In some of the Swedish provinces, a strong kind of cloth is said to be prepared from hop stalks: and in the Transactions of the Swedish Academy for the year 1750, there is an account of an experiment made in consequence of that report. Of the stalks, gathered in autumn, about as many were taken as equalled in bulk a quantity of flax that would have produced a pound after preparation. The stalks were put into water, and kept covered therewith during the winter. In March they were taken out, dried in a stove, and dressed as flax. The prepared filaments weighed nearly a pound, and proved fine, soft, and white: They were spun and woven into six ells of fine strong cloth. The author, Mr Shisler, observes, that hop stalks take much longer time to rot than flax; and that, if not fully rotted, the woody part will not separate, and the cloth will neither prove white nor fine.

Hemp, flax, and all other vegetable filaments, and thread or cloth prepared from them, differ remarkably from wool, hair, silk, and other animal productions, not only in the principles into which they are resoluble by fire, but likewise in some of their more interesting properties, particularly in their disposition to imbibe colouring matters; sundry liquors, which give a beautiful and durable dye to those of the animal, giving no stain at all to those of the vegetable kingdom.

A solution of copper in aquafortis, which had been changed blue by an addition of volatile spirit, on being mixed with a little solution of tin, became turbid and greenish. Pieces of white silk and flannel boiled, without any previous preparation, in this mixture, received a bright deep yellow dye; whilst pieces of linen, prepared and unprepared, came out as colourless as they were put in.

Fishing nets are usually boiled with oak bark or other like astringents, which render them more lasting. Those made of flax receive from this decoction a brownish colour, which, by the repeated alternations of water and air, is in a little time discharged, whilst the fine glossy brown, communicated by the same means to silken nets, permanently resists both the air and water, and stands as long as the animal filaments themselves. In like manner the stain of ink, or the black dye from solutions of iron, mixed with vegetable astringents, proves durable in silk and woollen; but from linen, the astringent matter is extracted by washing, and only the yellow iron mould remains.

The red decoction of cochineal, which, heightened with a little solution of tin, gives the fiery scarlet dye to wool or silk that have been previously impregnated with solution of tartar, makes no impression upon linen or cotton prepared in the same manner. M. du Fay informs us, in the Memoirs of the French Academy for the year 1737, that having prepared a mixed cloth whose warp was of wool and the woof of cotton, and thoroughly blended the two together by fulling, he still found the cotton to resist the action of the scarlet liquor, and the wool to receive the same colour from it as wool by itself, the stuff coming out all over marbled fiery and white.

Many other instances of this kind are known too well to the callico printer; whose grand desideratum it is, to find means of making linen receive the same colours that wool does. The physical cause of the difference is wholly unknown; and indeed, of the theory of dyes in general, we know as yet extremely little. (See Dyeing). Are animal filaments tubular, and the colouring atoms received within them? Are vegetable filaments solid, and the colour deposited on the surface? Or, does not their different susceptibility of colour depend rather on the different intrinsic properties of the two? There are many instances of a like diversity, even in the metallic kingdom, where a mechanical difference in texture can scarcely be presumed to be the cause: Thus silver receives a deep stain from sulphureous or putrid vapours, which have no effect upon tin.

Filaments, among botanists. See Botany *Index*.

FILANDERS, in falconry, a disease in hawks, &c. consisting of filaments or strings of blood coagulated; and occasioned by a violent rupture of some vein, by which the blood extravasating, hardens into these figures, and incommodes the reins, hips, &c.

Filanders, are also worms as small as thread, and about an inch long, that lie wrapt up in a thin skin or net, near the reins of a hawk, apart from either gut or gorge. This malady is known by the hawk's poverty; by ruffling her tail; by her straining the fist or perch, with her pounces; and lastly, by croaking in the night, when the filanders prick her. The disease proceeds from bad food; and must be remedied in time, to prevent its spreading over the whole body, and destroying the bird. These must not be killed as other worms are, for fear of imposthumes from their corruption, being incapable of passing away with the hawk's meat. They must only be stupified, to prevent their being offensive; and this is done by giving the hawk a clove of garlic, after which she will feel nothing of the filanders for 40 days. It will be prudent in the falconer, when he observes the hawk poor and low, to give her a clove of garlic once a month by way of prevention.

FILANGIERI, Gaetan, an eminent Italian writer on legislation. See Supplement.

FILBERT, or Filberd, the fruit of the corylus, or hazel. See Corylus, Botany *Index*.

FILE, among mechanics, a tool used in metal, &c. in order to smooth, polish, or cut.

This instrument is of iron or forged steel, cut in little furrows, with chissels and a mallet, this and that way, and of this or that depth, according to the grain or touch required. After cutting the file, it must be tempered with a composition of chimney soot, very hard and dry, diluted and wrought up with urine, vinegar, and salt, the whole being reduced to the consistence of mustard. Tempering the files consists in rubbing them over with this composition, and covering them in loam; after which they are put in a charcoal fire, and taken out by that time they have acquired a cherry colour, which is known by a small rod of the same steel put in along with them. Being taken out of the fire, they are thrown into cold spring water; and when cold, they are cleaned with charcoal and a rag; and being clean and dry, are kept from rust by laying them up in wheat bran. Iron filings require more heating than steel ones. Files are of different forms, sizes, cuts, and degrees of fineness, according to the different uses and occasions for which they are made. See Filing.

File, in the art of war, a row of soldiers, standing one behind another, which is the depth of the battalion or squadron. The files of a battalion of foot are generally three deep; as are sometimes those of a squadron of horse. The files must be straight and parallel one to another.

File, in *Law*, a thread, string, or wire, upon which writs and other exhibits in courts and offices are fastened or filed, for the more safe keeping, and ready turning to the same. A file is a record of the court; and the filing of a process of a court makes it a record of it. An original writ may be filed after judgment given in the cause, issued forth before; declarations, &c. are to be filed, and affidavits must be filed, some before they are read in court, and some presently when read in court. Before filing a record removed by *certiorari*, the justices of B. R. may refuse to receive it, if it appears to be for delay, &c.; and remand it back for the expedition of justice: but if the *certiorari* be once filed, the proceedings below cannot be revived. An indictment, &c. cannot be amended after it is filed.

FILIAL, something belonging to the relation of son. See Son.

The divines usually distinguish between a *servile* and a *filial* fear. The most abandoned may have a servile fear of God, such as that of a slave to his master; but not a filial fear, i. e. a fear resulting from love and respect. See Fear.

*Filial Piety*, the affectionate attachment of children to their parents; including in it love, reverence, obedience, and relief. These are duties prompted equally by nature and by gratitude, independent of the injunctions of religion. For where shall we find the person who hath received from any one benefits so great or so many, as children from their parents? And it may be truly said, that if persons are undutiful to their parents, they seldom prove good to any other relation. Profane history furnishes many fine examples of this amiable virtue; a few of which we shall select, according to the plan observed in other similar articles.

1. The Roman dictator T. Manlius having exercised great cruelty over the citizens, was cited at the expiration of his office to answer for his conduct. Among other things that were laid to his charge, he was accused of treating with barbarity one of his own sons. Manlius, according to Livy, had no other cause of complaint against this son than his having an impediment in his speech. For this reason he was banished far from the city, from his home, and the company of those of his own age and fortune, and condemned to servile works. All were highly exasperated against such inhuman conduct, except the son himself, who, under the greatest concern that he should furnish matter of accusation against his father, resolved upon a most extraordinary method to relieve him. One morning, without apprising any body, he came to the city armed with a dagger, and went directly to the house of the tribune Pomponius, who had accused his father. Pomponius was yet in bed. Young Manlius sent up his name, and was immediately admitted by the tribune, who did not doubt but he was come to discover to him some new instances of his father's severity. But Manlius, as soon as he was left alone with the tribune, drew out his dagger, and presented it to his breast; declaring he would stab him that moment if he did not swear in the form he should dictate, "Never to hold the assembly of the people for accusing his father." Pomponius, who saw the dagger glittering at his breast, himself alone, without arms, and attacked by a robust young man, full of a bold confidence in his own strength, took the oath demanded of him; and afterwards confessed with a kind of complacency in the thing, and a sincerity which suffi-

ciently argued he was not sorry for what he had done, that it was that violence which obliged him to desist from his design.

2. Among the multitude of persons who were proscribed under the second triumvirate of Rome, were the celebrated orator Cicero and his brother Quintus. The fate of the former, in endeavouring to make his escape, is related under the article CICERO. The latter found means to conceal himself so effectually at home, that the soldiers could not find him. Enraged at their disappointment, they put his son to the torture, in order to make him discover the place of his father's concealment; but filial affection was proof against the most exquisite tortures. An involuntary sigh, and sometimes a deep groan, was all that could be extorted from the youth. His agonies were increased; but with amazing fortitude he still persisted in his resolution of not betraying his father. Quintus was not far off; and it may be imagined better than can be expressed, how his heart must have been affected with the sighs and groans of a son expiring in tortures to save his life. He could bear no longer; but quitting the place of his concealment, he presented himself to the assassins, begging of them to put him to death, and dismiss the innocent youth, whose generous behaviour the triumvirs themselves, if informed of the fact, would judge worthy of the highest approbation. But the inhuman monsters, without being the least affected with the tears either of the father or the son, answered, that they both must die; the father because he was proscribed, and the son because he had concealed his father. Then a new contest of tenderness arose who should die first; but this the assassins soon decided, by beheading them both at the same time.—This anecdote is related by Appian, Dio, Plutarch, Valerius Maximus, and other historians.

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3. Cinna, who scrupled no attempt, how atrocious soever, which could serve his purpose, undertook to get Pomponius Strabo murdered in his tent; but his son saved his life, which was the first remarkable action of Pompey the Great. The treacherous Cinna, by many alluring promises, had gained over one Terentius, a confidant of Pompey's, and prevailed on him to assassinate the general, and seduce his troops. Young Pompey being informed of this design a few hours before it was to be put in execution, placed a faithful guard round the prætorium; so that none of the conspirators could come near it. He then watched all the motions of the camp, and endeavoured to appease the fury of the soldiers, who hated the general his father, by such acts of prudence as were worthy of the oldest commanders. However, some of the mutineers having forced open one of the gates of the camp, in order to desert to Cinna, the general's son threw himself flat on his back in their way, crying out, that they should not break their oath and desert their commander, without treading his body to death. By this means he put a stop to their desertion, and afterwards wrought so effectually upon them by his affecting speeches and engaging carriage, that he reconciled them to his father.

4. Olympias, Alexander's own mother, was of such an unhappy disposition, that he would never allow her to have any concern in the affairs of the government. She used frequently to make very severe complaints on that account; but he always submitted to her ill humour with great mildness and patience. Antipater, one of his friends, having one day written a long letter against her to the king then absent, the latter, after reading it, replied, "Antipater does not know that one single tear shed by a mother will obliterate ten thousand such letters as this." A behaviour like this, and such an answer, show at one and the same time, that Alexander was both an affectionate son and an able politician.

5. Epaminondas is universally acknowledged to have been one of the greatest generals and one of the best men which Greece ever produced. Before him the city of Thebes was not distinguished by any memorable action, and after him it was not famous for its virtues, but its misfortunes, till it sunk into its original obscurity; so that it saw its glory take birth and expire with this great man. The victory he obtained at Leuctra had drawn the eyes and admiration of all the neighbouring people upon Epaminondas, who looked upon him as the support of Thebes, as the triumphant conqueror of Sparta, as the deliverer of Greece: in a word, as the greatest man, and the most excellent captain, that ever was in the world. In the midst of this universal applause, so capable of making the general of an army forget the man for the victor, Epaminondas, little sensible to so affecting and so deserved a glory, "My joy (said he) arises from my sense of that which the news of my victory will give my father and my mother."

6. Among an incredible number of illustrious persons who were falsely accused and put to death by Nero, was one Bareae Soranus; a man, as Tacitus informs us, of singular vigilance and justice in the discharge of his duty. During his confinement, his daughter Servilia was apprehended and brought into the senate, and there arraigned.. The crime laid to her charge was, that she had turned into money all her ornaments and jewels, and the most valuable part of her dress, to defray the expence of consulting magicians. To this the young Servilia, with tears, replied, That she had indeed consulted magicians, but the whole of her inquiry was to know whether the emperor and senate would afford protection and safety to her dear and indulgent parent against his accusers. "With this view (said she) I presented the diviners, men till now utterly unknown to me, with my jewels, apparel, and the other ornaments peculiar to my quality, as I would have presented my blood and my life, could my blood and life have procured my father's liberty. But whatever this my proceeding was, my unfortunate father was an utter stranger to it; and if it is a crime, I alone am the delinquent." She was, however, together with her father, condemned to die; but in what manner, history is silent. [Vid. *Taciti Annales*, lib. vi. cap. 20.].

7. Valerius Maximus † likewise relates a very singular fact upon this subject. A woman of illustrious birth had been condemned to be strangled. The Roman prætor delivered her up to the triumvir, who caused her to be carried to prison, in order to her being put to death. The gaoler, who was ordered to execute her, was struck with compassion, and could not resolve to kill her. He chose therefore to let her die of hunger. Besides which, he suffered her daughter to

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† Lib. v. 4. *Plinii Hist.* lib. vii. 36.

to see her in prison; taking care, however, that she brought her nothing to eat. As this continued many days, he was surprised that the prisoner lived so long without eating; and suspecting the daughter, upon watching her, he discovered that she nourished her mother with her own milk. Amazed at so pious, and at the same time so ingenious an invention, he told the fact to the triumvir, and the triumvir to the prætor, who believed the thing merited relating in the assembly of the people. The criminal was pardoned, and a decree was passed that the mother and daughter should be subsisted for the rest of their lives at the expence of the public.

The same author gives a similar instance of filial piety in a young woman named Xantippe to her aged father Cimonus, who was likewise confined in prison, and which is universally known by the name of the *Roman Charity*. Both these instances appeared so very extraordinary and uncommon to that people, that they could only account for them, by supposing that the love of children to their parents was the first law of nature. *Putaret aliquis* (says our author) *hoc contra naturam factum esse, nisi prima naturæ lex esset diligere parentes.*

In addition to the foregoing examples, we may refer to the article Ætna, where a very noble instance of filial piety is taken notice of. See also the article Pietas.

FILIBEG, or Philibeg. See Philibeg.

FILICACIA, Vincent, a celebrated Italian poet, was born at Florence in 1642. He was a member of the Academy della Crusca and of that of the Arcadi, and became secretary to the duke of Tuscany. He died in 1707. His poems are much esteemed for the delicacy and nobleness of their sentiments. Scipio de Filicacia, his son, had them all printed together, under the title of *Poesie Fosiano di Vicenzo da Filicacia*, in 1707, 4to.

FILICES, (from *filum*, "a thread," *quasi filatim incisa*), Ferns; one of the seven tribes or families of the vegetable kingdom, according to Linnæus, by whom it is thus characterized: "having their fructification on the back side of the frondes." They constitute the first order in the class cryptogamia; and consist of 16 genera, which are divided into *fructificationes, spicatæ, frondosæ, et radicales.* This order comprehends the entire 16th class of Tournefort, in whose system the filices make only a single genus, in the first section of the above-mentioned class.

Filices, is also an order of plants in the *fragmenta methodi naturalis* of Linnæus. See Botany *Index*.

FILIGRANE, Filigree, or Fillagree, *Work*. See Fillagree.

FILING, one of the principal operations in smithery, &c. succeeding to forging. See File.

The coarser cut files are always to be succeeded by finer; and in all the kinds the rule is, to lean heavy on the file in thrusting it forwards, because the teeth of the file are made to cut forwards. But in drawing the file back again for a second stroke, it is to be lightly lifted just above the work, by reason it cuts not coming back.

The rough or coarse-toothed file (which, when large, is called a *rubber*) serves to take off the unevennesses of the work, left by the hammer in forging.

The bastard toothed file is to take out too deep cuts and file strokes made by the rough file. The fine-toothed file takes out the cuts or file-strokes the bastard file made; and the smooth file those left by the fine file.

In this order, the files of several cuts are to succeed each other till the work is as smooth as it can be filed. After which it may be made yet smoother with emery, tripoli, &c. See Polishing.

FILIPENDULA, Dropwort, a species of spiræa. See Spiræa, Botany *Index*.

FILIX, Fern. See Filices, Botany *Index*.

FILLAGREE, Filigree, or Filigrane, *Work*, a kind of enrichment on gold or silver, wrought delicately, in manner of little threads or grains, or both intermixed. The word is compounded of *fil* or *filum*, "thread," and *granum*, "grain." In Latin it is called *filatim elaboratum opus, argentum, aurum.*

There is no manufacture in any part of the world, that has been more admired and celebrated, than the fine gold and silver fillagree of Sumatra. And what renders it a matter of greater curiosity is the coarseness of the tools employed in the workmanship, and which, in the hands of an European, would not be thought sufficiently perfect for the most ordinary purposes.—They are rudely and inartificially formed, by the goldsmith (*pandi*) from any old iron he can pick up. When you engage one of them to execute a piece of work, his first request is usually for a piece of iron hoop, to make his wire-drawing instrument; an old hammer head, stuck in a block, serves for an anvil; and a pair of compasses is often composed of two old nails tied together at one end. The gold is melted in a piece of a *preeoo* or earthen rice-pot, or sometimes in a crucible of their own make, of ordinary clay. In general they use no bellows, but blow the fire with their mouths, through a joint of bamboo; and if the quantity of metal to be melted is considerable, three or four persons sit round their furnace, which is an old broken quallee or iron pot, and blow together. At Padang alone, where the manufacture is more considerable, they have adopted the Chinese bellows. Their method of drawing the wire differs but little from that used by European workmen. When drawn to a sufficient fineness, they flatten it by beating it on their anvil; and when flattened, they give it a twist like that in the whalebone handle of a punch ladle, by rubbing it on a block of wood with a flat stick. After twisting they again beat it on the anvil, and by these means it becomes flat wire with indented edges. With a pair of nippers they fold down the end of the wire, and thus form a leaf, or element of a flower in their work, which is cut off. The end is again folded and cut off, till they have got a sufficient number of leaves, which are laid on singly. Patterns of the flowers or foliage, in which there is not very much variety, are prepared on paper, of the size of the gold plate on which the filagree is to be laid. According to this, they begin to dispose on the plate the larger compartments of the foliage, for which they use plain flat wire of a larger size, and fill them up with the leaves before mentioned: To fix the work, they employ a gelatinous substance, made of the red-hot berry called *boca sago*, ground to a pulp on a rough stone. This pulp they place on a

*Marsden's Account of Sumatra*, p. 141.

young cocoa nut about the size of a walnut, the top and bottom being cut off. After the leaves have been all placed in order, and stuck on, bit by bit, a solder is prepared of gold filings and borax, moistened with water, which they strew over the plate; and then putting it in the fire for a short time, the whole becomes united. This kind of work on a gold plate, they call *carrang papan*: when the work is open, they call it *carrang trouse*. In executing the latter, the foliage is laid out on a card, or soft kind of wood, and stuck on, as before described, with the sago berry; and the work, when finished, being strewed over with their solder, is put into the fire, when the card or soft wood burning away, the gold remains connected. If the piece be large, they solder it at several times. In the manufacture of badjoo buttons, they first make the lower part flat, and having a mould formed of a piece of buffalo's horn, indented to several sizes, each like one half of a bullet mould, they lay their work over one of these holes, and with a horn punch they press it into the form of the button. After this they complete the upper part. When the filagree is finished, they cleanse it, by boiling it in water with common salt and alum, or sometimes lime juice; and in order to give it that fine purple colour which they call *sapo*, they boil it in water with brimstone. The manner of making the little balls with which their works are sometimes ornamented, is as follows: They take a piece of charcoal, and having cut it flat and smooth, they make in it a small hole, which they fill with gold dust, and this melted in the fire becomes a little ball. They are very inexpert at finishing and polishing the plain parts, hinges, screws, and the like, being in this as much excelled by the European artists, as these fall short of them in the fineness and minuteness of the foliage. The Chinese also make fillagree mostly of silver, which looks elegant, but wants likewise the extraordinary delicacy of the Malay work. The price of the workmanship depends upon the difficulty or uncommonness of the pattern. In some articles of usual demand, it does not exceed one-third of the value of the gold; but in matters of fancy, it is generally equal to it.

**FILLET**, or **Filet**, in *Architecture*, denotes a little square member or ornament used in divers places, and on divers occasions, but generally as a sort of corona over a greater moulding.

The fillet is the same with what the French call *reglet*, *bande*, and *bandelette*; the Italians *lista* or *listella*.

**Fillet**, in *Heraldry*, a kind of orle or bordure, containing only a third or fourth part of the breadth of the common bordure. It is supposed to be withdrawn inwards, and is of a different colour from the field. It runs quite round, near the edge, as a lace over a cloak.

**Fillet** is also used for an ordinary drawn like the bar from the sinister point of the chief across the shield, in manner of a scarf; though it is sometimes also seen in the situation of a bend, fesse, cross, &c.

According to Guillim, the fillet is a fourth part of the chief, and is placed in the chief point of the escutcheon.

**Fillet** is also used among painters, gilders, &c. for a little rule or reglet of leaf gold, drawn over certain mouldings; or on the edges of frames, pannels, &c. especially when painted white, by way of enrichment.

**Fillets**, in the *Manege*, are the loins of a horse, which begin at the place where the hinder part of the saddle rests.

**FILLY**, a term among horse-dealers, to denote the female colt.

**FILM**, a thin skin or pellicle. In plants, it is used for that thin, woody skin, which separates the seeds in the pods, and keeps them apart.

**FILTER**, or **Filtre**, in *Chemistry*, &c. a piece of woollen cloth, linen, paper, or other matter, some of which are in the form of hollow inverted cones, used to filtrate or strain liquors through. The filtre has the same use and effect with regard to liquids that the sieve or searce has in dry matters.

Filtres are of two sorts. The first are simple pieces of paper or cloth, through which the liquor is passed without farther trouble. The second are twisted up like a skain or wick, and first wetted, then squeezed, and one end put in the vessel that contains the liquor to be filtrated: the other end is to be out, and hang down below the surface of the liquor; by means hereof the purest part of the liquor distils drop by drop out of the vessel, leaving the coarser part behind. This filter acts as a syphon.

Water is freed from various impurities by means of basins made of porous stones, which vessels must be peculiarly beneficial in long voyages, and even upon land they are of considerable benefit, when none but stagnant waters are to be found, or springs issuing through clay.

A patent was granted in 1790 to a female potter, for inventing a composition to make filtering basins, as a succedaneum for that porous stone which is not every where to be found. She took four out of nine equal parts of tobacco pipe-clay, and five out of nine equal parts of sea, river, or pit sand, which she used for making small basins sufficient to contain one gallon of water. Her next proportions were equal parts of sea, river, or pit sand, and tobacco-pipe clay; her third proportions were three out of nine equal parts of tobacco-pipe clay; one out of nine equal parts of Stourbridge clay, or one out of nine equal parts of Windsor or other loam: and her fourth proportions were four out of eight equal parts of the burnt ground clay of which crucibles are made.

A patent was also granted to Mr Joshua Collier of Southwark, for a most ingenious method of filtering and sweetening water, oil, and every other liquid. The following is the contrivance, which combines the application of machinery with the antiseptic properties of charcoal.

Fish oil is one of the liquids which he had particularly in view, to free it from every thing disagreeable, either in taste, smell, or colour; to accomplish which he poured a quantity of oil into a convenient vessel, heated to the temperature of 120° of Fahrenheit's thermometer, adding caustic mineral alkali of the specific gravity of 1.25. He then agitated the mixture, afterwards allowing it to stand till the sediment subsided; and then drew it off into another vessel, with a sufficient quantity of burnt charcoal finely powdered, and a small quantity of diluted sulphuric acid, to decompose the saponaceous matter still suspended in the oil, when the oil became

came clear at the surface. He then agitated the contents of this vessel, and left the coaly, saline, and aqueous particles to subside; afterwards passing it through proper strainers, when it became quite transparent and fit for use.

The principle of the improved filtering machines consists in combining hydrostatic pressure with the mode of filtering *per ascensum*, which procures the peculiar advantage of causing the fluid and its sediment take opposite directions. The filtering surface remains the same, while the dimensions of the chamber in which the sediment is received may be varied. To adapt the machines to every purpose for which they are intended, chambers must be provided of various capacities, for the precipitated matter. The space required is very great with respect to the oil trade, and as all dimensions will be required occasionally, no particular limits can be fixed. For distilleries and breweries they may be smaller in proportion; and a very small chamber will be sufficient for domestic economy. If water is to be freed from noxious particles, it must be made to pass through an iron box in its way to the filtering chamber, and the box must contain charcoal finely powdered. The water is received into this box and delivered by two apertures, which are opened and closed by cocks.

Another part of the invention consists in filtering machines in the form of stills, in which charcoal may be repeatedly burnt after any fluid substances have passed through it, for the purpose of freeing them from noxious particles, or discharging their colouring matter.

To the filtering apparatus of Mr Collier, instruments are attached for discovering the comparative qualities of oils, which depend in some measure on their specific gravities; spermaceti oil, when compared with fish oils being as 875 to 920. To do this, a glass vessel of any shape most convenient is employed, with a glass bubble, and a thermometer. If the oil is pure, the bubble sinks, when the mercury rises to a particular standard. When spermaceti oil is pure, the bubble floats, though of the temperature required.

To determine the tendency of oils used for burning to congeal in cold weather, a freezing mixture may be put into a phial of thin glass, into which let a thermometer be immersed, and a single drop of the oil permitted to fall on the outside of the vessel, where it will instantly congeal. As the cold produced by the mixture decreases, let the temperature be observed by the thermometer at which the oil becomes fluid, and runs down the side of the glass.

Plate CCXVII. fig. 1.

The following is a short description of the apparatus contrived for this purpose. A (fig. 1. Plate CCXVII.) is the cistern, into which the water or other liquor to be filtered is put. B B, is a tube opening into the bottom of the cistern A, and being put along the bottom of the machine, conveying the fluid into C C C, the filtering chamber, which is covered with leather bound down round its circular rim, and through which leather the water is percolated. DD, The bason rising above the level of the chamber, and receiving the filtered liquor. E, The spout by which it runs off into a pitcher or other vessel. F, Another spout furnished with a cock to draw off the foul water from the chamber when necessary. G G G, The air tube, which begins above the level of the chamber, is covered with a button, which saves the leather from being cut, and has a small lateral aperture for the air to be carried off. This pipe passes along the bottom and up the side, and rising above the level of the water in the cistern, is there closed, except a small lateral aperture through which the air escapes. H, A guard or rim with cross bars put over the leather, to keep it from being forced up by the water. It is fastened down by means of two notches on opposite sides of the ground, by which it locks into two staples rivetted into the bottom of the bason. I, The lid sliding down to cover the water from dust, and suspended at pleasure by means of K K, two springs on each tube for that purpose. L M N O, A cylindrical box containing charcoal, which is connected with the above by means of the tube P, and a continuation of the tube B. LM, The water tube B continued below the charcoal apparatus, so that the fluid may pass through the same into the cylinder, from whence it enters the chambers at P, so as to be filtered through the leather as before described. R R, Collars which may be unscrewed at pleasure, so as to detach the charcoal apparatus whenever the charcoal requires to be purified by heat. S S, Two cocks to direct the fluid through the charcoal cylinder or immediately into the filtering chamber.

Fig. 2.

Fig. 2. A, A tub or cistern containing the oil to be filtered, and supplying a tube of sufficient height for the hydrostatic pressure to operate. B B, A main tube of wood, tin, leather, or cloth, to which any number of bags, C C, of the size and shape of corn sacks, or any convenient size or shape, may be connected. These are bound to D D D, straight double iron bars, furnished with a hinge at one end and a screw at the other, by opening which the bags may be emptied. F, A trough underneath, made to receive the filtered oil from the receivers E E E.

Fig. 3.

Fig. 3. A, A funnel, cask, or cistern into which the fluid is put which passes down. B, A tube fitted into the same through which it enters. C, An iron still, or still of any other substance capable of sustaining heat, full of finely powdered and sifted charcoal, through the head of which the fluid passes into any receiver. D, A fire-place of any construction to drive over the fluid remaining interspersed among the charcoal, and also to purify the charcoal by an increase of temperature when required. E, A cock to let water into the flues to cool the apparatus for a subsequent operation.

Fig. 4. The trial glass with its thermometer.

Fig. 4.

FILTER is also a charm, supposed to have a virtue of inspiring love. The word is derived from φιλτρον, which signifies the same thing, of φιλεω, *amo*, "I love."

The Greeks, when their love was without success, had several arts to procure the affections of their beloved. The Thessalian women were famous for their skill in this as well as other magical practices. The means whereby it was effected were of divers sorts; it was sometimes done by potions called φιλτρα, which are frequently mentioned in authors of both languages. Juvenal speaks thus:

> *Hic magicus affert cantus, hic Thessala vendit*
> Philtra, *quibus valeant mentem vexare mariti.*

Their operations were violent and dangerous, and commonly deprived such as drank them of their reason. Plutarch

## FILTERING APPARATUS

*Fig. 1.*

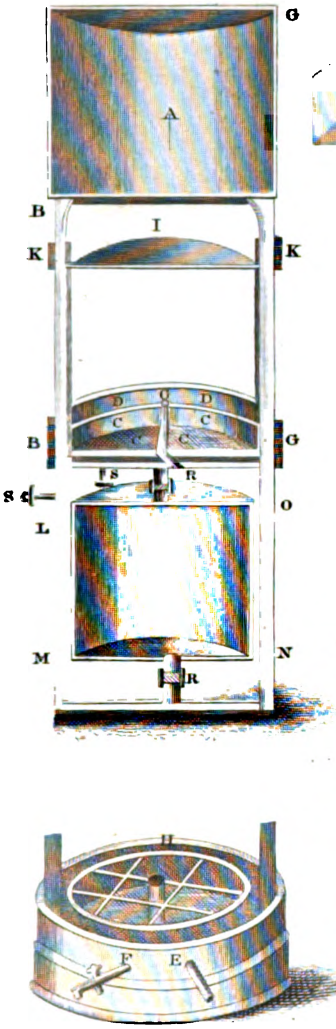


*Fig. 2.*

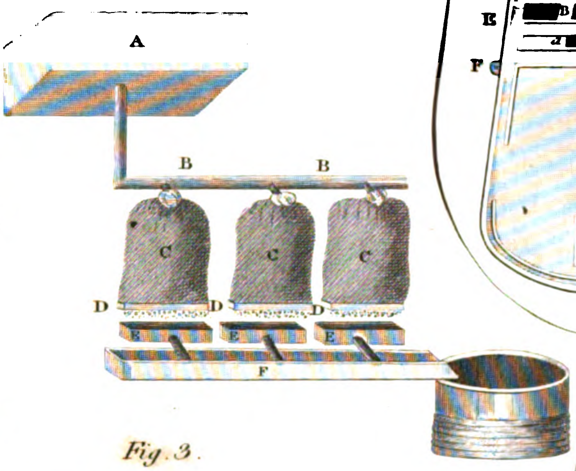


*Fig. 3.*

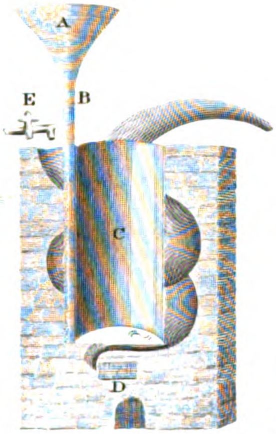
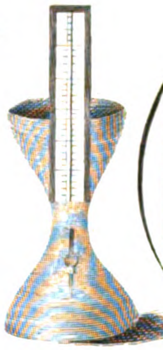


*Fig. 4.*



## FIRE PLACE

*Fig. 1.*

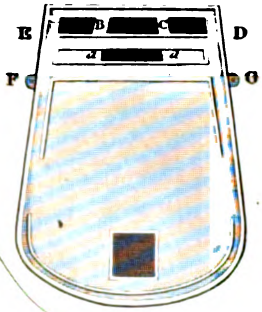


*Fig. 2.*

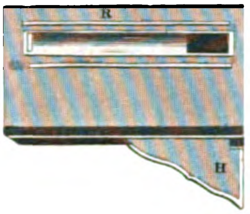


*Fig. 3.*

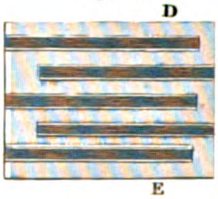


*Fig. 4.*

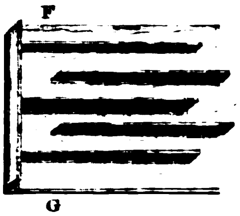
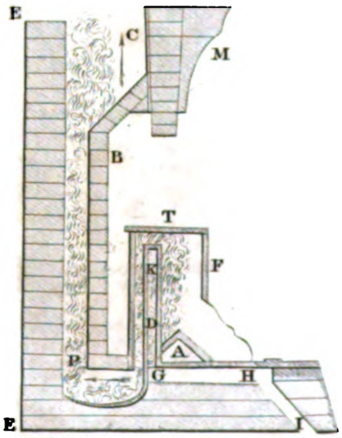
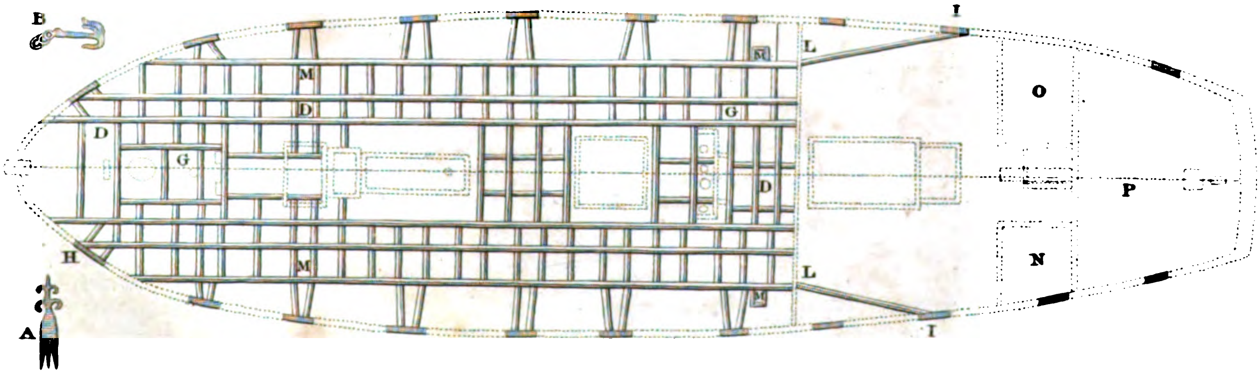


*Fig. 5.*

*Fig. 6.*



## FIRE SHIP



E. Mitchell sculp!

Plutarch and Cornelius Nepos report that Lucullus the Roman general first lost his reason, and afterwards his life, by one of them. Lucretius the poet ended his life by the same way; and Caius Caligula, as Suetonius reports, was driven into a fit of madness by a filter given him by his wife Cæsonia, which story is mentioned by the same poet. Ovid likewise assures us, that this was the usual effect of such potions.

The ingredients they were made of were of various sorts; several of which applied by themselves were thought effectual.

**FILTRATION**, the act of passing any liquor through a filter, called also *colature*, *percolation*, and *transcolation*. See Filter.

**FIMBRIÆ**, *Fringes*. The extremities or borders of the tubæ Fallopianæ were formerly so called; the word signifying a *fringed border*, which that part resembles.

**FIMBRIATED**, in *Heraldry*, an ordinary with a narrow border or hem of another tincture.

**FIN**, in *Natural History*, a well known part of fishes, consisting of a membrane supported by rays, or little bony or cartilaginous ossicles.

The office of the fins has commonly been supposed to be analogous to that of feathers in fowls; and to assist the fish in its progressive motion, or swimming; but the later naturalists find this a mistake.

The tail is the great instrument of swimming: the fins only serve to keep the fish upright, and prevent vacillation or wavering. See Ichthyology *Index*.

**FINAL**, in general, whatever terminates or concludes a thing; as *final* judgment, *final* sentence, &c.

*Final Cause*, is the end for which the thing is done. The final cause is the first thing in the intention of a person who does a thing; and the last in the execution. See Cause.

*Final Letters*, among the Hebrew grammarians, five letters so called, because they have a different figure at the end of words from what they have in any other situation.

**Final**, in *Geography*, a port town of Italy, subject to Genoa, and situated on the Mediterranean, about 37 miles south-west of that city. It was sold to the Genoese in 1713, by the emperor Charles VI.— E. Long. 9. 12. N. Lat. 44. 30.

**FINANCES**, in political economy, denote the revenues of a king or state: analogous to the treasury or exchequer of the English, and the fiscus of the Romans. The word is derived from the German *finantz*, " scraping, usury." Though Du Cange chooses rather to deduce it from the barbarous Latin *financia*, *pres-atio pecuniaria*.

*Council of the Finances*, under the former French overnment, corresponds to our lords commissioners of he treasury; the comptroller general of the *finances*, o our lord high treasurer, &c.

The French had a peculiar kind of figures, or nuerical characters, which they call *chiffre de finance*.

**FINCH-kind**, in *Ornithology*, a genus of birds nown by the name of Fringilla. See Fringilla, rnithology *Index*.

**Finch**, *Heneage*, earl of Nottingham, the son of r Heneage Finch, some time recorder of London, d of a younger branch of the Winchelsea family, was rn in 1621. By his good parts and diligence, he became a noted proficient in the municipal laws; was made solicitor general by Charles II. on his restoration, and was very active in the prosecution of the regicides. In 1670 he was appointed attorney general; about three years after, lord keeper of the great seal, on the removal of the earl of Shaftesbury; and lord chancellor in 1675. He was created earl of Nottingham in 1681; and died in the year following, being quite worn out by the fatigues of business. He published several speeches on the trials of the judges of King Charles I. with some few other things; and left behind him Chancery Reports in MS.

**FINE**, that which is pure and without mixture. The term is particularly used in speaking of gold or silver.

**Fine**, in *Law*, hath divers applications. Sometimes it is used for a formal conveyance of lands or tenements, or of any thing inheritable, being *in esse temporis finis*, in order to cut off all controversies. Others define it to be a final agreement between persons, concerning any lands or rents, &c. of which any suit or writ is depending between them in any court.

**Fine**, sometimes signifies a sum of money paid for entering lands or tenements let by lease; and sometimes a pecuniary mulct for an offence committed against the king and his laws, or against the lord of the manor.

*Blackst. Comment.*

*Fines for Alienation*, in *Feodal Law*. One of the attendants or consequences of tenure by vassalship, *Knight-Service*, was that of fines due to the lord for every alienation, whenever the tenant had occasion to make over his land to another. This depended on the nature of the feodal connection; it not being reasonable, nor allowed, that a feudatory should transfer his lord's gift to another, and substitute a new tenant to do the service in his own stead, without the consent of the lord: and, as the feodal obligation was considered as reciprocal, the lord also could not alienate his seignory without the consent of his tenant, which consent of his was called an *attornment*. The restraint upon the lord soon wore away; that upon the tenant continued longer. For when every thing came in process of time to be bought and sold, the lords would not grant a license to their tenants to aliene, without a fine being paid; apprehending that, if it was reasonable for the heir to pay a fine or relief on the renovation of his paternal estate, it was much more reasonable that a stranger should make the same acknowledgment on his admission to a newly purchased feud. In England, these fines seem only to have been exacted from the king's tenants *in capite*, who were never able to aliene without a license: but as to common persons, they were at liberty by *magna charta*, and the statute of *quia emptores* (if not earlier), to alienate the whole of their estate, to be holden of the same lord as they themselves held it of before. But the king's tenants *in capite*, not being included under the general words of these statutes, could not aliene without a license: for if they did, it was in ancient strictness an absolute forfeiture of the land; though some have imagined otherwise. But this severity was mitigated by the statute 1 Edw. III. c. 12. which ordained, that in such case the lands should not be forfeited, but a reasonable fine be paid to the king. Upon one statute it was settled, that one-third of the yearly value should be paid

Fines || Fingal.

paid for a license of alienation; but, if the tenant presumed to aliene without a license, a full year's value should be paid. These fines were at last totally taken away by statute 12 Car. II. c. 24. See *Knight-Service*.

*Fine-Drawing*, or *Rentering*, a dexterous sewing-up or rejoining the parts of any cloth, stuff, or the like, torn or rent in the dressing, wearing, &c.

It is prohibited to *fine-draw* pieces of foreign manufacture upon these of our own, as has formerly been practised. Jee Rentering.

*Fine-Stiller*, in the distillery. That branch of the art which is employed on the distilling the spirit from treacle or other preparations or recrements of sugar, is called *fine-stilling*, by way of distinction from malt-stilling; and the person who exercises this part of the trade is called a *fine-stiller*.

The operation in procuring the spirit from sugar is the same with that used in making the malt spirit; a wash of the saccharine matter being made with water from treacle, &c. and fermented with yeast. It is usual to add in this case, however, a considerable portion of malt, and sometimes powdered jalap, to the fermenting backs. The malt accelerates the fermentation, and makes the spirit come out the cheaper, and the jalap prevents the rise of any musty head on the surface of the fermenting liquor, so as to leave a greater opportunity for the free access of the air, and thus to shorten the work, by turning the foamy into a hissing fermentation.

FINERS *of* Gold *and* Silver, are those who purify and part those metals from other coarser ones by fire and acids. They are also called *parters* in our old law books, and sometimes *departers*.

FINERY, in the iron works, is one of the two forges at which they hammer the sow or pig iron.

Into the finery they first put the pigs of iron, placing three or four of them together behind the fire, with a little of one end thrust into it; where, softening by degrees, they stir and work them with long bars of iron, and expose at different times different parts to the blast of the bellows, in order to refine it as equally as possible, till the metal runs together with a round mass or lump, which they call a *half bloom*. They then take this out, and give it a few strokes with their sledges; afterwards they carry it to a great heavy hammer, raised by the motion of a water wheel; where, applying it dexterously to the blows, they presently beat it out into a thick short square. This they put into the finery again, and heating it red hot, they work it under the same hammer till it comes to be in the shape of a bar in the middle, but with two square knobs at the ends, which they call an *ancony*. It is then carried into the other forge called the *chaffry*.

FINEERING. See Veneering.

FINESSE, a French term, of late current in English. Literally, it is of no farther import than our English *fineness;* but among us it is chiefly used to denote that peculiar delicacy or subtility perceived in works of the mind, and the nicest and most secret and sublime parts of any science or art.

It is sometimes used to express that kind of subtility made use for the purposes of deception.

FINGAL, king of Morven, in ancient Caledonia. He flourished in the third century: and according to the Irish histories died in the year 283, although there is some reason from Ossian's poems for placing his death a few years later. Fingal was descended in all probability from those Celtic tribes who were the first inhabitants of Britain. Tradition, and the poems of Ossian, give him a long line of royal ancestors, such as Combal, Trenmor, Trathal, &c. who had all reigned over the same territory. Whether this territory was bounded by the Caledonian forest, or extended somewhat farther to the south, towards the Roman province, is uncertain; but there is no doubt of its having extended over all the north and west Highlands, comprehending the Hebrides, whose petty chiefs were all subject to the king of Morven. His principal place of residence was Selma, which was probably in the neighbourhood of Glenco, supposed to be the Cona of Ossian; though some imagine it to have been in Strath-Conan in Moray. The truth seems to be, that as Fingal and his people lived by hunting, they often shifted their habitations. Hence, in all parts of the Highlands we find, in the names of places, buildings, &c. such monuments as justify their several claims for the honour of Fingal's residence. Fingal acquired great fame by his prowess in arms. He made many successful incursions into the Roman province, from whence he carried away those spoils which his son so often mentions under the names of the *wine of the stranger*, and the *wax of the stranger*. By sea we find him frequently making voyages to Scandinavia, the Orkneys, and Ireland; called by Ossian *Lochlin*, *Innistore* and *Ullin*. Several of these expeditions were celebrated by his son in epic poems, of which two only remain, Fingal and Temora. In the last of these poems, we find Fingal fighting together with his grandson Oscar. How long he lived afterwards is uncertain. He is said to have died a natural death; and therefore none of his son's poems relate to this event, though it is occasionally mentioned in many of them. "Did thy beauty last, O Ryno? Stood the strength of car-borne Oscar? Fingal himself passed away; and the halls of his fathers have forgot his steps. The blast of the north opens thy gates, O king, and I behold thee sitting on mist, dimly gleaming in all thine arms. Thy form now is not the terror of the valiant; but like a watery cloud, when we see the stars behind it, with their weeping eyes. Thy shield is like the aged moon; thy sword, vapour half kindled with fire. Dim and feeble is the chief who travelled in brightness before. But thy steps are on the winds of the desert, and the storms darken in thy hand. Thou takest the sun in thy wrath, and hidest him in thy clouds. The sons of little men are afraid, and a thousand showers descend."—*Berrathon.*

"The character of Fingal (Dr Blair observes) is perhaps the most perfect that ever was drawn by a poet, for we may boldly defy all the writers of antiquity to show us any hero equal to Fingal. Throughout the whole of Ossian's works, he is presented to us in all that variety of lights which give the full display of a character. In him concur almost all the qualities that can ennoble human nature; that can either make us admire the hero, or love the man. He is not only unconquerable in war, but he makes his people happy by his wisdom in the days of peace. He is truly the father of his people. He is known by the epithet of

'Fingal of the mildest look,' and distinguished on every occasion by humanity and generosity. He is merciful to his foes, full of affection to his children, full of concern about his friends, and never mentions Agandecca, his first love, without the utmost tenderness. He is the universal protector of the distressed; none ever went sad from Fingal.—'O Oscar! bend the strong in arms, but spare the feeble hand. Be thou a stream of many tides against the foes of thy people; but like the gale that moves the grass to those who ask thine aid: so Trenmor lived; such Trathal was; and such has Fingal been. My arm was the support of the injured; the weak rested behind the lightning of my steel.' These were the maxims of true heroism to which he formed his grandson. His fame is represented as everywhere spread; the greatest heroes acknowledge his superiority; his enemies tremble at his name; and the highest encomiums that can be bestowed on one whom the poet would most exalt, is to say, That his soul was like the soul of Fingal. Wherever he appears, we behold the hero. The objects he pursues are always great; to bend the proud, to protect the injured, to defend his friends, to overcome his enemies by generosity more than by force. Some strokes of human imperfection and frailty are what usually give us the most clear view and the most sensible impression of a character, because they present to us a man such as we have seen; they recall known features of human nature. When poets go beyond this range, and attempt to describe a faultless hero, they, for the most part, set before us a sort of vague undistinguishable character, such as the imagination cannot lay hold of, or realize to itself as the object of affection. But Fingal, though exhibited without any of the common human failings, is nevertheless a real man; a character which touches and interests every reader."

We may observe, that Fingal appears to have been no less a poet than a warrior; at least, in all those passages ascribed to him in the poems of his son, there is a grandeur and loftiness that elevates them above the common style even of Ossian. The following passage from the poem of *Carthon* may be taken as a specimen of Fingal's poetry.—'Raise, ye bards,' said the mighty Fingal, 'the praise of the unhappy Moina. Call her ghost, with your songs, to our hills; that she may rest with the fair of Morven, the sunbeams of other days, and the delight of the heroes of old.—I have seen the walls of Balclutha, but they were desolate. The fire had resounded in the halls; and the voice of the people is heard no more. The stream of Clutha was removed from its place by the fall of the walls. The thistle shook, there, its lonely head: the moss whistled to the wind. The fox looked out from the windows; the rank grass of the wall waved round his head. Desolate is the dwelling of Moina: silence is in the house of her fathers. Raise the song of mourning, O bards, over the land of strangers. They have but fallen before us; for, one day we must fall.—Why dost thou build the hall, son of the winged days? Thou lookest from thy towers to-day; yet a few years, and the blast of the desert comes; it howls in thy empty court, and whistles round thy half-worn shield.—And let the blast of the desert come! We shall be renowned in our day. The mark of my arm shall be in the battle, and my name in the song of bards. Raise the song; send round the shell: and let joy be heard in my hall. When thou, sun of heaven, shalt fail! if thou shalt fail, thou mighty light! if thy brightness is for a season, like Fingal; our fame shall survive thy beams.'—Such was the joy of Fingal in the day of his joy. His thousand bards leaned forward from their seats, to hear the voice of the king. It was like the music of the harp on the gale of the spring. Lovely were thy thoughts, O Fingal! Why had not Ossian the strength of thy soul? But thou standest alone, my father; and who can equal the king of Morven?" See OSSIAN.

FINGERS, in *Anatomy*, the extreme part of the hand, divided into five members. See ANATOMY, N° 56.

FINING *of* LIQUORS. See CLARIFICATION.

FINISTERRE, the most westerly cape or promontory of Spain, in 10. 15. W. Long, and 43. N. Lat. This cape is likewise the most westerly part of the continent of Europe.

FINITE, something bounded or limited, in contradistinction to INFINITE.

FINLAND, the duchy of, is bounded on the west by the gulf of Bothnia, on the east by Russia, on the south by the gulf of Finland and Ingria, and on the north by Bothnia and Lapland. It is about 200 miles in length, and almost as much in breadth. It contains many lakes; on which are several islands, which are generally rocks or inaccessible mountains. The inhabitants are small of stature, capable of enduring hardships, and good soldiers. The Russians conquered the Swedish part of Finland in 1808, and now possess the whole. The population of all Finland is about 1,100,100. The Fins speak a language of their own, quite different both from the Russian and the Swedish. As to religion, the Fins are in general Lutherans. The Russians have divided the country into 13 circles; the capital of the whole province is Abo. The climate of Finland is mild, compared with that of Northern Russia. It is an agreeable country, diversified with mountains, forests, lakes, meadows, and pleasant fields. The inhabitants salt the fish they do not consume themselves, and send it into foreign countries.

FINNINGIA, or FENNINIA, in *Ancient Geography*, the true reading for *Eningia* in Pliny, which he makes an island, but is more truly a peninsula. Now FINLAND, a province of Sweden. *Fenni*, or *Finni*, the people; whose ferocity was extraordinary, poverty extreme, herbs their food, skins their covering, and the ground their couch: regardless of man and of gods, they attained to a very difficult thing, not to have a single wish to form, (Tacitus).

FIR-TREE. See PINUS, BOTANY *Index*.

FIRE, in *Physiology*, signifies that subtile invisible substance by which bodies are expanded or enlarged in bulk, and become hot to the touch; fluids are rarefied into vapour; solid bodies become fluid, and in like manner are at last dissipated, or, if incapable of being carried off in vapour, are at length melted into glass. It seems likewise to be the chief agent in nature on which animal and vegetable life have an immediate dependence, and without which it does not appear that nature itself could subsist a single moment.

The disputes concerning fire, which for a long time

divided;

divided philosophers, have now in a great measure, though not wholly, subsided. The celebrated philosophers of the last century, Bacon, Boyle, and Newton, were of opinion that fire was no distinct substance from other bodies, but that it consisted entirely in the violent motion of the parts of any body. As no motion, however, can be produced without a cause, they were obliged to have recourse to a mechanical force or impulse as the ultimate cause of fire in all cases. Thus Boyle tells us, that "when a piece of iron becomes hot by hammering, there is *nothing* to make it so, except the forcible motion of the hammer impressing a vehement and variously determined agitation on the small parts of the iron." Bacon defines *heat*, which he makes synonymous with fire, to be "an expansive undulatory motion in the minute particles of a body, whereby they tend with some rapidity from a centre towards a circumference, and at the same time a little upwards." Sir Isaac Newton said nothing positive upon the subject; but conjectured that gross bodies and light might be convertible into one another; and that great bodies of the size of our earth, when violently heated, might continue and increase their heat by the mutual action and reaction of their parts.

But while the mechanical philosophers thus endeavoured to account for the phenomena of fire upon the same principles which they judged sufficient to explain those of the universe in general, the chemist as strenuously asserted that fire was a fluid of a certain kind, distinct from all others, and universally present throughout the whole globe. Boerhaave particularly maintained this doctrine; and in support of it brought the following argument, that steel and flint would strike fire, and produce the very same degree of heat in Nova Zembla, which they would do under the equator. Other arguments were drawn from the increased weight of metalline calces, which they supposed to proceed from the fixing of the element of fire in the substance whose weight was thus increased. By these experiments Mr Boyle himself seems to have been staggered; as he published a treatise on the possibility of making fire and flame ponderable; though this was directly contrary to his own principles already quoted. For a long time, however, the matter was most violently disputed; and the mechanical philosophers, though their arguments were equally inconclusive with those of their adversaries, at last prevailed through the prejudice in favour of Sir Isaac Newton, who indeed had scarce taken any active part in the contest.

That the cause of fire cannot be any mechanical motion which we can impress, is very evident; because on mechanical principles an effect must always be proportionable to the cause, In the case of fire, however, the effect is beyond all calculation greater than the cause, supposing the latter to be only a mechanical percussion, as in the case of hammering iron till it be red hot. By a few strokes of a hammer, the particles of a piece of iron, we shall allow, may be set in a violent motion, and thus produce fire. If, however, we direct the motion of these particles upon another body whose parts are at rest, and in some degree coherent, it is plain that the latter will resist and diminish that motion of the particles already moved, in proportion to their *vis inertiæ*, as well as the cohesion of the parts of the second body, if indeed we can suppose the *vis inertiæ* of matter to be different from the effect of gravitation, cohesion, or some other power acting upon it. By no argumentation whatever, then, can we show upon mechanical principles, why fire should have such a tendency to increase and multiply itself without end, as we see it has, even abstracting from all consideration of the necessity of air for continuing the action of fire.

The action of the air in augmenting and continuing the power of fire, seems scarce at all to have been considered by those who first undertook an investigation of the subject. It evidently gave rise to the Hutchinsonian hypothesis, that fire, light, and air, were convertible into one another. This, however, is equally untenable with the mechanical hypothesis; for later discoveries have shown, that our atmosphere is composed of two distinct fluids, only one of which is fit for supporting flame; and if we should suppose this to be the only proper air, it is in like manner demonstrated, that this pure fluid is not homogeneous, but composed of a gravitating and non-gravitating substance; the latter of which only has the properties of fire; so that this element is still as invisible as ever; nor can it be shown by any experiment that *fire per se* has ever been changed into a palpable or gravitating substance.

The experiments which first seemed to bring this dispute to a decision were those of Dr Black, concerning what he called *latent heat;* on which some other names, such as *absolute heat*, *specific fire*, &c. have been bestowed, very little to the advancement of science in general. From these discoveries it appears, that fire may exist in bodies in such a manner as not to discover itself in any other way than by its action upon the minute parts of the body; but that suddenly this action may be changed in such a manner as no longer to be directed upon the particles of the body itself, but upon external objects: in which case we then perceive its action by our sense of feeling, or discover it by the thermometer, and call it *sensible heat*. This expression, it must be owned, is improper; and the use of the word *heat*, instead of *fire*, has produced some confusion, which it is not now easy to avoid in speaking on these subjects. By the word *heat*, we ought always to understand the effect of fire, or the fluid acting in a certain manner, rather than the mere element itself, which, it is certain, from the experiments just mentioned, may exist in substances actually *cold* to the touch.

From this discovery made by Dr Black, along with many others in electricity, and recorded at length in various articles of this work, it is now almost universally allowed, that fire is a distinct fluid, capable of being transferred from one body to another. But when this was discovered, another question no less perplexing occurred, viz. what kind of fluid it was; or whether it bears any anology to those with which we are better acquainted? Here we find two fluids, viz. the solar light, and the electric matter, both of which occasionally act as fire, and which therefore seem likely to be all the same at bottom. By the vulgar, indeed, the matter has long ago been determined; and the rays of the sun, as well as the electrical fluid, have been promiscuously denominated *elementary fire*. Philosophers, indeed, have withheld their assent; though their

their reasons for so doing are by no means apparent. The most strange suppositions, however, have been made concerning the nature of both those fluids; and on the most slender grounds imaginable, or rather on no grounds at all, they have been supposed to be phlogiston itself, or to contain a large proportion of it. Mr Scheele went so far in this way as to form an hypothesis, which he endeavoured to support by some experiments, that fire is composed of dephlogisticated air and phlogiston. But it is now ascertained beyond all possibility of dispute, that the result of such a combination is not fire, but fixed air; so that we need not take any farther notice of this hypothesis than just to observe, that it would have been altogether untenable, even though this discovery had not been made; because the dephlogisticated air itself is not a simple but a compound substance, as has already been observed; and that in all cases of combustion the one part of the air is separated from the other.

It was long ago observed by Sir Isaac Newton, that heat was certainly conveyed by a medium more subtile than the common air; because two thermometers, one included in the vacuum of an air pump, the other placed in the open air, at an equal distance from the fire, would grow equally hot in near the same time. The consequence of this, had he pursued the thought, was, that fire itself was equally present in all places, and as active where there was no terrestrial matter as where there was. New improvements in the air pump have enabled succeeding philosophers to make more perfect vacuums, such as it has been supposed even the electric matter cannot pass through. It is not to be doubted, however, that, even there, the thermometer would be heated by a fire as well as in the open air. Fire, therefore, exists and acts where there is no other matter, and of consequence is a fluid *per se*, independent of every terrestrial substance, without being generated or compounded of any thing we are yet acquainted with. To determine the nature of the fluid, we have only to consider whether any other can be discovered which will pass through the perfect vacuum just mentioned, and act there as fire. Such a fluid we find in the solar light, which is well known to act even *in vacuo* as the most violent fire. The solar light will likewise act in the very same manner in the most intense cold; for M. de Saussure has found, that on the cold mountain top the sunbeams are equally, nay, more powerful, than on the plain below. It appears, therefore, that the solar light will produce heat independent of any other substance whatever; that is, where no other body is present, at least as far as we can judge, except the light itself and the body to be acted upon. We cannot therefore avoid concluding, that a certain modification of the light of the sun is the cause which produces heat, expansion, vapour, &c. and answers to the rest of the characters given in our definition of fire, and that independent of any other substance whatever.

For a further discussion of this subject, see Chemistry and Electricity *Index*.

*Wild Fire*, a kind of artificial or factitious fire, which burns even under water, and that with greater violence than out of it.

It is composed of sulphur, naphtha, pitch, gum, and bitumen; and is only extinguishable by vinegar mixed with sand and urine, or by raw hides. Its motion or tendency is said to be contrary to that of natural fire, and always follows the direction in which it is thrown; whether it be downwards, sidewise, or otherwise. The French call it *Greek fire*, or *feu Grequois*, because first used by the Greeks, about the year 660: as is observed by the Jesuit Petavius, on the authority of Nicetas, Theophanes, Cedrenus, &c.

The inventor, according to the same Jesuit, was an engineer of Heliopolis, in Syria, named *Callinicus*, who first applied it in the sea-fight commanded by Constantine Pogonates, against the Saracens, near Cyzicus, in the Hellespont; and with such effect, that he burnt the whole fleet therewith wherein were 30,000 men. But others will have it of a much older date, and hold Marcus Gracchus the inventor: which opinion is supported by several passages both in the Greek and Roman writers, which shows it to have been anciently used by both these nations in their wars.

Constantine's successors used it on divers occasions with equal advantage as himself: and what is remarkable enough is, that they were so happy as to keep the secret of the composition to themselves, so that no other nation knew it in the year 960.

Hugh king of Burgundy, demanding ships of the emperor Leo, for the siege of Fresne, desired likewise the Greek fire.

F. Daniel gives a good description of the Greek fire, in his account of the siege of Damietta under St Louis. Every body, says that author, was astonished with the Greek fire, which the Turks then prepared; and the secret whereof is now lost. They threw it out of a kind of mortar; and sometimes shot it with an odd sort of cross-bow, which was strongly bent by means of a handle or winch, of much greater force than the mere arm. That thrown with the mortar sometimes appeared in the air of the size of a tun, with a long tail, and a noise like that of thunder. The French by degrees got the secret of extinguishing it, in which they succeeded several times.

Ann. Reg. xviii. 117.

*Machine for preserving from Fire.* This machine consists of a pole, a rope, and a basket. The pole is of fir, or a common scaffold pole, of any convenient length from 36 to 46 feet; the diameter at bottom, or greatest end, about five inches; and at the top, or smallest end, about three inches. At three feet from the top is a mortoise through the pole, and a pulley fixed to it of nearly the same diameter with the pole in that part. The rope is about three quarters of an inch diameter, and twice the length of the pole, with a spring hook at one end, to pass through the ring in the handle of the basket when used: it is put through the mortise over the pulley, and then drawn tight on each side to near the bottom of the pole, and made fast there till wanted. The basket should be of strong wicker-work, three feet and a half long, two feet and a half wide, rounded off at the corner, and four feet deep, rounding every way at the bottom. To the top of the basket is fixed a strong iron curve or handle, with an eye or ring in the middle; and to one side of the basket, near the top, is fixed a small cord or guide-rope of about the length of the pole. When the pole is raised, and set against a house over the window from which any persons are to escape, the manner of using it is so plain and obvious, that it needs not be described. The most convenient distance from the house for the foot of the pole to stand, where practicable, is about 12 or 14 feet. If two strong iron straps, about three feet long, rivetted to a bar across and spreading about 14 inches at the foot, were fixed at the bottom of the pole, this would prevent its turning round or slipping on the pavement. And if a strong iron hoop, or ferrule, rivetted (or welded) to a semicircular piece of iron spreading about 12 inches, and pointed at the ends, were fixed on at the top of the pole, it would prevent its sliding against the wall.

When these two last mentioned irons are fixed on, they give the pole all the steadiness of a ladder; and because it is not easy, except to persons who have been used to it, to raise and set upright a pole of 40 feet or more in length, it will be convenient to have two small poles or spars of about two inches diameter, fixed to the sides of the great pole at about two or three feet above the middle of it, by iron eyes rivetted to two plates so as to turn every way; the lower end of these spars to reach within a foot of the bottom of the great pole, and to have ferrules and short spikes to prevent sliding on the pavement, when used occasionally to support the great pole like a tripod. There should be two strong ash trundles let through the pole, one at four feet and one at five feet from the bottom, to stand out about eight inches on each side, and to serve as handles, or to twist the rope round in lowering a very heavy weight. If a block and pulley were fixed at about the middle of the rope, above the other pulley, and the other part of the rope made to run double, it would diminish any weight in the basket nearly one half, and be very useful in drawing any person up, to the assistance of those in the chambers, or for removing any effects out of a chamber, which it might be dangerous to attempt by the stairs.

It has been proved by repeated trials, that such a pole as we have been speaking of can be raised from the ground, and two or three persons taken out of the upper windows of a house, and set down safely in the street, in the space of 35 seconds, or a little more than half a minute. Sick and infirm persons, women, children, and many others, who cannot make use of a ladder, may be safely and easily brought down from any of the windows of a house on fire by this machine, and, by putting a short pole through the handles of the basket, may be removed to any distance without being taken out of the basket. The pole must always have the rope ready fixed to it, and may be conveniently laid up upon two or three iron hooks under any shade or gateway, and the basket should be kept at the watch-house. When the pole is laid up, the two spars should always be turned towards the head of it. The basket should be made of peeled rods, and the pole and spars painted of a light stone colour, to render it more visible when used in the night.

*Machines for extinguishing* FIRE. In the year 1734, the state of Sweden offered a premium of 20,000 crowns for the best method of stopping the progress of accidental fires; when one Mr Fuches, a German physician, made a preparation for that end, and the experiment was made on a house built on purpose of dry fir, at Legard island. In the building were placed several tubs of tar and pitch, and a great quantity of chips, all which were set on fire; flames issuing through the top of the house, windows, &c. when he threw in one of the barrels containing the preparation, which immediately quenched the flames; a second barrel entirely cleared the smoke away; and the whole was executed to the satisfaction of the spectators, and to the no small satisfaction of the inventor, who was about to return home, when unexpectedly the flames broke out again, supposed to be occasioned by a small quantity of combustible matter being introduced and set on fire secretly by some malicious person. Upon this the wrong-headed mob fell upon Mr Fuches, and beat him most unmercifully, so that he narrowly escaped with his life. He soon after left the country, and never could be prevailed on (though strongly persuaded by some of the most eminent citizens) to return. It is said, another experiment of the same kind was tried in the year 1761 in Holland; but rendered abortive through the perverseness of the populace.

Attempts of a similar nature have met with a better reception in England. Of these the most successful was that of Mr Godfrey, whose contrivance is thus described by Mr Ambrose Godfrey, grandson to the inventor. "The machine to be employed consists of a small portion of gunpowder closely confined; which, when animated by fire, acts by its elastic force upon a proper medium, and not only divideth it into the minutest atoms, but disperseth it also in every direction, so as immediately to extinguish any fire within a certain distance. This medium is a liquor strongly impregnated with a preparation of antiphlogistic principles, which by their action upon burning materials extinguish the flames and reduce them in general to the state of a black coal; and, by its opposite nature to fire, hinders the remaining sparks, notwithstanding the admission of the air, from kindling the flames afresh. By this means, the great point is obtained, in giving sufficient time for totally extinguishing any remains of fire.

"They who presume that water only will perform this will find themselves greatly mistaken, as the draught of air will certainly rekindle the neighbouring materials, which are very fit to receive a fresh flame, the fire not being extinguished by the quantity of water, but rather by the expansion and rarefaction of its particles. There are several sizes of these machines, from five to fifty pounds weight, in a portable and rather small compass, and may generally be carried to any place where a man can go himself.

"But though these machines will prevent great fires by a timely application, they will not extinguish them after they have reached a frightful height, and several houses, perhaps near a whole street, are in flames. The floors must be standing, and access to the building safe, otherwise no person can be supposed to approach near enough to apply them in a proper manner. Every fire has its beginning for the most part in some apartment; and, as soon as discovered, the family, instead of losing all presence of mind, should immediately apply one or more of these machines, which will then fully answer the intention. The proper time of applying them, supposes that they are ready at hand. It will be in vain to think of fetching them from any considerable distance, as it will then be too late for them to perform any important service: except indeed being the probable means of saving some adjacent house, by extinguishing

tinguishing the flames as often as they break out, till the building first on fire is totally consumed, and, by falling into ruins, leaves the other in perfect safety."

On the 19th of May 1761, at noon, Mr Godfrey's experiment for extinguishing fire, was tried in a house erected for that purpose, near Mary-le-bone. Their royal highnesses, the duke of York, Prince William Henry, Prince Henry Frederick, a great number of persons of rank and distinction, and many of the learned world, gave their attendance on this singular occasion. The house, which was of brick, consisted of three rooms one above another, a staircase, chimney, lath and plaster ceilings, and a kind of wainscotting round the rooms, of rough deal. Exactly at 12 o'clock the ground room, and that up one pair of stairs, were set on fire by lighting the faggots and shavings laid in there for that purpose: in about 15 minutes the wainscot of the under room was thought to be sufficiently in flames, and three of the machines were thrown in; which, by almost immediate and sudden explosions, instantaneously extinguished the flames, and the very smoke in that apartment in a few minutes totally disappeared. By this time, the firemen, &c. who had the care of thowing in the machines, gave an alarm that the staircase had taken fire, and that it was necessary directly to go to work upon the next room; which was accordingly done, and with the same effect. The experiment, however, hitherto did not universally satisfy: in the last instance especially it was thought to be too hastily put in execution; and the populace without side the paling, who were supposed to amount to near 20,000, and whose curiosity, from the very nature of their situation, remained much dissatisfied, began to grow rather riotous, and talked of a second bottle conjuror. For the sake of the experiment, therefore, and to remove all manner of doubt, Mr Godfrey consented to a third experiment in the upper room, which was entirely of wood. The flames were now suffered to get to a considerable height, and even the window frames destroyed, before the machines were thrown in: which, however, answered exactly as the former had done; and, being quite in sight of the outstanders, met with universal approbation.

These machines of Mr Godfrey's, it is evident, would be of great use in extinguishing fires on shipboard; and might be considered as a no less necessary part of a ship's lading, than her stores or ammunition.

The hint of these machines is said to have been taken by Mr Godfrey from the invention of one Zachary Greyl, who exhibited machines similar to those of Mr Godfrey, before persons of the first rank, but without meeting with any encouragement. His machines were made of wood, and the liquor employed was only water, and consequently inferior to Mr Godfrey's in its power of extinguishing fire. The latter is said to have mixed his water with a certain quantity of oil of vitriol, or with sal ammoniac. These machines, however, as already observed, are found to be only serviceable in the beginning of a fire. When the roof had fallen in, they had no effect.

*Composition for extinguishing* FIRE. For this purpose the following has been invented by M. Von Aken, of which the account is taken from *Nicholson's Journal*, vol. ii. 4to.

| | |
|---|---|
| Burnt alum | 30 lbs. |
| Green vitriol powdered | 40 |
| Cinabrese or red ochre in powder | 20 |
| Potter's clay, or other clay, also powdered | 200 |
| Water | 630 |

With 40 measures of this mixture an artificial fire was extinguished under the direction of the inventor by three persons, which would have required the labour of 20 men and 1500 measures of common water. Sig. Fabbroni was commissioned to examine the value of this invention, and found in his comparative trials with engines of equal power, worked by the same number of men, that the mixture extinguished the materials in combustion in one-sixth part less time, and three-eighths less of fluid, than when common water was used. He observed, as might indeed have been imagined from the nature of the material, that the flame disappeared wherever the mixture fell, and that the saline, metallic, and earthy matters formed an impenetrable lute round the hot combustible matter, which prevented the access of the air, and consequently the renewal of the destructive process.

It is scarcely probable that this practice in the large way, with an engine throwing upwards of 200 gallons (value about 3l. 10s.) each minute, would be thought of or adopted, or that a sufficient store of the materials would be kept in readiness; since at this rate the expenditure for an hour would demand a provision to the amount of 210l. sterling. But in country places the process, or some variation of it, might be applied with sufficient profit in the result; more especially if it be considered that common salt or alum, or such saline matter as can be had and mixed with the water, together with clay, chalk, or lime, ochreous earth or common mud, or even these last without any salt, may answer the purpose of the lute with more or less effect, and extinguish an accidental fire with much greater speed and certainty than clear water would do.

*Water-Engine for extinguishing* FIRE. See HYDROSTATICS.

In using this machine we have the following improvement by Dr Hoffman, which promises to be of great efficacy. As soon as the engine is in readiness to work, stir into the water that immediately is to be discharged, seven or eight pounds of pearl ashes in powder, and continue to add it in this manner as occasion requires; taking care that it be directed against the timber or wainscot, &c. just beginning to burn, and not wasted against the brick-work; or, where time will admit, dissolve any quantity of pearl ashes in a copper with water, and as fast as it dissolves, which will be in few minutes, mix a pailful with the water in the engine, pretty often; and whatever burning wood it is played upon, will be extinguished as if it was dipped in water, and will not burn afresh in the part extinguished.

*Easy method of Extinguishing* FIRE *in Chimneys*. It is well known, that the inner parts of chimneys easily take fire; the soot that kindles therein emits a greater flame, according as the tunnel is more elevated, because the inferior air feeds the fire. If this air could therefore be suppressed, the fire would soon be extinguished. In order to this, some discharge a pistol into the chimney, which produces no effect; others lay under

under the chimney a copper full of water; but the vapours that rise from it, far from extinguishing the fire, seem to give it new force. Water thrown into the chimney at top is equally of no effect, because it comes down through the middle of the tunnel, and not along the sides. It would be more adviseable to stop with dung the upper orifices of the tunnel for quenching the fire. But the surest and readiest method is, to take a little gunpowder, and having humected it with spittle for binding it, to form it into small masses, and so throw it into the heart of the chimney. When it is burnt, and has produced a considerable vapour, a second, afterwards a third, are thrown, and so on, as much as is necessary. In a little time the fire is extinguished, and, as it were, choked by this vapour; and cakes of inflamed soot are seen to fall from the tunnel, till at last not the least vestige of fire appears.

*Securing buildings against* FIRE. Dr Hales proposes to check the progress of fires by covering the floors of the adjoining houses with earth. The proposal is founded on an experiment which he made with a fir board half an inch thick, part of which he covered with an inch depth of damp garden mould, and then lighted a fire on the surface of the mould; though the fire was kept up by blowing, it was two hours before the board was burnt through, and the earth prevented it from flaming. The thicker the earth is laid on the floors, the better; however, Dr Hales apprehends that the depth of an inch will generally be sufficient; and he recommends to lay a deeper covering on the stairs, because the fire commonly ascends by them with the greatest velocity.

Mr Hartley made several trials in the years 1775 and 1776, in order to evince the efficacy of a method which he had invented for restraining the spread of fire in buildings. For this purpose thin iron plates are well nailed to the tops of the joists, &c. the edges of the sides and ends being lapped over, folded together, and hammered close. Partitions, stairs, and floors, may be defended in the same manner; and plates applied to one side have been found sufficient. The plates are so thin as not to prevent the floor from being nailed on the joists, in the same manner as if this preventive were not used: they are kept from rust by being painted or varnished with oil and turpentine. The expence of this addition, when extending through a whole building, is estimated at about five per cent. Mr Hartley has a patent for this invention, and parliament has voted a sum of money towards defraying the expence of his numerous experiments. The same preservative may also be applied to ships, furniture, &c.

Lord Mahon has also discovered and published a very simple and effectual method of securing every kind of building against all danger of fire. This method he has divided into three parts, viz. under-flooring, extra-lathing, and inter-securing.

The method of under-flooring, is either single or double. In single under-flooring, a common strong lath of oak or fir, about one-fourth of an inch thick, should be nailed against each side of every joist, and of every main timber, supporting the floor which is to be secured. Other similar laths are then to be nailed along the whole length of the joists, with their ends butting against each other. The top of each of these laths or fillets ought to be at $1\frac{1}{8}$ inch below the top of the joists or timbers against which they are nailed; and they will thus form a sort of small ledge on each side of all the joists. These fillets are to be well bedded in a rough plaster hereafter mentioned, when they are nailed on, so that there may be no interval between them and the joists: and the same plaster ought to be spread with a trowel upon the tops of all the fillets, and along the sides of that part of the joists which is between the top of the fillets and the upper edge of the joists. In order to fill up the intervals between the joists that support the floor, short pieces of common laths, whose length is equal to the width of these intervals, should be laid in the contrary direction to the joists, and close together in a row, so as to touch one another: their ends must rest upon the fillets, and they ought to be well bedded in the rough plaster, but are not to be fastened with nails. They must then be covered with one thick coat of the rough plaster, which is to be spread over them to the level of the tops of the joists: and in a day or two this plaster should be trowelled over close to the sides of the joists, without covering the tops of the joists with it.

In the method of double flooring, the fillets and short pieces of laths are applied in the manner already described; but the coat of rough plaster ought to be little more than half as thick as that in the former method. Whilst this rough plaster is laid on, some more of the short pieces of laths above mentioned must be laid in the intervals between the joists upon the first coat, and be dipped deep in it. They should be laid as close as possible to each other, and in the same direction with the first layer of short laths. Over this second layer of short laths there must be spread another coat of rough plaster, which should be trowelled level with the tops of the joists without rising above them. The rough plaster may be made of coarse lime and hair; or, instead of hair, hay chopped to about three inches in length may be substituted with advantage. One measure of common rough sand, two measures of slaked lime, and three measures of chopped hay, will form in general a very good proportion, when sufficiently beat up together in the manner of common mortar. The hay should be put in after the two other ingredients are well beat up together with water. This plaster should be made stiff; and when the flooring boards are required to be laid down very soon, a fourth or fifth part of quicklime in powder, formed by dropping a small quantity of water on the limestone a little while before it is used, and well mixed with this rough plaster, will cause it to dry very fast. If any cracks appear in the rough plaster work near the joists when it is thoroughly dry, they ought to be closed by washing them over with a brush wet with mortar wash: this wash may be prepared by putting two measures of quicklime and one of common sand in a pail, and stirring the mixture with water till it becomes of the consistence of a thin jelly.

Before the flooring boards are laid, a small quantity of very dry common sand should be strewed over the plaster work, and struck smooth with a hollow rule, moved in the direction of the joists, so that it may lie rounding between each pair of joists. The plaster work and sand should be perfectly dry before the boards are laid, for fear of the dry rot. The method of under-flooring may be successfully applied to a wooden staircase; but no sand is to be laid upon the rough plaster work. The method of extra-lathing may be applied to ceiling joists, to sloping roofs, and to wooden partitions.

The third method, which is that of inter-securing, is very similar to that of under-flooring; but no sand is afterwards to be laid upon it. Inter-securing is applicable to the same parts of a building as the method of extra-lathing, but is seldom necessary.

Lord Mahon has made several experiments in order to demonstrate the efficacy of these methods. In most houses it is only necessary to secure the floors; and the extra expence of under-flooring, including all materials, is only about ninepence per square yard, and with the use of quicklime a little more. The extra expence of extra-lathing is no more than sixpence per square yard for the timber side walls and partitions; but for the ceiling about ninepence per square yard. But in most houses no extra-lathing is necessary.

*Fire-Eater*. We have a great number of mountebanks who have procured the attention and wonder of the public by eating of fire, walking on fire, washing their hands in melted lead, and the like tricks.

The most celebrated of these was our countryman Richardson, much talked of abroad. His secret, as related in the *Journal de Sçavans*, of the year 1680, consisted in a pure spirit of sulphur, wherewith he rubbed his hands, and the parts that were to touch the fire; which burning and cauterizing the epidermis, hardened and enabled the skin to resist the fire.

Indeed this is no new thing: Amb. Parée assures us he has tried it on himself; that after washing the hands in urine, and with unguentum aureum, one may safely wash them in melted lead.

He adds also, that by washing his hands in the juice of onions, he could bear a hot shovel on them while it melted lead.

FIRE, in *Theology*. See HELL.

We read of the sacred fire in the first temple of Jerusalem, which came down from heaven: it was kept with the utmost care, and they were forbidden to carry any strange fire into the temple. This fire is one of the five things which the Jews confess were wanting in the second temple.

The Pagans had their sacred fires, which they kept in their temples with the most religious care, and which were never to be extinguished. Numa was the first who built a temple to Fire as a goddess at Rome, and instituted an order of priestesses for the preservation of it. See VESTALS.

Fire was the supreme god of the Chaldeans; the Magi were worshippers of fire; and the Greeks and Armenians still keep up a ceremony called the *holy fire*, upon a persuasion that every Easter day a miraculous fire descends from heaven into the holy sepulchre, and kindles all the lamps and candles there.

*Fire kindled spontaneously in the Human Body*. See *Extraordinary Cases of* BURNING.

*Fire-Barrel*. See FIRE-*Ship*, Note (B).

*Fire-Bavins*. Ibid. Note (D).

*Fire-Arrow*, in naval artillery, is a small iron dart furnished with springs and bars, together with a match impregnated with sulphur and powder, which is wound about its shaft. It is intended to fire the sails of the enemy, and is for this purpose discharged from a musquetoon or swivel gun. The match being kindled by the explosion, communicates the flame to the sail against which it is directed, where the arrow is fastened by means of its bars and springs. The weapon is peculiar to hot climates, particularly the West Indies, where the sails being extremely dry by reason of the great heat, they instantly take fire, and of course set fire to the masts and rigging, and lastly to the vessel itself.

*Fire-Balls*, in artillery, a composition of meal powder, sulphur, saltpetre, pitch, &c. about the bigness of a hand grenade, coated over with flax, and primed with the slow composition of a fuze. This is to be thrown into the enemy's works in the night time, to discover where they are, or to fire houses, galleries, or blinds of the besiegers; but they are then armed with spikes, or hooks of iron, that they may not roll off, but stick or hang where they are desired to have any effect. See *Fire*-BALLS, and *Light*-BALLS.

*Balls of Fire*, in *Meteorology*, a kind of luminous bodies, generally appearing at a great height above the earth, with a splendour surpassing that of the moon; and sometimes equalling her apparent size. They generally proceed in this hemisphere from north to south with vast velocity, frequently breaking into several smaller ones, sometimes vanishing with a report, sometimes not.

These luminous appearances no doubt constitute one part of the ancient prodigies, blazing stars or comets, which last they sometimes resemble in being attended with a train; but frequently they appear with a round and well-defined disk. The first of these of which we have any accurate account, was observed by Dr Halley and some other philosophers at different places, in the year 1719. From the slight observations they could take of its course among the stars, the perpendicular height of this body was computed at about 70 miles from the surface of the earth. The height of others has also been computed, and found to be various; though in general it is supposed to be beyond the limits assigned to our atmosphere, or where it loses its refractive power. The most remarkable of these on record appeared on the 18th of August 1783, about nine o'clock in the evening. It was seen to the northward of Shetland, and took a southerly direction for an immense space, being observed as far as the southern provinces of France, and one account says that it was seen at Rome also. During its course it appears frequently to have changed its shape; sometimes appearing in the form of one ball, sometimes of two or more; sometimes with a train, sometimes without one. It passed over Edinburgh nearly in the zenith, and had then the appearance of a well-defined round body, extremely luminous, and of a greenish colour; the light which it diffused on the ground giving likewise a greenish cast to objects. After passing the zenith it was attended by a train of considerable length, which continually augmenting, at last obliterated the head entirely; so that it looked like a wedge, flying with the obtuse end foremost. The motion was not apparently swift, by reason of its great height; though in reality it must have moved with great rapidity, on account of the vast space it travelled over in a short time. In other places its appearance

pearance was very different. At Greenwich we are told, that "two bright balls parallel to each other led the way, the diameter of which appeared to be about two feet; and were followed by an expulsion of eight others, not elliptical, seeming gradually to mutilate, for the last was small. Between each two balls a luminous serrated body extended, and at the last a blaze issued which terminated in a point. Minute particles dilated from the whole. The balls were tinted first by a pure bright light, then followed a tender yellow, mixed with azure, red, green, &c.; which, with a coalition of bolder tints, and a reflection from the other balls, gave the most beautiful rotundity and variation of colours that the human eye could be charmed with. The sudden illumination of the atmosphere, and the form and singular transition of this bright luminary, tended much to make it awful: nevertheless, the amazing vivid appearance of the different balls, and other rich connective parts not very easy to delineate, gave an effect equal to the rainbow in the full zenith of its glory."

Dr Blagden, in a paper on this subject in the 74th volume of the Philosophical Transactions, has not only given a particular account of this and other meteors of the kind, but added several conjectures relating to the probable causes of them. The first thing which occurred to philosophers on this subject was, that the meteors in question were burning bodies rising from the surface of the earth, and flying along the atmosphere with great rapidity. But this hypothesis was soon abandoned, on considering that there was no power known by which such bodies could either be raised to a sufficient height, or projected with the velocity of the meteors. The next hypothesis was, that they do not consist of one single body, but of a train of sulphureous vapours, extending a vast way through the atmosphere, and being kindled at one end display the luminous appearances in question by the fire running from one end of the train to the other. To this hypothesis, which was invented by Dr Halley, Dr Blagden objects that no just explanation is given of the nature of the vapours themselves, the manner in which they are raised up, or in which they can be regularly arranged in straight lines of such vast extent; or how they can be supposed to burn in such rarefied air. "Indeed, (says he) it is very difficult to conceive how vapours could be prevented, in those regions where there is in a manner no pressure, from spreading out on all sides in consequence of their natural elasticity, and instantly losing that degree of density which seems necessary for inflammation. Besides, it is to be expected, that such trains would sometimes take fire in the middle, and thus present the phenomenon of two meteors at the same time, receding from one another in a direct line."

For these and other reasons this hypothesis of Dr Halley was abandoned, and another substituted in its place. This was, that the meteors we speak of are permanent solid bodies, not rising from the earth, but revolving round it in very eccentric orbits, and thus in their perigeon moving with inconceivable rapidity. But the doctor shows, that, even on this supposition, the velocity of such bodies must scarce be one third of that with which fire-balls move, and which has been calculated at upwards of 1000 miles per minute. The hypothesis is likewise liable to a number of other objections which cannot be answered, particularly from the variations in their appearance; for it is impossible to show in what manner one solid and permanent body could assume the appearance of eight or ten, as was the case with the meteor of 1783: nor can it be shown why a body, which in passing over Edinburgh appeared with a disk evidently less than that of the sun, should, in passing over Greenwich, assume the appearance of *two* bodies, each of which had a disk considerably larger than the apparent disk of that luminary. To obviate, in some measure, objections of this kind, it has been supposed that the revolving bodies are surrounded by a kind of electrical atmosphere by which they are rendered luminous; but (says the doctor) I think, whoever carefully peruses the various accounts of fire balls, and especially ours of the 18th of August, when it divided, will perceive that their phenomena do not correspond with the idea of a solid nucleus involved in a subtile fluid, any more than with the idea of another learned gentleman, that they become luminous by means of a contained fluid, which occasionally explodes through the thick solid outer shell."

Another hypothesis, which Dr Blagden has not mentioned, is, that the meteors in question are a kind of bodies which take fire as soon as they come within the atmosphere of the earth. But this cannot be supposed, without implying a previous knowledge of these bodies, which it is altogether impossible we can have. The only opportunity we have of seeing them is when they are on fire. Before that time they are in an invisible and unknown state; and it is surely improper to argue concerning them in this state, or pretend to determine any one of their properties, when we have it not in our power to see or investigate them in the least. As the meteors therefore never manifest themselves to our senses but when they are on fire, the only rational conclusion we can draw from thence is, that they have no existence in any other state; and consequently that their substance must be composed of that fluid which, when acting after a certain manner, becomes luminous and shows itself as fire; remaining invisible and eluding our researches in every other case. On this hypothesis we must conclude that the fire-balls are great bodies of electric matter, moving from one part of the heavens where, to our conception, it is superabundant, to another where it is deficient. This opinion is adopted by Dr Blagden for the following reasons:

1. On account of their prodigious velocity, which is not less than 1200 miles in a minute, and seems incompatible with any other substance we know besides the electric fluid. "This (says he) is perhaps the only case in which the course or direction of that fluid is rendered perceptible to our senses, in consequence of the large scale on which these meteors move."

2. Various electrical phenomena have been observed to attend them, such as lambent fires settling upon men, horses, &c.; and sparks coming from them, "or the whole meteor itself (adds our author), it is said, have damaged ships, houses, &c. after the manner of lightning." This last circumstance, however, we can believe only of another kind of fire-balls, of which we shall afterwards treat, which keep at a small distance from the earth, or run along its surface; for the great

meteors of which we now speak, flying at the distance of 50 or 60, or more miles from the surface of the earth, cannot be less from their apparent size than a mile or a mile and a half in diameter. Such an immense body of electric matter descending on the earth, would by its explosion ruin a large tract of country; and there is no probability that when engendered in such a rare atmosphere, it could break through the whole body of gross and dense air which lies between these regions and the earth, and which we know resists the passage of the electric fluid very strongly. Notwithstanding this, there is no impossibility that the atmosphere may be electrified to a great degree by such a meteor passing over it; and thus electrical appearances may attend these bodies, without any actual emission of their substance, as Dr Blagden supposes. "If there be really (says he) any hissing noise heard while the meteors are passing, it seems explicable on no other supposition than that of streams of electric matter issuing from them, and reaching the earth with a velocity equal to that of the meteor, namely, in two or three seconds. Accordingly, in one of our late meteors, the hissing was compared to that of electricity issuing from a conductor. The sparks flying off so perpetually from the body of fire-balls may possibly have some connexion with these streams. In the same manner the sound of explosions may perhaps be brought to us quicker than if it were propagated to us by the air alone. Should these ideas be well founded, the change of direction, which meteors seem at times to undergo, may possibly be influenced by the state of the surface of the earth over which they are passing, and to which the streams are supposed to reach. A similar cause may occasion the apparent explosion, the opening of new channels giving new vent and motion to the electric fluid. May not the deviation and explosion which appear to have taken place in the fire-ball of the 18th of August over Lincolnshire, have been determined by its approach towards the fens, and an attraction produced by that large body of moisture?

The explosion mentioned by our author over Lincolnshire does not seem to have been the only one which happened during the course of this meteor. Several people heard reports after it had vanished; and these were sometimes single and sometimes double. At Edinburgh two reports were heard, the one immediately following the other, at the distance of six or seven minutes after the meteor had passed. These reports no doubt indicated a temporary dissolution of the body; but it is by no means probable that the dissolution could have taken place either on account of the state of the earth or atmosphere. We must consider that both earth and atmosphere are always full of electric fluid; and if there happens to be what is called a *deficiency* in one of them, the other instantly supplies it. It is impossible, therefore, that either the earth or atmosphere could receive such an immense additional quantity in one part without a vent being provided for it somewhere else. In thunder-storms we naturally conclude that a vast quantity of electrical matter is put in motion; but from the effects of lightning it appears that this quantity must be very trifling in comparison with what the meteor we now speak of contained. A violent flash of lightning has been known to perforate a looking-glass, and make only a hole of about an inch diameter. Now we have no reason to suppose that the flash, tremendous as it might appear to our eyes, was any other than an electric spark of an inch in diameter. The meteor, on the other hand, appears not to have been less than a mile in diameter; so that the disproportion betwixt it and a single flash of lightning appears almost beyond calculation; and we may reasonably conclude that it could not have been equalled by 10,000 thunder-storms. Had this amazing body of electric fire descended through the atmosphere, and dissipated itself on the fens of Lincolnshire, it must have produced the most violent and unheard-of effects, not only in that place, but probably throughout the whole island. Its dissipation must therefore have been in the higher regions, where there was ample space to receive it; and where its explosion, whatever concussion it might make among the ethereal matter itself, could not affect our earth or atmosphere in any remarkable degree. Its re-appearance was owing to the same tendency in the fluid to circulate which had originally produced it; and which probably was the violent earthquake in Calabria, and the eruption in Iceland.

3. Another argument adduced by Dr Blagden in favour of the electrical origin of fire-balls, is their connexion with the aurora borealis, and the resemblance they bear to this phenomenon, which is now almost universally allowed to be electrical. "Instances (says he) are recorded, where northern lights have been seen to join, and form luminous balls, darting about with great velocity, and even leaving a train behind them like the common fire-balls. This train I take to be nothing else but the rarefied air left in such an electrified state as to be luminous; and some streams of the northern lights are very much like it." The aurora borealis appears to occupy as high, if not a higher region above the surface of the earth, as may be judged from the very distant countries to which it has been visible at the same time; indeed the great accumulation of electric matter seems to lie beyond the verge of our atmosphere, as estimated by the cessation of twilight. Also with the northern lights a hissing noise is said to be heard in some very cold climates: Gmelin speaks of it in the most pointed terms, as frequent and very loud in the north-eastern parts of Siberia; and other travellers have related similar facts."

4. Our author thinks that the strongest argument for the electrical origin of these meteors is the direction of their course, which is constantly either from the north or north-west quarter of the heavens, or towards it; or, as our author thinks, nearly in the direction of the magnetical meridian. Such a course, however, seems only to belong to the very large fire-balls of which we now speak; the smaller ones, called *Falling Stars*, being moved in all directions; "perhaps (says the doctor), because they come further within the verge of our atmosphere, and are thereby exposed to the action of extraneous causes. That the smaller sort of meteors, such as shooting stars, are really lower down in the atmosphere, is rendered very probable by their swifter apparent motion: perhaps it is this very circumstance which occasions them to be smaller, the electric fluid being more divided in more resisting air. But as those masses of electric matter which move where

where there is scarce any resistance, so generally affect the direction of the magnetic meridian, the ideas which have been entertained of some analogy between these two obscure powers of nature seem not altogether without foundation. If the foregoing conjectures be just, distinct regions are allotted to the electrical phenomena of our atmosphere. Here below we have thunder and lightning, from the unequal distribution of the electric fluid among the clouds; in the loftier regions, whither the clouds never reach, we have the various gradations of falling stars; till, beyond the limits of our corpuscular atmosphere, the fluid is put into motion in sufficient masses to hold a determined course, and exhibit the different appearances of what we call *fire-balls;* and probably at a still greater elevation above the earth, the electricity accumulates in a lighter and less condensed form, to produce the wonderfully diversified streams and coruscations of the aurora borealis."

The paper from whence these extracts are taken was written before Mr Morgan's account of the non-conducting power of a perfect vacuum made its appearance. The meteor in question, and others of the same nature, afford a proof of the theory of the deficiency of electric fluid proposed by some. Dr Halley, speaking of the fire-ball of 1719, the height of which he calculated at very little less than 70 miles, expresses his surprise that sound should be propagated through a medium near 300,000 times rarer than the common air, and the next thing to a perfect vacuum. Now it remains, and for ever will remain, to be proved, that Mr Morgan's most perfect vacuum, formed by boiling quicksilver in a tube ever so long, contains a medium *more* than 300,000 times rarer than the common atmosphere. From Mr Cavallo's experiments it appears, that when air is only rarefied 1000 times, the electric light is excessively weak; so that there is not the least probability that in an aerial medium 300,000 times rarer than the present, if indeed such a medium can exist, there could be any light made visible in the ordinary experiments. We see, however, by the many examples of meteors which have occurred at prodigious heights in the atmosphere, that the electric light in such a rarefied atmosphere is not only visible, but acts as vigorously in every respect as if it were on the surface of the earth. This circumstance therefore affords a complete demonstration of the fallacy of Mr Morgan's argument, and a direct proof that the electric fluid pervades space as completely divested of air as the best artificial vacuum we can make; nay, where it is generally believed by mathematicians that the atmosphere has ceased altogether. His other arguments drawn *à priori* are still more inconclusive than that we have just mentioned. He tells us, that if a vacuum was a conductor, the whole quantity of electric matter contained in the earth and atmosphere would be perpetually flying off through the regions of infinite space, as being surrounded by a boundless conductor. But even this does not follow, though we should suppose these regions to be an absolute vacuity; for we know that electricity does not fly to a conducting substance merely because it is a conductor, but because it opens a passage to some place whither it has a tendency to go though the conductor was not there. Now, on the present hypothesis, as the conductor would lead to *no place* to which the electric matter had any previous tendency, we cannot assign any reason why it should acquire a tendency to fly off merely on account of the neighbourhood of a conductor, even though boundless. His other objection (that, on the supposition of a vacuum being capable of conducting electricity, the whole space in the universe would be filled with electric fluid) may be admitted in its fullest extent, without any detriment whatever to science; and indeed, if we allow the electric fluid to be only a modification of the light of the sun, we must own that the whole universe is filled with it. The meteors in question then will be no other than discharges of electricity from one part of the celestial spaces to another, similar to the discharges between the positive and negative side of an electrified bottle; thus intimating, that a circulation has taken place in the fluid, which the meteor at once completes and puts an end to. See METEOROLOGY.

Besides these already just mentioned of such vast magnitude, there are others much smaller and nearer the surface of the earth, rolling upon it, or falling upon it, exploding with violence, as is the case with those which appear in the time of thunder, and frequently producing mischievous effects. One of these is mentioned by some authors as falling in a serene evening in the island of Jamaica; exploding as soon as it touched the surface of the ground, and making a considerable hole in it. Another is mentioned by Dr Priestley as rolling along the surface of the sea, then rising and striking the top-mast of a man of war, exploding, and damaging the ship. In like manner, we hear of an electrified cloud at Java, in the East Indies; whence, without any thunder storm, there issued a vast number of fire-balls which did incredible mischief. This last phenomenon points out to us the true origin of balls of this kind, viz. an excessive accumulation of electricity in one part, or a violent tendency to circulate, when at the same time the place where the motion begins is at so great a distance, or meets with other obstacles of such a nature, that it cannot easily get thither. Urged on, however, by the vehement pressure from behind, it is forced to leave its place; but being equally unable to displace the great quantity of the same fluid, which has no inclination to move the same way with itself, it is collected into balls, which run hither and thither, according as they meet with conductors capable of leading them, into some part of the circle. This is even confirmed by an experiment related at the end of Dr Priestley's fifth volume on Air. He relates, that a gentleman having charged, with a very powerful machine, a jar, which had the wire supporting the knob of a considerable length, and passed through the glass tube, a globe of fire was seen to issue out of it. This globe gradually ascended up the glass tube till it came to the top of the knob, where it settled, turning swiftly on its axis, and appearing like a red-hot iron ball of three quarters of an inch diameter. On continuing to turn the machine, it gradually descended into the jar; which it had no sooner done, than there ensued a most violent explosion and flash, the jar being discharged and broken at the same time. This experiment, however, is singular in its kind; for neither the gentleman who performed it, nor any other, has yet been able to repeat it. Single as it is, however, we may yet gather from it, that a fire-ball will be the consequence of a

very

very violent electrification of any substance, provided at the same time that the air be in a very non-conducting state, so that the electricity may not evaporate into it as fast as it is collected; for this would produce only lucid streams and flashes, as in the common experiments with the Leyden phial; and it is probably an inattention to this circumstance which has hitherto prevented the repetition of the experiment above mentioned. The case is the same in thunder storms, where an excessive accumulation of electric matter always produces fire-balls, the most mischievous kind of lightning, as is explained under that article.

With regard to the uses which fire-balls serve in the system of nature, it is plain that they are the means of preserving the equilibrium in the electric fluid in the atmosphere, which would otherwise produce the most dreadful tempests. As there must be a constant current of electric matter through the bowels of the earth from the equator to the poles, and from the poles to the equator, through the atmosphere, the great meteors serve for keeping up the equilibrium in this great atmospherical current, while the smaller ones answer a like purpose in the general mass of electric matter dispersed over the surface of the earth, and therefore are seen to move in all directions, as the equilibrium happens to require them in different parts. With regard to those which are observed in the lower regions of the earth, or rolling on the surface of the ground itself, they undoubtedly answer purposes of a similar kind in these lower regions; for as fire-balls in general are produced by a great excess of electricity in one place, there must of course be an equal deficiency in another; and to restore the equilibrium, or, to speak more properly, to prevent a dangerous commotion from taking place throughout the whole mass of electric fluid, the fire-ball breaks forth, and either puts a stop at once to the disturbance by an explosion, or by a silent and invisible evaporation. From some accounts indeed it would seem that even the large celestial meteors detached part of their substance to accomplish this purpose; though, for the reasons already given, it would seem more probable that they operated by electrifying the atmosphere, or setting the fluid contained in it in motion, so as to produce small fire-balls of itself, rather than by detaching any part of their own bodies to such a distance. Dr Blagden, in the paper above quoted, gives an account of an appearance of this kind. It was described in a letter to Sir Joseph Banks from the Abbé Mann, director of the academy at Brussels. "It happened (says the Abbé) at Mariekercke, a small village on the coast, about half a mile west of Ostend. The curate of the village was sitting in the dusk of the evening with a friend, when a sudden light surprised them, and immediately after, a small ball of light-coloured flame came through a broken pane of glass, crossed the room where they were sitting, and fixed itself on the chink of a door opposite to the window where it entered, and there died gradually away. It appeared to be a kind of phosphoric light carried along by the current of air. The curate and his friend, greatly surprised at what they saw, apprehended fire in the neighbourhood; but going out, found that the fire which had come in through the window had been detached from a large meteor in its passage."

*Fire-Cocks*. Churchwardens in London and within the bills of mortality, are to fix fire-cocks at proper distances in streets, and keep a large engine and hand-engine for extinguishing fire, under the penalty of 10l. stat. 6 Ann. c. 31.

On the breaking out of any fire in London or Westminster, the constables and beadles of parishes shall repair to the place with their staves, and assist in extinguishing it, and cause the people to work for that end, &c.

*Fire-Engine*. See *Steam-Engine*.

*Fire-Flair*, in *Ichthyology*. See Raja, Ichthyology *Index*.

*Fire-Flies*, a species of flies common in Guiana, of which there are two species. The largest is more than an inch in length, having a very large head connected with the body by a joint of a particular structure, with which at some times it makes a loud knock, particularly when laid on its back. The fly has two feelers or horns, two wings, and six legs. Under its belly is a circular patch, which, in the dark, shines like a candle; and on each side of the head near the eyes is a prominent, globular, luminous body, in size about one-third larger than a mustard seed. Each of these bodies is like a living star, emitting a bright, and not small, light; since two or three of these animals, put into a glass vessel, afford sufficient light to read without difficulty, if placed close to the book. When the fly is dead, these bodies will still afford considerable light, though it is less vivid than before; and if bruised, and rubbed over the hands or face, they become luminous in the dark, like a board smeared over with phosphorus. They have a reddish brown or chesnut colour; and live in rotten trees in the day, but are always abroad in the night. The other kind is not more than half as large as the former: their light proceeds from under their wings, and is seen only when they are elevated, like sparks of fire appearing or disappearing at every second. Of these the air is full in the night, though they are never seen in the day. They are common not only in the southern but in the northern parts of America, during the summer.

*Fire-Lock*, or *Fusil*, a small gun which fires with a flint. It is distinguished from the old musket or match-lock, which was fired with a match. The firelock is now in common use in the European armies.

*Fire-Philosophers*, or *philosophi per ignem*, a fanatical sect of philosophers who appeared towards the close of the 16th century, and made a figure in almost all the countries of Europe. The distinguishing tenet from which they derived this appellation was, that the intimate essences of natural things were only to be known by the trying efforts of fire, directed in a chemical process. They were also called *Theosophists*, from their declaring against human reason as a dangerous and deceitful guide, and representing a divine and supernatural illumination as the only means of arriving at truth; they were likewise denominated *Paracelsists*, from the name of Paracelsus, the eminent physician and chemist, who was the chief ornament and leader of this extraordinary sect. It was patronized in England by Robert Flood or Fludd, who endeavoured to illustrate the philosophy of Paracelsus in a great number of treatises: in France it was zealously propagated by Rivier; in Denmark, by Severinus; in Germany, by Kunrath, an eminent physician of Dresden; and in other countries by warm and successful votaries, who assumed a striking air of piety and devotion, and proposed to themselves no other end than the advancement of the divine glory, and the restoration of peace and concord in a divided church: accordingly they were joined by several persons eminent for their piety, and distinguished by their zeal for the advancement of true religion. One of the most celebrated of these was Daniel Hoffman, professor of divinity in the university of Helmstadt, who, availing himself of some unguarded passages in the writings of Luther, extravagantly maintained, that philosophy was the mortal enemy of religion; that truth was divisible into two branches, the philosophical and theological; and that what was true in philosophy was false in theology. Hoffman was afterwards obliged, by the interposition of Henry Julius, duke of Brunswick, to retract his invectives against philosophy, and to acknowledge in the most open manner the harmony and union of sound philosophy with true and genuine theology.

*Fire-Places* are contrivances for communicating heat to rooms, and also for answering various purposes of art and manufacture. See CHIMNEY, FURNACE, and STOVE.

The ingenious Dr Franklin, having recounted the inconveniences and advantages of fire-places in common use, proposes a new contrivance for this purpose, called the *Pennsylvania fire-place*. 1. This machine consists of a bottom-plate, or hearth-piece, fig. 1. Plate CCXVII. with a rising moulding before for a fender, two perforated ears *F*, *G*, for receiving two screw-rods; a long air-hole *u a*, through which the outward air passes into an air-box; and three smoke-holes, represented by dark squares in *BC*, through which the smoke descends and passes away; besides, double ledges for receiving between them the lower edges of the other plates. 2. A back-plate without holes, and furnished with a pair of ledges to receive, 3. The two side-plates, each of which has a pair of ledges to receive the side edges of the front plate, with a shoulder on which it rests; two pair of ledges to receive the side edges of the two middle plates which form the air-box, and an oblong air-hole near the top, through which the air warmed in the box is discharged into the room, and a wing or bracket as *H*, and a small hole as *R*, for the axis of the register to turn in. See fig. 2. which represents one of these plates. 4. An air-box, composed of the two middle plates *DE* and *FG*, fig. 3. and 4. The first has five thin ledges or partitions cast on it, the edges of which are received into so many pair of ledges cast in the other: the tops of all the cavities formed by these thin deep ledges are also covered by a ledge of the same form and depth cast with them; so that when the plates are put together, and the joints luted, there is no communication between the air-box and the smoke. In the winding passages of this box, fresh air is warmed as it passes into the room. 5. A front plate, which is arched on the under side, and ornamented with foliages, &c. 6. A top plate with a pair of ears, *MN*, (fig. 5.) answerable to those in the bottom plate, and perforated for the same purpose. It has also a pair of ledges running round the under side to receive the top edges of the front, back, and side plates. The air-box does not reach up to the top plate by 2½ inches.

All these plates are of cast iron; and when they are all in their proper places, they are bound firmly together by a pair of slender rods of wrought iron with screws, and the machine appears as in fig. 5. There are also two thin plates of wrought iron, viz. 7. The shutter which is of such a length and breadth as to close well the opening of the fire-place, and serving to blow up the fire, and to secure it in the night. It is raised or depressed by means of two brass knobs, and slides into a groove left between the foremost ledge of the side plates and the face of the front plate. 8. The register, which is placed between the back plate and air-box, and furnished with a key; so that it may be turned on its axis, and made to lie in any position between level and upright. The operation of this machine, and the method of fixing it, may be understood by observing the profile of the chimney and fire-places in fig. 6. *M* is the mantle-piece or breast of the chimney; *C* the funnel; *B* the false back, made of brick work in the chimney, four inches or more from the true back, from the top of which a closing is to be made over to the breast of the chimney, that no air may pass into the chimney except that which goes under the false back, and up behind it: *E* the true back of the chimney; *T* the top of the fire-place; *F* the front of it; *A* the place where the fire is made; *D* the air-box; *K* the hole in the side plate, through which the warmed air is discharged out of the air-box into the room; *H* the hollow, formed by removing some bricks from the hearth under the bottom plate filled with fresh air, entering at the passage *l*, and ascending into the air-box through the air-hole in the bottom plate near *G*, the partition in the hollow, designed to keep the air and smoke apart; *P* the passage under the false back, and part of the hearth, for the smoke; and the arrows in the figure show the course of the smoke. The fire being made at *A*, the flame and smoke will ascend, strike the top *T*, and give it a considerable heat; the smoke will turn over the air-box, and descend between it and the back plate to the holes near *G* in the bottom plate, heating in its passage all the plates of the machine; it will then proceed under and behind the false back, and rise into the chimney. The air of the room contiguous to the several plates, and warmed by them, becomes specifically lighter than the other air in the room, and is obliged to rise; but being prevented by the closure over the fire-place from going up the chimney, is forced out into the room, and rising by the mantle-piece to the ceiling, is again driven down gradually by the steam of newly-warmed air that follows; and thus the whole room becomes in a little time equally warmed. The air also, warmed under the bottom plate and in the air-box, rises and comes out of the holes in the side plates, thus warming and continually changing the air of the room. In the closing of the chimney, a square opening for a trap-door should be left for the sweeper to go up: the door may be made of slate or tin, and so placed, that by turning up against the back of the chimney when open, it closes the vacancy behind the false back, and shoots the soot that falls in sweeping out upon the hearth. It will also be convenient to have a small hole, about five or six inches square, cut near the ceiling through into the funnel, and provided with a shutter; by occasionally opening which,

which, the heated air of the room and smoke of tobacco, &c. may be carried off without incommoding the company. For a farther account of the manner of using this fire-place, the advantages attending it, answers to objections, and directions to the bricklayer in fixing it, the curious reader may consult Franklin's Letters and Papers on Philosophical Subjects, p. 284—318. edit. 1769.

*Fire-Pots*, in the military art, small earthen pots, into which is put a charged grenade, and over that powder enough till the grenade is covered; then the pot is covered with a piece of parchment, and two pieces of match across lighted: this pot being thrown by a handle of matches where it is designed, it breaks and fires the powder, and burns all that is near it, and likewise fires the powder in the grenade, which ought to have no fuse, to the end its operations may be the quicker.

*Fire-Reeds*. See the next article, Note (c).

*Fire-Ship*, an old vessel filled with combustible materials, and fitted with grappling irons to hook, and set fire to, the enemies ships in battle, &c.

As there is nothing particular in the construction of this ship, except the apparatus by which the fire is instantly conveyed from one part to another, and from thence to the enemy, it will be sufficient to describe the fire-room, where these combustibles are enclosed, together with the instruments necessary to grapple the ship intended to be destroyed.

The fire-room is built between decks, and limited on the after part by a *bulk-head*, *L*, behind the mainmast, from which it extends quite forward, as represented in Plate CCXVII. The train enclosed in this apartment is contained in a variety of wooden troughs, *D*, *G*, which intersect each other in different parts of the ship's length; being supported at proper distances by cross pieces and stanchions. On each side of the ship are six or seven ports, *H*, about 18 inches broad and 15 inches high; and having their lids to open downward, contrary to the usual method.

Against every port is placed an iron chamber (A), which, at the time of firing the ship, blows out the port-lid, and opens a passage for the flame. Immediately under the main and fore-shrouds is fixed a wooden funnel *M*; whose lower end communicates with a fire-barrel (B), by which the flame passing through the funnel is conducted to the shrouds. Between the funnels, which are likewise called *fire-trunks*, are two scuttles, or small holes, in the upper deck, serving also to let out the flames. Both funnels must be stopped with plugs, and have sailcloth or canvas nailed close over them, to prevent any accident happening from above to the combustibles laid below.

*Falconer's Marine Dictionary.*

The ports, funnels, and scuttles, not only communicate the flames to the outside and upper works of the ship and her rigging; but likewise open a passage for the inward air, confined in the fire-room, which is thereby expanded so as to force impetuously through these outlets, and prevent the blowing up of the decks, which must of necessity happen from such a sudden and violent rarefaction of the air as will then be produced.

On each side of the bulk-head behind is cut a hole, *L*, of sufficient size to admit a trough of the same dimensions as the others. A leading trough, *L I*, whose foremost end communicates with another trough within the fire-room, is laid close to this opening, from whence it extends obliquely to a sally-port, *I*, cut through the ship's side. The decks and troughs are well covered with melted rosin. At the time of the firing

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(A) The iron chambers are 10 inches long and 3.5 in diameter. They are breeched against a piece of wood fixed across the ports, and let into another a little higher. When loaded, they are almost filled with corn-powder, and have a wooden tompion well driven into their muzzles. They are primed with a small piece of quick-match thrust through their vents into the powder, with a part of it hanging out. When the ports are blown open by means of the iron chambers, the port-lids either fall downwards or are carried away by the explosion.

(B) The fire-barrels ought to be of a cylindrical form, as most suitable to contain the reeds with which they are filled, and more convenient for stowing them between the troughs in the fire-room. Their inside chambers should not be less than 21 inches, and 30 inches is sufficient for their length. The bottom parts are first well stored with short double-dipped reeds placed upright; and the remaining vacancy is filled with fire-barrel composition well mixed and melted, and then poured over them. The composition used for this purpose is a mass of sulphur, pitch, tar, and tallow.

There are five holes, of three-fourths of an inch in diameter and three inches deep, formed in the top of the composition while it is yet warm; one being in the centre, and the other four at equal distances round the sides of the barrel. When the composition is cold and hard, the barrel is primed by filling these holes with fuse composition, which is firmly driven into them, so as to leave a little vacancy at the top to admit a strand of quick-match twice doubled. The centre hole contains two strands at their whole length, and every strand must be driven home with mealed powder. The loose ends of the quick-match being then laid within the barrel, the whole is covered with a dipped curtain, fastened on with a hoop that slips over the head of the barrel, to which it is nailed.

The barrels should be made very strong, not only to support the weight of the composition before firing, when they are moved or carried from place to place, but to keep them together whilst burning: for if the staves are too light and thin, so as to burn very soon, the remaining composition will tumble out and be dissipated, and the intention of the barrels, to carry the flame aloft, will accordingly be frustrated.

The curtain is a piece of coarse canvas, nearly a yard in breadth and length, thickened with melted composition, and covered with saw-dust on both sides.

firing either of the leading troughs, the flame is immediately conveyed to the opposite side of the ship, whereby both sides burn together.

The spaces *N*, *O*, behind the fire-room, represent the cabins of the lieutenant and master, one of which is on the starboard, and the other on the larboard side. The captain's cabin, which is separated from these by a bulkhead, is exhibited also by *P*.

Four of the eight fire-barrels are placed under the four fire-trunks; and the other four between them, two on each side the fire-scuttles, where they are securely cleated to the deck. The longest reeds (c) are put into the fore and aft trough, and tied down: the shortest reeds are laid in the troughs athwart, and tied down also. The bavins (D), dipped at one end, are tied fast to the troughs over the reeds, and the curtains are nailed up to the beams, in equal quantities, on each side of the fire-room.

The remainder of the reeds are placed in a position nearly upright, at all the angles of every square in the fire-room, and there tied down. If any reeds are left, they are to be put round the fire-barrels, and other vacant places, and there tied fast.

### Instructions to Prime.

Take up all your reeds, one after another, and strew a little composition at the bottom of all the troughs under the reeds, and then tie them gently down again: next strew composition upon the upper part of the reeds throughout the fire-room; and upon the said composition lay double quick-match upon all the reeds, in all the troughs: the remainder of the composition strew over all the fire-room, and then lay your bavins loose.

Cast off all the covers of the fire-barrels, and hang the quick-match loose over their sides, and place leaders of quick-match from the reeds into the barrels, and from thence into the vent of the chambers, in such a manner as to be certain of their blowing open the pots, and setting fire to the barrels. Two troughs of communication from each door of the fire-room to the sally ports, must be laid with a strong leader of quick-match, four or five times double: also a cross-piece to go from the sally-port, when the ship is fired, to the communication trough, laid with leaders of quick-match, that the fire may be communicated in both sides at once.

What quick-match is left place so that the fire may be communicated to all parts of the room at once, especially about the ports and fire-barrels, and see that the chambers are well and fresh primed. [N. B. The port-fire used for firing the ship, burns about 12 minutes. Great care must be taken to have no powder on board when the ship is fired.]

The sheer hooks (represented by *A*) are fitted so as to fasten on the yard-arms of the fire-ship, where they hook the enemy's rigging. The fire-grapplings (*B*) are either fixed on the yard-arms, or thrown by hand, having a chain to confine the ships together, or fasten those instruments wherever necessary.

When the commanding officer of a fleet displays the signal to prepare for action, the fire-ships fix their sheer hooks, and dispose their grapplings in readiness. The battle being begun, they proceed immediately to prime, and prepare their fire-works. When they are ready for grappling, they inform the admiral thereof by a particular signal.

To avoid being disabled by the enemy's cannon during a general engagement, the fire-ships continue sufficiently distant from their line of battle, either to windward or to leeward.

They cautiously shun the openings or intervals of the line, where they would be directly exposed to the enemy's fire, from which they are covered by lying on the opposite side of their own ships. They are attentively to observe the signals of the admiral or his seconds, in order to put their designs immediately in execution.

Although no ship of the line should be previously appointed to protect any fire-ship, except a few of the smallest particularly destined to this service, yet the ship before whom she passes in order to approach the enemy, should escort her thither, and assist her with an armed boat, or whatever succour may be necessary in her situation.

The captain of the fire-ship should himself be particularly attentive that the above instructions are punctually executed, and that the yards may be so braced when he falls alongside of the ship intended to be destroyed, that the sheer-hooks and grapplings fastened to the yard-arms, &c. may effectually hook the enemy. He is expected to be the last person who quits the vessel; and being furnished with every necessary assistance and support, his reputation will greatly depend on the success of his enterprise.

*Lambent* FIRES, as the shining of meat at certain seasons, the luminousness of the sea, of insects, vapours, &c. See LIGHT, CHEMISTRY *Index*; *Fire-Flies*, ENTOMOLOGY *Index*; *Glow-Worm*, &c.

*Port*-FIRE. See *Port-Fire*.

*Spur*-FIRE. See *Spur-Fire*.

FIRE-*Works*, are preparations made of gunpowder, sulphur,

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(c) The reeds are made up in small bundles of about a foot in circumference, cut even at both ends, and tied together in two places. They are distinguished into two kinds, viz. the long and short; the former of which are four feet, and the latter two feet five inches in length. One part of them are singly dipped, i. e. at one end; the rest are dipped at both ends in a kettle of melted composition. After being immersed about seven or eight inches in this preparation, and then drained, they are sprinkled over with pulverized sulphur upon a tanned hide.

(D) The bavins are made of birch, heath, or other brush-wood, which is tough and readily kindled. They are usually two or three feet in length, and have all their brush-ends lying one way, the other ends being tied together with small cords. They are dipped in composition at the bush-ends, whose branches are afterwards confined by the hand, to prevent them from breaking off by moving about: and also to make them burn more fiercely. After being dipped in the same manner as the reeds, they also are sprinkled with sulphur.

sulphur, and other inflammable and combustible ingredients, used on occasion of public rejoicings and other solemnities.

The invention of fire-works is by M. Mahudel attributed to the Florentines and people of Sienna; who found out likewise the method of adding decorations to them of statues, with fire issuing from their eyes and mouths.

The art of preparing and managing these is called *pyrotechny*. See PYROTECHNY.

FIRING, in the military art, denotes the discharge of the fire-arms; and its object is to do the utmost execution to the enemy.

The method of firing by platoons is said to have been invented by Gustavus Adolphus, and first used about the year 1618: the reason commonly given for this method is, that a constant fire may be always kept up. There are three different ways of platoon firing; viz. standing, advancing, and retreating. But previous to every kind of firing, each regiment or battalion must be told off in grand divisions, subdivisions, and platoons, exclusively of the grenadiers, which form two subdivisions or four platoons of themselves. In firing standing, either by divisions or platoons, the first fire is from the division or platoon on the right; the second fire from the left; the third from the right again; and so on alternately, till the firing comes to the centre platoon, which is generally called the *colour platoon*, and does not fire, remaining as a reserve for the colours. Firing advancing is performed in the same manner, with this addition, that before either division or platoon fires, it advances three paces forward. Firing retreating varies from either of the former methods; for before either division or platoon fires, if they are marching from the enemy, it must go to the right about, and after firing, to the left about again, and continue the retreat as slow and orderly as possible.

In hedge firing the men are drawn up two deep, and in that order both ranks are to fire standing. Oblique firing is either to the right and left, or from the right and left to the centre, according to the situation of the object. The Prussians have a particular contrivance for this purpose; if they are to level to the right, the rear ranks of every platoon make two quick but small paces to the left, and the body of each soldier turns one-eighth of a circle, and *vice versa*. Parapet firing depends on the nature of the parapet over which the men are to fire, and also upon that of the attack made to possess it. This method of firing is sometimes performed by single ranks stepping on the banquette and firing; each man instantly handing his arms to the centre rank of the same file, and taking his back in the room of it; and the centre rank giving it to the rear to load, and forwarding the arms of the rear to the front rank; by which means the front rank men can fire six or seven rounds in a minute with exactness. Parapet firing may also be executed two deep, when the banquette is three feet broad, or in field works where no banquettes are made. Square firing is performed by a regiment or body of men drawn up in a hollow square, in which case each front is generally divided into four divisions or firings, and the flanks of the square, being the weakest part, are covered by four platoons of grenadiers. The first fire is from the right division of each face; the second from the left division of each face, &c. and the grenadiers make the last fire. Street firing is practised in two ways; either by making the division or platoon that has fired to wheel by half-rank to the right and left outwards from the centre, and to march in that order by half divisions down the flanks on each side of the column, and to draw up in the rear, and go on with their priming and loading; or, to make the division or platoon, after firing, to face to the right and left outwards from the centre, and one half rank to follow the other; and in that order to march in one centre file down on each side of the column into the rear, and there draw up as before.

*FIRING Iron*, in *Farriery*, an instrument not unlike the blade of a knife; which being made red hot is applied to a horse's hams, or other places standing in need of it, as in preternatural swellings, farcy, knots, &c. in order to discuss them.

FIRKIN, an English measure of capacity for things liquid, being the fourth part of the barrel: it contains eight gallons of ale, soap, or herrings; and nine gallons of beer.

FIRLOT, a dry measure used in Scotland. The oat firlot contains $21\frac{1}{4}$th pints of that country; the wheat firlot contains about 2211 cubical inches; and the barley firlot, 31 standard pints. Hence it appears that the Scotch wheat firlot exceeds the English bushel by 33 cubical inches.

FIRMAMENT, in the ancient astronomy, the eighth heaven or sphere; being that wherein the fixed stars were supposed to be placed. It is called the *eighth*, with respect to the seven heavens or spheres of the planets which it surrounds.

It is supposed to have two motions; a diurnal motion, given it by the *primum mobile*, from east to west, about the poles of the ecliptic; and another opposite motion from west to east; which last it finishes, according to Tycho, in 25,412 years; according to Ptolemy, in 36,000; and according to Copernicus, in 258,000; in which time the fixed stars return to the same precise points wherein they were at the beginning. This period is commonly called Plato's year, or the great year.

In various places of Scripture the word *firmament* is used for the middle region of the air. Many of the ancients allowed, with the moderns, that the firmament is a fluid matter; though they, who give it the denomination of *firmament*, must have taken it for a solid one.

FIRMAN, is a passport or permit granted by the Great Mogul to foreign vessels, to trade within the territories of his jurisdiction.

FIRMICUS MATERNUS, JULIUS, an ecclesiastical writer, who lived about the middle of the fourth century. Nothing is known with certainty respecting his country, profession, or character, as we find no mention made of him in the writings of ancient authors. Some say that he was by birth a Sicilian, and practised in the forum as a barrister for some time, becoming a convert to Christianity when far advanced in years; which appears to derive considerable support from different passages in his writings. He was author of a treatise *De errore profanarum religionum*, which was dedicated to the emperors Constantius and Constans. This work must

must have been written between 340 and 350, in which Constans was slain by Magnentius. It is allowed to be a learned, able, and well written performance, in which the reasonableness of the Christian religion is strongly contrasted with the absurdity and immorality of the gentile creed. It must not be dissembled, however, that he sometimes betrays such a spirit of intolerance as is wholly incompatible with the genius of the Christian religion, which breathes nothing but benevolence towards the whole human race. The arguments employed by him in its defence are disgraced by an exhortation to the civil power to propagate it by force of arms, and to crush the advocates of error by severe edicts. This work was first published at Strasburg in 1562, at Heidelberg in 1559, and at Paris in 1610.

The greater part of critics ascribe to him a work entitled *Astronomicorum, seu de Mathesi*, lib. viii. In it he treats of the power and influence of the stars, agreeably to the doctrine of the Egyptians and Babylonians, blending a considerable degree of mathematical knowledge with the unmeaning jargon of judicial astrology. Those who imagine that so good a man as Firmicus could not have been the author of such an absurd performance, should remember that it was probably composed prior to his conversion, when such absurdities would constitute a part of his creed.

FIRMNESS, denotes the consistence of a body, or that state wherein its sensible parts cohere in such a manner, that the motion of one part induces a motion in the rest.

FIRST-BORN. See PRIMOGENITURE, for the literal meaning of the term.

In Scripture it is also used often in a figurative sense for that which is first, most excellent, most distinguished in any thing. Thus it is said of Christ (Col. i. 5.), that he is "the first-born of every creature;" and in Revelation (i. 5.) he is called "The first-begotten of the dead;" that is, according to the commentators, begotten of the Father before any creature was produced; and the first who rose from the dead by his own power. "The first-born of the poor," (Isa. xiv. 30.) signifies, The most miserable of all the poor; and in Job (xviii. 13.) "The first-born of death;" that is, The most terrible of all deaths.

*First Fruits* (*primitiæ*), among the Hebrews, were oblations of part of the fruits of the harvest, offered to God as an acknowledgment of his sovereign dominion. The first of these fruits was offered in the name of the whole nation, being either two loaves of bread, or a sheaf of barley which was thrashed in the court of the temple. Every private person was obliged to bring his first fruits to the temple; and these consisted of wheat, barley, grapes, figs, apricots, olives, and dates.

There was another sort of first fruits which were paid to God. When bread was kneaded in a family, a portion of it was set apart and given to the priest or Levite who dwelt in the place; if there was no priest or Levite there, it was cast into the oven, and consumed by the fire. These offerings made a considerable part of the revenues of the Hebrew priesthood.

*First Fruits* are frequently mentioned in ancient Christian writers as one part of the church revenue. One of the councils of Carthage enjoins, that they should consist only of grapes and corn; which shows, that this was the practice of the African church.

*First Fruits* in the church of England, are the profits of every spiritual benefice for the first year, according to the valuation thereof in the king's books.

FISC, (*Fiscus*), in the *Civil Law*, the treasury of a prince or state; or that to which all things due to the public do fall. The word is derived from the Greek φισκος, "a great basket," used when they went to market.—By the civil law, none but a sovereign prince has a right to have a fisc or public treasury.

At Rome, under the emperors, the term *ærarium* was used for the revenues destined for support of the charges of the empire; the *fiscus* for those of the emperor's own family. The treasury, in effect belonged to the people, and the fiscus to the prince. Hence the goods of condemned persons, if appropriated to the use of the public, were said *publicari*; if to the support of the emperor or prince, *confiscari*.

FISCAL, in the *Civil Law*, something relating to the pecuniary interest of the prince or people. The officers appointed for the management of the fisc, were called *procuratores fisci*, and *advocati fisci*; and among the cases enumerated in the constitutions of the empire where it was their business to plead, one is against those who have been condemned to pay a fine to the fisc on account of their litigiousness or frivolous appeals.

FISCUS. See FISC.

FISH, in *Natural History*, an animal that lives in the waters as the natural place of its abode.

Fishes form the fourth class of animals in the Linnæan system. Their most general or popular division is into *fresh* and *salt* water ones. Some, however, are of opinion, that all fishes naturally inhabit the salt waters, and that they have mounted up into rivers only by accident. A few species only swim up into the rivers to deposit their spawn; but by far the greatest number keep in the sea, and would soon expire in fresh water. There are about 400 species of fishes (according to Linnæus) of which we know something: but the unknown ones are supposed to be many more; and as they are thought to lie in great depths of the sea remote from land, it is probable that many species will remain for ever unknown.

For the subdivisions, characters, and natural history of this class of animals, see ICHTHYOLOGY *Index*.

*Blowing of* FISH, is a practice similar to that of blowing flesh, poultry, and pigs, and adopted for the same deceitful purposes. The method of blowing fish, especially cod and whitings, is by placing the end of a quill or tobacco-pipe at the vent, and pricking a hole with a pin under the fin which is next the gill; thereby making the fish appear to the eye large and full, which when dressed will be flabby, and little else than skin and bones. But this imposition may be discovered by placing the finger and thumb on each side of the vent, and squeezing it hard; the wind may be perceived to go out, the skin will fall in, and the fish appear lank, and of little value.

*Breeding of* FISHES may be turned to great advantage; for, besides furnishing the table, obliging one's friends, and raising money, the land will be thereby greatly

greatly improved, so as to yield more this way than by any other employment whatever. See *Fish Pond*.

*Castration of* FISH, is a method first practised by Mr Tull in order to prevent the excessive increase of fish in some of his ponds, where the numbers did not permit any of them to grow to an advantageous size. But he afterwards found, that the castrated fish grew much larger than their usual size, were more fat, and always in season. This operation may be performed both on male and female fish; and the most eligible time for it is when the ovaries of the female have their ova in them, and when the vessels of the male, analogous to these, have their seminal matter in them; because, at this time, these vessels are more easily distinguished from the ureters, which convey the urine from the kidneys into the bladder, and are situated near the seminal vessels on each side of the spine; which, without sufficient attention, may be mistaken for the ovaries, especially when these last are empty. The time least proper for this operation, is just after they have spawned, because the fish are then too weak and languid to bear, with success, so severe an operation; however, with skill and care, it may be performed almost at any time. When a fish is to be castrated, it must be held in a wet cloth with its belly upwards; then with a sharp penknife, having its point bent backwards, the operator cuts through the integuments of the rim of the belly, taking care not to wound any of the intestines. As soon as a small aperture is made, he carefully inserts a hooked pen-knife, and with this dilates the aperture from between the two fore-fins almost to the anus. He then, with two small blunt silver-hooks, five or six inches long, and of this form P, by the help of an assistant, holds open the belly of the fish; and with a spoon or spatula, removes carefully the intestines from one side. When these are removed, you see the ureter, a small vessel, nearly in the direction of the spine, and also the ovary, a larger vessel, lying before it, nearer the integuments of the belly. This last vessel is taken up with a hook of the same kind with those before mentioned, and, after detaching it from the side far enough for the purpose, divided transversely with a pair of sharp scissars, care being taken that the intestines are not wounded or injured. After one of the ovaries has been divided, the operator proceeds to divide the other in the same manner; and then the divided integuments of the belly are sewed with silk, the stitches being inserted at a small distance from one another. Mr Tull observes farther, that the spawning time is very various; that trouts are full about Christmas; perch in February; pikes in March, and carp and tench in May; and that allowance must be made for climate and situation, with regard to the spawning of fish. When the fish are castrated, they are put into the water where they are intended to continue; and they take their chance in common with other fish, as though they were not castrated. With tolerable care, few die of the operation. *Phil. Trans.* vol. xlviii. Part 2. art. 106.

Although we could not properly avoid inserting the above detail, it is presumed that few will be pleased with the invention. The operation is peculiarly cruel, and the purpose of it only a detestable piece of Apician refinement.

*Feeding of* FISHES. When they are fed in large pools or ponds, either malt boiled, or fresh grains, is the best food; thus carps may be raised and fed like capons, and tenches will feed as well. The care of feeding them is best committed to a gardener or the butler, who should be always at hand. When fed in a stew, any sort of grain boiled, especially pease, and malt coarsely ground, are proper food; also the grains after brewing, while fresh and sweet; but one bushel of malt not brewed will go as far as two of grains.

*Stealing of* FISH, by persons armed and disguised, is felony without benefit of clergy, by 9 Geo. I. cap. 22. See *Black Act*. And by 5 Geo. III. cap. 14. the penalty of transportation for seven years is inflicted on persons stealing or taking fish in any water, within a park, paddock, orchard, or yard; and on the receivers, aiders, and abettors; and a forfeiture of five pounds to the owner of the fishery is made payable by persons taking or destroying (or attempting so to do) any fish in any river or other water within any enclosed ground, being private property.

Amæn. Acad. tom. iii.

*Preserving of* FISH *for Cabinets*. Linnæus's method is, to expose them to the air; and when they acquire such a degree of putrefaction that the skin loses its cohesion to the body of the fish, it may be slid off almost like a glove; the two sides of this skin may then be dried upon paper like a plant, or one of the sides may be filled with plaster of Paris to give the subject a due plumpness.

A fish may be prepared, after it has acquired this degree of putrefaction, by making a longitudinal incision on the belly, and carefully dissecting the fleshy part from the skin, which is but slightly attached to it in consequence of the putrescency. The skin is then to be filled with cotton and the antiseptic powder as directed for birds; and, lastly, to be sowed up where the incision was made.

*Gold* FISH. See CYPRINUS, ICHTHYOLOGY *Index*.

*Gilding on* FISH. In the posthumous papers of Mr Hooke, a method is described of gilding live craw fish, carps, &c. without injuring the fish. The cement for this purpose is prepared, by putting some burgundy pitch into a new earthen pot, and warming the vessel till it receives so much of the pitch as will stick round it; then strewing some finely powdered amber before the pitch when growing cold, adding a mixture of three pounds of linseed oil and one of oil of turpentine, covering the vessel, and boiling them for an hour over a gentle fire, and grinding the mixture, as it is wanted, with so much pumice-stone in fine powder as will reduce it to the consistence of paint. The fish being wiped dry, the mixture is spread upon it; and the gold-leaf being then laid on, and gently pressed down, the fish may be immediately put into water again, without any danger of the gold coming off, for the matter quickly grows firm in water.

FISH, in a ship, a plank or piece of timber, fastened to a ship's mast or yard, to strengthen it; which is done by nailing it on with iron spikes, and winding ropes hard about them.

FISHES, in *Heraldry*, are the emblems of silence and watchfulness; and are borne either upright, imbowed, extended, endorsed respecting each other, surmounting one another, fretted, &c.

In blazoning fishes, those borne feeding, should be deemed *devouring*; all fishes borne upright and having fins, should be blazoned *hauriant;* and those borne transverse the escutcheon, must be termed *naiant*.

*Fish Ponds*, those made for the breeding or feeding of fish.

Fish ponds are no small improvement of watery and boggy lands, many of which are fit for no other use. In making of a pond, its head should be at the lowest part of the ground, that the trench of the flood-gate or sluice, having a good fall, may not be too long in emptying. The best way of making the head secure, is to drive in two or three rows of stakes above six feet long, at above four feet distance from each other, the whole length of the pond head, whereof the first row should be rammed at least about four feet deep. If the bottom is false, the foundation may be laid with quicklime; which slaking, will make it as hard as a stone. Some lay a layer of lime, and another of earth dug out of the pond, among the piles and stakes; and when these are well covered, drive in others as they see occasion, ramming in the earth as before, till the pond head be of the height designed.

The dam should be made sloping on each side, leaving a waste to carry off the over abundance of water in times of floods or rains; and as to the depth of the pond, the deepest part need not exceed six feet, rising gradually in shoals towards the sides, for the fish to sun themselves, and lay their spawn. Gravelly and sandy bottoms, especially the latter, are best for breeding; and a fat soil with a white fat water, as the washings of hills, commons, streets, sinks, &c. is best for fattening all sorts of fish. For storing a pond, carp is to be preferred for its goodness, quick growth, and great increase, as breeding five or six times a-year. A pond of an acre, if it be a feeding and not breeding one, will every year feed 200 carps of three years old, 300 of two years old, and 400 of a year old. Carps delight in ponds that have marl or clay bottoms, with plenty of weeds and grass, whereon they feed in the hot months.

Ponds should be drained every three or four years, and the fish sorted. In breeding ones, the smaller ones are to be taken out, to store other ponds with; leaving a good stock of females, at least eight or nine years old, as they never breed before that age. In feeding ponds, it is best to keep them pretty near of a size.

FISHER, John, bishop of Rochester, was born at Beverly in Yorkshire, in the year 1459, and educated in the collegiate church of that place. In 1484, he removed to Michael house in Cambridge, of which college he was elected master in the year 1495. Having applied himself to the study of divinity, he took orders; and, becoming eminent as a divine, attracted the notice of Margaret countess of Richmond, mother of Henry VII. who made him her chaplain and confessor. In 1501, he took the degree of doctor of divinity, and the same year was elected chancellor of the university. In the year following, he was appointed Lady Margaret's first divinity professor; and in 1504, consecrated bishop of Rochester; which small bishopric he would never resign, though he was offered both Ely and Lincoln. It is generally allowed, that the foundation of the two colleges of Christ church and St John's, in Cambridge, was entirely owing to Bishop Fisher's persuasion and influence with the countess of Richmond: he not only formed the design, but superintended the execution. On the promulgation of Martin Luther's doctrine, our bishop was the first to enter the lists against him. On this occasion he exerted all his influence, and is generally supposed to have written the famous book by which Henry VIII. obtained the title of *Defender of the Faith*. Hitherto he continued in favour with the king; but in 1527, opposing his divorce, and denying his supremacy, the implacable Harry determined, and finally effected, his destruction. In 1543, the parliament found him guilty of misprision of treason, for concealing certain prophetic speeches of a fanatical impostor, called the *Holy Maid of Kent*, relative to the king's death; and condemned him, with five others, in loss of goods and imprisonment during his majesty's pleasure; but he was released on paying 300l. for the king's use.

King Henry being now married to Anne Boleyn, his obsequious parliament took an oath of allegiance proper for the occasion. This oath the bishop of Rochester steadily refused; alleging, that his conscience could not be convinced that the king's first marriage was against the law of God. For refusing this oath of succession, he was attainted by the parliament of 1534; and committed to the Tower, where he was cruelly treated, and where he would probably have died a natural death, had not the pope created him a cardinal. The king, now positively determined on his destruction, sent Rich the solicitor general, under the pretence of consulting the bishop on a case of conscience, but really with a design to draw him into a conversation concerning the supremacy. The honest old bishop spoke his mind without suspicion or reserve, and an indictment and conviction of high treason was the consequence. He was beheaded at Tower Hill on the 22d of June 1535, in the 77th year of his age. Thus died this good old prelate; who, notwithstanding his inflexible enmity to the Reformation, was undoubtedly a learned, pious, and honest man. He wrote several treatises against Luther, and other works, which were printed at Wurtzburg in 1597, in one volume folio.

FISHERY, a place where great numbers of fish are caught.

The principal fisheries for salmon, herrings, mackrel, pilchards, &c. are along the coasts of Scotland, England, and Ireland: for cod, on the banks of Newfoundland: for whales, about Greenland; and for pearls, in the East and West Indies.

*Free-Fishery*, in *Law*, or an exclusive right of fishing in a public river, is a royal franchise; and is considered as such in all countries where the feodal polity has prevailed: though the making such grants, and by that means appropriating, what it seems unnatural to restrain, the use of running water, was prohibited for the future, by King John's Great Charter; and the rivers that were fenced in his time were directed to be laid open, as well as the forests to be disforested. This opening was extended by the second and third charters of Henry III. to those also that were fenced under Richard I.; so that a franchise of free fishery ought now to be as old at least as the reign of Henry II. This differs from a *several of piscary*, because he that has a several fishery must also be the owner of the soil, which in a free fishery is not requisite. It differs also from a *common* fishery in that the free fishery is an exclusive

right,

right, the common fishery is not so: and therefore, in a free fishery, a man has property in the fish before they are caught; in a common piscary, not till afterwards. Some indeed have considered a *free* fishery not as a royal franchise; but merely as a private grant of a liberty to fish in the *several* fishery of the grant. But the considering such right as originally a flower of the prerogative, till restrained by Magna Charta, and derived by royal grant (previous to the reign of Richard I.) to such as now claim it by prescription, may remove some difficulties in respect to this matter with which our law books are embarrassed.

**Fishery**, denotes also the commerce of fish, more particularly the catching them for sale.

Were we to enter into a very minute and particular consideration of fisheries, as at present established in this kingdom, this article would swell beyond its proper bounds; because, to do justice to a subject of such concernment to the British nation, requires a very ample and distinct discussion. We shall, however, observe, that since the Divine Providence hath so eminently stored the coasts of Great Britain and Ireland with the most valuable fish; and since fisheries, if successful, become permanent nurseries for breeding expert seamen; it is not only a duty we owe to the Supreme Being, not to despise the wonderful plenty he hath afforded us, by neglecting to extend this branch of commerce to the utmost; but it is a duty we owe to our country, for its natural security, which depends upon the strength of our royal navy. No nation can have a navy where there is not a fund of business to breed and employ seamen without any expence to the public, and no trade is so well calculated for training up these useful members of society as fisheries.

The situation of the British coasts is the most advantageous in the world for catching fish: the Scottish islands, particularly those to the north and west, lie most commodious for carrying on the fishing trade to perfection; for no country in Europe can pretend to come up to Scotland in the abundance of the finest fish, with which its various creeks, bays, rivers, lakes, and coasts, are replenished. Of these advantages the Scots seem indeed to have been abundantly sensible; and their traffic in herrings, the most valuable of all the fisheries, is noticed in history so early as the ninth century. The frequent laws which were enacted in the reigns of James III. IV. and V. discover a steady determined zeal for the benefit of the native subjects, and the full restoration of the fisheries, which the Dutch had latterly found means to engross; and do honour to the memory of those patriots whom modern times affect to call barbarians.

The expedition of James V. to the Hebrides and western parts of the Highlands, and his assiduity in exploring and sounding the harbours, discovered a fixed resolution in that active prince, to civilize the inhabitants, to promote the valuable fisheries at their doors, and to introduce general industry. His death, at an early period, and the subsequent religious and civil commotions in the kingdom, frustrated those wise designs, and the western fisheries remained in their original state of neglect. At length, 1602, James VI. resumed the national purposes which had been thus chalked out by his grandfather. "Three towns (says Dr Robertson) which might serve as a retreat for the industrious, and a nursery for arts and commerce, were appointed to be built in different parts of the Highlands; one in Cantire, another in Lochaber, and a third in the isle of Lewis; and in order to draw the inhabitants thither, all the privileges of the royal boroughs were to be conferred upon them. Finding it, however, to be no easy matter to inspire the inhabitants of those countries with the love of industry, a resolution was taken to plant amongst them colonies of people from the more industrious counties. The first experiment was made in the isle of Lewis; and as it was advantageously situated for the fishing trade (a source from which Scotland ought naturally to derive great wealth), the colony transported thither was drawn out of Fife, the inhabitants of which were well skilled in that branch of commerce. But before they had remained there long enough to manifest the good effects of this institution, the islanders, enraged at seeing their country occupied by those intruders, took arms, and surprising them in the night time, murdered some of them, and compelled the rest to abandon the settlement. The king's attention being soon turned to other objects, particularly to his succession to the English crown, we hear no more of his salutary project."

The Scottish fisheries were, however, resumed by Charles I. who "ordained an association of the three kingdoms, for a general fishing within the hail seas and coasts of his majesty's said kingdoms; and for the government of the said association, ordained, that there should be a standing committee chosen and nominated by his majesty, and his successors from time to time," &c. &c. Several persons of distinction embarked in the design, which the king honoured with his patronage, and encouraged by his bounty. He also ordered Lent to be more strictly observed; prohibited the importation of fish taken by foreigners; and agreed to purchase from the company his naval stores and the fish for his fleets. Thus the scheme of establishing a fishery in the Hebrides began to assume a favourable aspect; but all the hopes of the adventurers were frustrated by the breaking out of the civil wars, and the very tragical death of their benefactor.

In 1661, Charles II. the duke of York, Lord Clarendon, and other persons of rank and fortune, resumed the business of the fisheries with greater vigour than any of their predecessors. For this purpose the most salutary laws were enacted by the parliaments of England and Scotland; in virtue of which, all materials used in, or depending upon the fisheries, were exempted from all duties, excises, or imposts whatever. In England, the company were authorised to set up a lottery, and to have a voluntary collection in all parish churches; houses of entertainment, as taverns, inns, ale-houses, were to take one or more barrels of herrings, at the stated price of 30s. per barrel; and 2s. 6d. per barrel was to be paid to the stock of this company on all imported fish taken by foreigners. Some Dutch families were also invited, or permitted to settle in Stornaway. The herrings cured by the Royal English company gave general satisfaction, and, as mentioned above, brought a high price for those days. Every circumstance attending this new establishment seemed to be the result of a judicious plan and thorough knowledge of the business, when the necessities of the king obliged him to withdraw his subscription or bounty; which gave such umbrage to the parties concerned, that they soon after dissolved.

In 1677, a new royal company was established in England, at the head of which was the duke of York, the earl of Derby, &c. Besides all the privileges which former companies had enjoyed, the king granted this new company a perpetuity, with power to purchase lands; and also 20l. to be paid them annually, out of the customs of the port of London, for every dogger or buss they should build and send out for seven years to come. A stock of 10,980l. was immediately advanced, and afterwards 1600l. more. This small capital was soon exhausted in purchasing and fitting out busses, with other incidental expences. The company made, however, a successful beginning; and one of their busses or doggers actually took and brought home 32,000 cod fish; other vessels had also a favourable fishery. Such favourable beginnings might have excited fresh subscriptions, when an unforeseen event ruined the whole design beyond the possibility of recovery. Most of the busses had been built in Holland, and manned with Dutchmen; on which pretence the French, who were then at war with Holland, seized six out of seven vessels, with their cargoes and fishing tackle: and the company being now in debt, sold, in 1680, the remaining stores, &c. A number of gentlemen and merchants raised a new subscription of 60,000l. under the privileges and immunities of the former charter. This attempt also came to nothing, owing to the death of the king, and the troubles of the subsequent reign.

Soon after the Revolution this business was again resumed, and upon a more extensive scale; the proposed capital being 300,000l. of which 100,000l. was to have been raised by the surviving patentees or their successors, and 200,000l. by new subscribers. Copies of the letters patent, the constitution of the company, and terms of subscription, were lodged at sundry places in London and Westminster, for the perusal of the public, while the subscription was filling. It is probable, that King William's partiality to the Dutch fisheries, the succeeding war, or both of these circumstances, frustrated this new attempt; of which we have no farther account in the annals of that reign or since.

The Scottish parliament had also, during the three last reigns, passed sundry acts for erecting companies and promoting the fisheries; but the intestine commotions of that country, and the great exertions which were made for the Darien establishment, enfeebled all other attempts, whether collectively or by individuals, within that kingdom.

In 1749, his late majesty having, at the opening of the parliament, warmly recommended the improvement of the fisheries, the house of commons appointed a committee to inquire into the state of the herring and white fisheries, and to consider of the most probable means of extending the same. All ranks of men were elevated with an idea of the boundless riches that would flow into the kingdom from this source. A subscription of 500,000l. was immediately filled in the city, by a body of men who were incorporated for 21 years by the name of *The Society of the Free British Fishery*. Every encouragement was held out by government, both to the society, and to individuals who might embark in this national business. A bounty of 36s. per ton was to be paid annually out of the customs, for 14 years, to the owners of all decked vessels or busses, from 20 to 80 tons burden, which should be built after the commencement of the act, for the use of, and fitted out and employed in, the said fisheries, whether by the society or any other persons. At the same time numerous pamphlets and newspaper essays came forth; all pretending to elucidate the subject, and to convince the public with what facility the herring fisheries might be transferred from Dutch to British hands. This proved, however, a more arduous task than had been foreseen by superficial speculators. The Dutch were frugal in their expenditures and living; perfect masters of the arts of fishing and curing, which they had carried to the greatest height and perfection. They were in full possession of the European markets; and their fish, whether deserving or otherwise, had the reputation of superior qualities to all others taken in our seas. With such advantages, the Dutch not only maintained their ground against this formidable company, but had also the pleasure of seeing the capital gradually sinking, without having procured an adequate return to the adventurers; notwithstanding various aids and efforts of government from time to time in their favour, particularly in 1757, when an advance of 20s. per ton was added to the bounty.

In 1786 the public attention was again called to the state of the British fisheries, by the suggestions of Mr Dempster in the house of commons, and by different publications that appeared upon the subject: in consequence of which the minister suffered a committee to be named, to inquire into this great source of national wealth. To that committee it appeared, that the best way of improving the fisheries was to encourage the inhabitants living nearest to the seat of them to become fishers: And it being found that the north-western coast of the kingdom, though abounding with fish and with fine harbours, was utterly destitute of towns, an act was passed for incorporating certain persons therein named, by the style of "*The British Society* for extending of the fisheries and improving the sea coasts of the kingdom;" and to enable them to subscribe a joint stock, and therewith to purchase lands, and build thereon free towns, villages, and fishing stations, in the Highlands and islands in that part of Great Britain called Scotland, and for other purposes. The isle of Mull, Loch Broom, the isles of Sky and of Cannay, have already been pitched upon as proper situations for some of these towns. The progress of such an undertaking from its nature must be slow, but still slower when carried on with a limited capital arising from the subscriptions of a few public-spirited individuals. But it is not to be doubted but that it will ultimately tend to the increase of our fisheries, and to the improvement of the Highland part of this kingdom. Its tendency is also to lessen the emigration of a brave and industrious race of inhabitants, too many of whom have already removed with their families to America.

1. *Anchovy* FISHERY. The anchovy is caught in the months of May, June, and July, on the coasts of Catalonia, Provence, &c. at which season it constantly repairs up the straits of Gibraltar, into the Mediterranean.

Collins says they are also found in plenty on the western coasts of England and Wales.

The fishing for them is chiefly in the night time; when a light being put on the stern of their little fishing vessels, the anchovies flock round, and are caught in the nets. But then it is asserted to have been found by experience, that anchovies taken thus by fire, are neither so good, so firm, nor so proper for keeping, as those which are taken without fire.

When the fishery is over, they cut off the heads, take out their gall and guts, and then lay them in barrels and salt them. The common way of eating anchovies is with oil, vinegar, &c. in order to which they are first boned, and the tails, fins, &c. slipped off.—Being put on the fire, they dissolve almost in any liquor. Or they are made into a sauce by mincing them with pepper, &c. Some also pickle anchovies in small delft or earthen pots, made on purpose, of two or three pounds weight, more or less, which they cover with plaster to keep them the better. Anchovies should be chosen small, fresh pickled, white on the outside and red within. They must have a round back; for those which are fat or large are often nothing but sardines. Besides these qualities, the pickle, on opening the pots or barrels, must be of a good taste, and not have lost its flavour.

2. *Cod* FISHERY. There are two kinds of cod fish; the one green or white cod, and the other dried or cured cod; though it is all the same fish, differently prepared; the former being sometimes salted and barrelled, then taken out for use; and the latter having lain some competent time in salt, dried in the sun or smoke. We shall therefore speak of each of these apart; and first of the

*Green*. The chief fisheries for green cod are in the bay of Canada, on the great bank of Newfoundland, and on the isle of St Peter, and the isle of Sable; to which places vessels resort from divers parts both of Europe and America. They are from 100 to 150 tons burden, and will catch between 30,000 and 40,000 cod each. The most essential part of the fishery is, to have a master who knows how to cut up the cod, one who is skilled to take off the head properly, and above all a good salter, on which the preserving of them, and consequently the success of the voyage depends. The best season is from the beginning of February to the end of April; the fish, which in the winter retire to the deepest water, coming then on the banks and fattening extremely. What is caught from March to June keeps well; but those taken in July, August, and September, when it is warm on the banks, are apt to spoil soon. Every fisher takes but one at a time: the most expert will take from 350 to 400 in a day; but that is the most; the weight of the fish and the great coldness on the bank fatiguing very much. As soon as the cod is caught, the head is taken off; they are opened, gutted, and salted; and the salter stows them in the bottom of the hold, head and tail, in beds a fathom or two square; laying layers of salt and fish alternately, but never mixing fish caught on different days. When they have lain thus three or four days to drain off the water, they are replaced in another part of the ship, and salted again; where they remain till the vessel is loaded. Sometimes they are cut in thick pieces, and put in barrels for the conveniency of carriage.

*Dry*. The principal fishery for this article is, from Cape Rose to the Bay des Exports, along the coast of Placentia, in which compass there are divers commodious ports for the fish to be dried in. These, though of the same kind with the fresh cod, are much smaller, and therefore fitter to keep, as the salt penetrates more easily into them. The fishery of both is much alike; only this latter is most expensive, as it takes up more time and employs more hands, and yet scarce half so much salt is spent in this as in the other. The bait is herrings, of which great quantities are taken on the coast of Placentia. When several vessels meet and intend to fish in the same part, he whose shallop first touches ground becomes entitled to the quality and privileges of admiral: he has the choice of his station, and the refusal of all the wood on the coast at his arrival. As fast as the masters arrive, they unrigg all their vessels, leaving nothing but the shrouds to sustain the mast; and in the mean time the mates provide a tent on shore, covered with branches of trees, and sails over them, with a scaffold of great trunks of pines, 12, 15, 16, and often 20 feet high, commonly from 40 to 60 feet long, and about one-third as much in breadth. While the scaffold is preparing, the crew are a-fishing; and as fast as they catch, they bring their fish ashore, and open and salt them upon moveable benches; but the main salting is performed on the scaffold. When the fish have taken salt, they wash and hang them to drain on rails; when drained, they are laid on kinds of stages, which are small pieces of wood laid across, and covered with branches of trees, having the leaves stripped off for the passage of the air. On these stages, they are disposed, a fish thick, head against tail, with the back uppermost, and are turned carefully four times every 24 hours. When they begin to dry, they are laid in heaps 10 or 12 thick, in order to retain their warmth; and every day the heaps are enlarged till they become double their first bulk; then two heaps are joined together, which they turn every day as before: lastly, they are salted again, beginning with those first salted; and being laid in huge piles, they remain in that situation till they are carried on board the ships, where they are laid on the branches of trees disposed for that purpose, upon the ballast, and round the ship, with mats to prevent their contracting any moisture.

There are four sorts of commodities drawn from cod, viz. the sounds, the tongues, the roes, and the oil extracted from the liver. The first is salted at the fishery together with the fish, and put in barrels from 600 to 700 pounds. The tongues are done in like manner, and brought in barrels from 400 to 500 pounds. The roes are also salted in barrels, and serve to cast into the sea to draw fish together, and particularly pilchards. The oil comes in barrels, from 400 to 520 pounds, and is used in dressing leather. In Scotland they catch a small kind of cod on the coasts of Buchan and all along the Murray frith on both sides; as also in the friths of Forth, Clyde, &c. which is much esteemed. They salt and dry them in the sun upon rocks, and sometimes in the chimney.

3. *Coral* FISHERY. See CORAL.

4. *Herring Fishery.* Our great stations for this fishery are off the Shetland and Western isles, and off the coast of Norfolk, in which the Dutch also share. There are two seasons for fishing herring; the first from June to the end of August; and the second in autumn, when the fogs become very favourable for this kind of fishing. The Dutch begin their herring fishing on the 24th of June, and employ a vast number of vessels therein, called *busses*, being between 45 and 60 tons burden each, and carrying three or four small cannon. They never stir out of port, without a convoy, unless there be enough together to make about 18 or 20 cannon among them, in which case they are allowed to go in company. Before they go out they make a verbal agreement, which has the same force as if it were in writing. The regulations of the admiralty of Holland are partly followed by the French and other nations, and partly improved and augmented with new ones; as, that no fisher shall cast his net within 100 fathoms of another boat: that while the nets are cast, a light shall be kept on the hind part of the vessel: that when a boat is by any accident obliged to leave off fishing, the light shall be cast into the sea; that when the greater part of a fleet leaves off fishing, and casts anchor, the rest shall do the same, &c.

Mr Anderson * gives to the Scots a knowledge of great antiquity in the herring fishery. He says that the Netherlanders resorted to these coasts as early as A. D. 836, to purchases alted fish of the natives; but, imposing on the strangers, they learned the art, and took up the trade, in after times of such immense emolument to the Dutch.

Sir Walter Raleigh's observations on that head, extracted from the same author, are extremely worthy the attention of the curious, and excite reflections on the vast strength resulting from the wisdom of well applied industry.

In 1603, he remarks, the Dutch sold to different nations as many herrings as amounted to 1,759,000l. sterling. In the year 1615, they at once sent out 2000 busses, and employed in them 37,000 fishermen. In the year 1618, they sent out 3000 ships, with 50,000 men to take the herrings, and 9000 more ships to transport and sell the fish; which by sea and land employed 150,000 men, besides those first mentioned. All this wealth was gotten on our coasts, while our attention was taken up in a distant whale fishery.

The Scottish monarchs seemed for a long time to direct all their attention to the preservation of the salmon fishery, probably because their subjects were such novices in sea affairs. At length James III. endeavoured to stimulate his great men to these patriotic undertakings: for by an act of his third parliament, he compelled certain lords spiritual and temporal, and burrows, to make ships, busses and boats, with nets and other pertinents, for fishing: that the same should be made in each burgh; in number according to the substance of each burgh, and the least of them to be of twenty tons: and that all idle men be compelled by the sheriffs in the country to go on board the same."

Numerous indeed have been the attempts made at different periods to secure this treasure to ourselves, but without success. In the late reign, a very strong effort was made, and bounties allowed for the encouragement of British adventurers: the first was of 30s. per ton to every buss of 70 tons and upwards. This bounty was afterwards raised to 50s. per ton, to be paid to such adventurers as were entitled to it by claiming it at the places of rendezvous. The busses are from 20 to 90 tons burden, but the best size is 80. A vessel of 80 tons ought to take ten lasts, or 120 barrels of herrings, to clear expences, the price of the fish to be admitted to be a guinea a barrel. A ship of this size ought to have 18 men, and three boats: one of 20 tons should have six men, and every five tons above require an additional hand. To every ton are 280 yards of nets; so a vessel of 80 tons carries 20,000 square yards: each net is 12 yards long, and 10 deep, and every boat takes out from 20 to 30 nets, and puts them together so as to form a long train; they are sunk at each end of the train by a stone, which weighs it down to the full extent: the top is supported by buoys, made of sheepskin, with a hollow stick at the mouth fastened tight: through this the skin is blown up, and then stopped with a peg, to prevent the escape of the air. Sometimes these buoys are placed at the top of the nets: at other times the nets are suffered to sink deeper, by the lengthening the cords fastened to them, every cord being for that purpose 10 or 12 fathoms long. But the best fisheries are generally in more shallow water.

Of the Scots fishery in the Western isles, the following account is given by Mr Pennant †. "The fishing is always performed in the night, unless by accident. The busses remain at anchor, and send out their boats a little before sunset: which continue out, in winter and summer, till day-light; often taking up and emptying their nets, which they do 10 or 12 times in a night, in case of good success. During winter it is a most dangerous and fatiguing employ, by reason of the greatness and frequency of the gales in these seas, and in such gales are the most successful captures: but by the Providence of heaven the fishers are seldom lost; and, what is wonderful, few are visited with illness. They go out well prepared, with a warm great coat, boots, and skin aprons, and a good provision of beef and spirits. The same good fortune attends the busses, which in the tempestuous season, and in the darkest nights, are continually shifting in these narrow seas, from harbour to harbour. Sometimes 80 barrels of herrings are taken in a night by the boats of a single vessel. It once happened in Loch Slappan, in Sky, that a buss of 80 tons might have taken 200 barrels in one night, with 10,000 square yards of net; but the master was obliged to desist, for want of a sufficient number of hands to preserve the capture. The herrings are preserved by salting, after the entrails are taken out. This last is an operation performed by the country people, who get three-halfpence per barrel for their trouble; and sometimes, even in the winter, can gain fifteen pence a-day. This employs both women and children; but the salting is only intrusted to the crew of the busses. The fish are laid on their backs in the barrels, and layers of salt between them. The entrails are not lost, for they are boiled into an oil: 8000 fish will yield ten gallons, valued at one shilling the gallon. A vessel of 80 tons, takes out 144 barrels of salt; a drawback of 2s. 8d. is allowed for each barrel used by the foreign or Irish exportation of the fish; but there is a duty of 1s. per barrel for the home consumption, and the same

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* Hist. of Commerce.

† Voyage to the Hebrides.

for those sent to Ireland. The barrels are made of oak staves chiefly from Virginia; the hoops from several parts of our own island, and are either of oak, birch, hazel or willow; the last from Holland, liable to a duty. The barrels cost about 3s. each, they hold from 500 to 800 fish, according to the size of the fish; and are made to contain 22 gallons. The barrels are inspected by proper officers; a cooper examines if they are statutable and good; if faulty, he destroys them, and obliges the maker to stand to the loss.

"Loch Broom has been celebrated for three or four centuries as the resort of herrings. They generally appear here in July; those that turn into this bay are part of the brigade that detaches itself from the western column of that great army which annually deserts the vast depths of the arctic circle, and comes, heaven-directed, to the seats of population, offered as a cheap food to millions, whom wasteful luxury or iron-hearted avarice hath deprived, by enhancing the price, of the wonted supports of the poor. The migration of the fish from their northern retreat is regular; their visits to the Western isles and coasts certain; but their attachment to one particular loch extremely precarious. All have their turns; that which swarmed with fish one year, is totally deserted the following; yet the next loch to it may be crowded with the shoals. These changes of place give often full employ to the busses, who are continually shifting their harbour in quest of news respecting these important wanderers. They commonly appear here in July; the latter end of August they go into deep water, and continue there for some time, without any apparent cause: in November, they return to the shallows, when a new fishery commences, which continues till January: at that time the herrings become full of roe, and are useless as articles of commerce. Some doubt, whether those herrings that appear in November are not part of a new migration; for they are as fat, and make the same appearance, as those that composed the first. The signs of the arrival of the herrings are flocks of gulls, who catch up the fish while they skim on the surface, and of gannets who plunge and bring them up from considerable depths. Both these birds are closely attended to by the fishers. Cod fish, haddocks, and dog fish, follow the herrings in vast multitudes: these voracious fish keep on the outsides of the columns, and may be a concurrent reason of driving the shoals into bays and creeks. In summer, they come into the bays generally with the warmest weather, and with easy gales. During winter, the hard gales from north-west are supposed to assist in forcing them into shelter. East winds are very unfavourable to the fishery."

Herrings are cured either white or pickled, or red.

Of the *first*, those done by the Dutch are the most esteemed, being distinguished into four sorts, according to their sizes; and the best are those that are fat, fleshy, firm, and white, salted the same day they are taken, with good salt, and well barrelled. The British cured herrings are little inferior, if not equal, to the Dutch: for in spite of all their endeavours to conceal the secret, their method of curing, lasting, or casking the herrings, has been discovered, and is as follows. After they have hauled in their nets, which they drag in the stern of their vessels backwards and forwards in traversing the coast, they throw them upon the ship's deck, which is cleared of every thing for that purpose: the crew is separated into sundry divisions, and each division has a peculiar task; one part opens and guts the herrings, leaving the milts and roes; another cures and salts them, by lining or rubbing their inside with salt; the next packs them, and between each row and division they sprinkle handfuls of salt; lastly, the cooper puts the finishing hand to all, by heading the casks very tight, and stowing them in the hold.

*Red* herrings must lie 24 hours in the brine, inasmuch as they are to take all their salt there; and when they are taken out, they are spitted, that is, strung by the head on little wooden spits, and then hung in a chimney made for that purpose. After which, a fire of brushwood, which yields a deal of smoke, but no flame, being made under them, they remain there till sufficiently smoked and dried, and are afterwards barrelled up for keeping.

5. *Lobster* FISHERY. Lobsters are taken along the British channel, and on the coast of Norway, whence they are brought to London for sale; and also in the frith of Edinburgh, and on the coast of Northumberland. By 10 and 11 W. III. cap. 24. no lobster is to be taken under eight inches in length, from the peak of the nose to the end of the middle fin of the tail; and by 9 Geo. II. cap. 33. no lobsters are to be taken on the coast of Scotland from the 1st of June to the 1st of September.

6. *Mackerel* FISHERY. The mackerel is a summer fish of passage, found in large shoals, in divers parts of the ocean, not far north; but especially on the French and English coasts. The fishing is usually in the months of April, May, and June, and even July, according to the place. They enter the English channel in April, and proceed up the straits of Dover as the summer advances; so that by June they are on the coasts of Cornwall, Sussex, Normandy, Picardy, &c. where the fishery is most considerable. They are an excellent food fresh; and not to be despised, when well prepared, pickled, and put up in barrels; a method of preserving them chiefly used in Cornwall.

The fish is taken two ways; either with a line or nets: the latter is the more considerable, and is usually performed in the night-time. The rules observed in the fishing for mackerel are much the same as those already mentioned in the fishery of herrings.

There are two ways of pickling them: the first is, by opening and gutting them, and filling the belly with salt, crammed in as hard as possible, with a stick; which done, they range them in strata or rows, at the bottom of the vessel, strewing salt between the layers. In the second way, they put them immediately into tubs full of brine, made of fresh water and salt; and leave them to steep, till they have imbibed salt enough to make them keep; after which, they are taken out, and barrelled up, taking care to press them close down.

Mackerel are not cured or exported as merchandise, except a few by the Yarmouth and Leostoff merchants, but are generally consumed at home; especially in the city of London, and the sea-ports between the Thames and Yarmouth, east, and the Land's End of Cornwall, west.

7. *Oyster* Fishery‡. This fishery is principally carried on at Colchester in Essex; Feversham and Milton in Kent; the Isle of Wight; the Swales of the Medway; and Tenby on the coast of Wales. From Feversham, and adjacent parts, the Dutch have sometimes loaded a hundred large hoys with oysters in a year. They are also taken in great quantities near Portsmouth, and in all the creeks and rivers between Southampton and Chichester: many of which are carried about by sea to London and to Colchester, to be fed in the pits about Wavenhoe and other places.

8. *Pearl* Fishery. See Pearl, Conchology *Index*, and Ceylon.

9. *Pilchard* Fishery. The chief pilchard fisheries are along the coasts of Dalmatia, on the coast of Bretagne, and along the coasts of Cornwall and Devonshire. That of Dalmatia is very plentiful: that on the coasts of Bretagne employs annually about 300 ships. Of the pilchard fishery on the coast of Cornwall the following account is given by Dr Borlase: "It employs a great number of men on the sea, training them thereby to naval affairs; employs men, women, and children, on land, in salting, pressing, washing and cleaning; in making boats, nets, ropes, casks, and all the trades depending on their construction and sale. The poor are fed with the offals of the captures, the land with the refuse of the fish and salt; the merchant finds the gains of commission and honest commerce, the fisherman the gains of the fish. Ships are often freighted hither with salt, and into foreign countries with the fish, carrying off at the same time part of our tin. Of the usual produce of the great number of hogsheads exported each year for ten years, from 1747 to 1756 inclusive, from the four ports of Fowey, Falmouth, Penzance, and St Ives, it appears that Fowey has exported yearly 1732 hogsheads; Falmouth, 14,631 hogsheads and two thirds; Penzance and Mounts-Bay 12,149 hogsheads and one-third; St Ives, 1280 hogsheads: in all amounting to 29,795 hogsheads. Every hogshead for ten years last past, together with the bounty allowed for each hogshead exported, and the oil made out of each hogshead, has amounted, one year with another at an average, to the price of 1l. 13s. 3d.; so that the cash paid for pilchards exported has, at a medium, annually amounted to the sum of 49,532l. 10s."—The numbers that are taken at one shooting out of the nets are amazingly great. Mr Pennant says, that Dr Borlase assured him, that on the 5th of October 1767, there were at one time enclosed in St Ives's Bay 7000 hogsheads, each hogshead containing 35,000 fish; in all 245 millions.

The pilchards naturally follow the light, which contributes much to the facility of the fishery; the season is from June to September. On the coasts of France they make use of the roes of the cod fish as a bait; which, thrown into the sea, makes them rise from the bottom, and run into the nets. On our coasts there are persons posted ashore, who, spying by the colour of the water where the shoals are, make signs to the boats to go among them to cast their nets. When taken, they are brought on shore to a warehouse, where they are laid up in broad piles, supported with backs and sides; and as they are piled, they salt them with bay salt; in which lying to soak for 30 or 40 days, they run out a deal of blood with dirty pickle and bittern: then they wash them clean in sea water; and, when dry, barrel and press them hard down to squeeze out the oil, which issues out at a hole in the bottom of the cask.

10. *Salmon* Fishery †. The chief salmon fisheries in Europe are in England, Scotland, and Ireland, in the rivers, and sea coasts adjoining to the river mouths. The most distinguished for salmon in Scotland are, the river Tweed, the Clyde, the Tay, the Dee, the Don, the Spey, the Ness, the Bewly, &c. in most of which it is very common, about the height of summer, especially if the weather happens to be very hot, to catch four or five score salmon at a draught. The chief rivers in England for salmon are, the Tyne, the Trent, the Severn, and the Thames. The fishing is performed with nets, and sometimes with a kind of locks or wears made on purpose, which in certain places have iron or wooden grates so disposed, in an angle, that being impelled by any force in a contrary direction to the course of the river, they may give way and open a little at the point of contact, and immediately shut again, closing the angle. The salmon, therefore, coming up into the rivers, are admitted into these grates, which open, and suffer them to pass through, but shut again, and prevent their return. The salmon is also caught with a spear, which they dart into him when they see him swimming near the surface of the water. It is customary likewise to catch them with a candle and lanthorn, or wisp of straw set on fire; for the fish naturally following the light, are struck with the spear, or taken in a net spread for that purpose, and lifted with a sudden jerk from the bottom.

"The capture of salmon in the Tweed, about the month of July (says Mr Pennant ‡) is prodigious. In a good fishery, often a boat load, and sometimes near two, are taken in a tide: some few years ago there were above 700 fish taken at one haul, but from 50 to 100 is very frequent. The coopers in Berwick then began to salt both salmon and grilses in pipes and other large vessels, and afterwards barrel them to send abroad, having then far more than the London markets can take off their hands.

"Most of the salmon taken before April, or to the setting in of the warm weather, is sent fresh to London in baskets: unless now and then the vessel is disappointed by contrary winds of sailing immediately; in which case the fish is brought ashore again to the coopers offices, and boiled, pickled, and kitted, and sent to the London markets by the same ship, and fresh salmon put in the baskets in lieu of the stale ones. At the beginning of the season, when a ship is on the point of sailing, a fresh clean salmon will sell from a shilling to eighteen pence a pound; and most of the time that this part of the trade is carried on, the prices are from five to nine shillings per stone; the value rising and falling according to the plenty of fish, or the prospect of a fair or foul wind. Some fish are sent in this matter to London the latter end of September, when the weather grows cool; but then the fish are full of large roes, grow very thin bellied, and are not esteemed either palatable or wholesome.

"The season for fishing in the Tweed begins November 30th, but the fishermen work very little till after Christmas: it ends on Michaelmas day; yet the corporation of Berwick (who are conservators of the river)

‡ See Ostrea, Conchology Index.

river) indulge the fishermen with a fortnight past that time, on account of the change of the style.

"There are on the river 41 considerable fisheries, extending upwards about 14 miles from the mouth (the others above being of no great value), which are rented for near 5400l. per annum: the expence attending the servants wages, nets, boats, &c. amount to 5000l. more; which together makes up the sum 10,400l. Now, in consequence, the produce must defray all, and no less than 20 times that sum of fish will effect it; so that 208,000 salmon must be caught there one year with another.

"Scotland possesses great numbers of fine fisheries on both sides of that kingdom. The Scotch in early times had most severe laws against the killing of this fish; for the third offence was made capital, by a law of James IV. Before that, the offender had power to redeem his life. They were thought in the time of Henry VI. a present worthy of a crowned head: for in that reign the queen of Scotland sent to the duchess of Clarence 10 casks of salted salmon; which Henry directed to pass duty free. The salmon are cured in the same manner as at Berwick, and a great quantity is sent to London in the spring; but after that time, the adventurers begin to barrel and export them to foreign countries; but we believe that commerce is far less lucrative than it was in former times, partly owing to the great increase of the Newfoundland fishery, and partly to the general relaxation of the discipline of abstinence in the Romish church.

"Ireland (particularly the north) abounds with this fish: the most considerable fishery is at Cranna, on the river Ban, about a mile and a half from Coleraine. When I made the tour of that hospitable kingdom in 1754, it was rented by a neighbouring gentleman for 620l. a-year; who assured me, that the tenant, his predecessor, gave 1600l. per annum, and was a much greater gainer by the bargain, for the reasons before mentioned, and on account of the number of poachers who destroy the fish in the fence months.

"The mouth of this river faces the north; and is finely situated to receive the fish that roam along the coast in search of an inlet into some fresh water, as they do along that end of the kingdom which opposes itself to the northern ocean. We have seen near Ballicastle, nets placed in the sea at the foot of the promontories that jut into it, which the salmon strike into as they are wandering close to shore; and numbers are taken by that method.

"In the Ban they fish with nets 18 score yards long, and are continually drawing night and day the whole season, which we think lasts about four months, two sets of 16 men each alternately relieving one another. The best drawing is when the tide is coming in: we were told, that at a single draught there were once 840 fish taken.

"A few miles higher up the river is a wear where a considerable number of fish that escape the nets are taken. We were lately informed, that, in the year 1760, about 320 tons were taken in the Cranna fishery."

*Curing Salmon.* When the salmon are taken, they open them along the back, take out the guts and gills, and cut out the greatest part of the bones, endeavouring to make the inside as smooth as possible: they then salt the fish in large tubs for the purpose, where they lie a considerable time soaking in brine; and about October they are packed close up in barrels, and sent to London, or exported up the Mediterranean. They have also in Scotland a great deal of salmon salted in the common way, which after soaking in brine a competent time, is well pressed, and then dried in smoke: this is called *kipper*, and is chiefly made for home consumption; and if properly cured and prepared, is reckoned very delicious.

*Sturgeon* † FISHERY. The greatest sturgeon fishery is in the mouth of the Volga, on the Caspian sea: where the Muscovites employ a great number of hands, and catch them in a kind of enclosure, formed by huge stakes representing the letter Z repeated several times. These fisheries are open on the side next the sea, and close on the other; by which means the fish ascending in its season up the river, is embarrassed in these narrow angular retreats, and so is easily killed with a harping iron. Sturgeons, when fresh, eat deliciously; and in order to make them keep, they are salted or pickled in large pieces, and put up in cags from 30 to 50 pounds. But the great object of this fishery is the roe, of which the Muscovites are extremely fond, and of which is made the cavear, or kavia, so much esteemed by the Italians. See CAVEAR.

† See *Accipenser, Ichthyology Index.*

*Tunny* FISHERY. The tunny (a species of SCOMBER), was a fish well known to the ancients, and made a great article of commerce: And there are still very considerable tunny fisheries on the coasts of Sicily, as well as several other parts of the Mediterranean.

The nets are spread over a large space of sea by means of cables fastened to anchors, and are divided into several compartments. The entrance is always directed, according to the season, towards that part of the sea from which the fish are known to come. A man placed upon the summit of a rock high above the water, gives a signal of the fish being arrived; for he can discern from that elevation what passes under the waters infinitely better than any person nearer the surface. As soon as notice is given that the shoal of fish has penetrated as far as the inner compartment, or the chamber of death, the passage is drawn close, and the slaughter begins.

The undertakers of these fisheries pay an acknowledgment to the king, or the lord upon whose land they fix the main stay or foot of the tonnara; they make the best bargain they can: and, till success has crowned their endeavours, obtain this leave for a small consideration; but the rent is afterwards raised in proportion to their capture.

The tunny enters the Mediterranean about the vernal equinox, travelling in a triangular phalanx, so as to cut the waters with its point, and to present an extensive base for the tides and currents to act against, and impel forwards. These fish repair to the warm seas of Greece to spawn, steering their course thither along the European shores, but as they return, approach the African coast; the young fry is placed in the van of the squadron as they travel. They come back from the east in May, and abound on the coast of Sicily and Calabria about that time. In autumn they steer northward, and frequent the neighbourhood of Amalfi and Naples; but during the whole season stragglers are occasionally caught.

When taken in May, the usual time of their appearance in the Calabrian bays, they are full of spawn, and their flesh is then esteemed unwholesome, apt to occasion headachs and vapours; the milts and roes are particularly so at that season. To prevent these bad effects, the natives fry them in oil, and afterwards salt them. The quantity of this fish consumed annually in the Two Sicilies almost exceeds the bounds of calculation. From the beginning of May to the end of October it is eaten fresh, and all the rest of the year it is in use salted. The most delicate part is the muzzle. The belly salted was called *tarantallum*, and accounted a great delicacy by the Romans; its present name is *Surra*. The rest of the body is cut into slices, and put into tubs.

*Turbot* FISHERY, Turbot grows to a large size, some of them weighing from 23 to 30 pounds. They are taken chiefly off the north coast of England, and others off the Dutch coast. The large turbot (as well as several other kinds of flat fish) are taken by the hook and line, for they lie in deep water; the method of taking them in wears or staked nets being very precarious. When the fishermen go out to fish, each person is provided with three lines, which are coiled on a flat oblong piece of wicker work; the hooks being baited, and placed regularly in the centre of the coil. Each line is furnished with 14 score of hooks, at the distance of six feet two inches from each other. The hooks are fastened to the lines upon sneads of twisted horse hair 27 inches in length. When fishing, there are always three men in each coble, and consequently nine of these lines are fastened together, and used in one line, extending in length near three miles, and furnished with 2520 hooks. An anchor and a buoy are fixed at the first end of the line, and one more of each at the end of each man's lines; in all four anchors, which are common perforated stones, and four buoys made of leather or cork. The line is always laid across the current. The tides of flood and ebb continue an equal time upon our coast, and, when undisturbed by winds, run each way about six hours; they are so rapid that the fishermen can only shoot and haul their lines at the turn of tide, and therefore the lines always remain upon the ground about six hours; during which time the *myxine glutinosa* of Linnæus will frequently penetrate the fish that are on the hooks, and entirely devour them, leaving only the skin and bones. The same rapidity of tides prevents their using hand lines; and therefore two of the people commonly wrap themselves in the sail, and sleep, while the other keeps a strict look-out, for fear of being run down by ships, and to observe the weather. For storms often rise so suddenly, that it is with extreme difficulty they can sometimes escape to the shore, leaving their lines behind.

Besides the coble, the fishermen have also a five-men boat, which is 40 feet long and 15 broad, and 25 tons burden; it is so called, though navigated by six men and a boy, because one of the men is commonly hired to cook, &c. and does not share in the profits with the other five. This boat is decked at each end, but open in the middle, and has two large lug sails. All our able fishermen go in these boats to the herring fishery at Yarmouth in the latter end of September, and return about the middle of November. The boats are then laid up till the beginning of Lent, at which time they go off in them to the edge of the Dogger, and other places to fish for turbot, cod, ling, skates, &c. They always take two cobles on board; and when they come upon their ground, anchor the boat, throw out the cobles, and fish in the same manner as those do who go from the shore in a coble: with this difference only, that here each man is provided with double the quantity of lines, and instead of waiting the return of the tide in the coble, return to their boat and bait their other lines; thus hauling one set and shooting another every turn of tide. They commonly run into harbour twice a-week to deliver their fish.

The best bait is fresh herring cut in pieces of a proper size; the five-men boats are always furnished with nets for taking them. Next to herrings are the lesser lampreys. The next baits in esteem are small haddocks cut in pieces, sand worms, and limpets, here called *flidders*; and when none of these can be had, they use bullock's liver. The hooks are two inches and a half long in the shank, and near an inch wide between the shank and the point. The line is made of small cording, and is always tanned before it is used.

Turbots are extremely delicate in their choice of baits; for if a piece of herring or haddock has been 12 hours out of the sea, and then used as bait, they will not touch it.

*Whale* FISHERY. See BALÆNA, CETOLOGY *Index*.

Whales are chiefly caught in the north seas; the largest sort are found about Greenland or Spitzbergen. At the first discovery of this country, whales not being used to be disturbed, frequently came into the very bays, and were accordingly killed almost close to the shore; so that the blubber being cut off was immediately boiled into oil on the spot. The ships in those times took in nothing but the pure oil and the whalebone, and all the business was executed in the country; by which means a ship could bring home the product of many more whales than she can, according to the present method of conducting this trade. The fishery also was then so plentiful, that they were obliged sometimes to send other ships to fetch off the oil they had made, the quantity being more than the fishing ships could bring away. But time and change of circumstances have shifted the situation of this trade. The ships coming in such numbers from Holland, Denmark, Hamburgh, and other northern countries, all intruders upon the English, who were the first discoverers of Greenland, the whales were disturbed, and gradually, as other fish often do, forsaking the place, were not to be killed so near the shore as before: but are now found, and have been so ever since, in the openings and space among the ice, where they have deep water, and where they go sometimes a great many leagues from the shore.

The whale fishery begins in May, and continues all June and July; but whether the ships have good or bad success, they must come away, and get clear of the ice by the end of August; so that in the month of September at farthest they may be expected home; but a ship that meets with a fortunate and early fishery in May may return in June or July.

A particular account of the recent history and present state of the British fisheries will be found in the article FISHERIES, in the SUPPLEMENT.

FISHGARD, or FISGARD, a town of Pembrokeshire, situated on a steep cliff on the sea shore, 254 miles from

from London, at the influx of the river Gwaine into the sea, which here forms a spacious bay. It is governed by a mayor, a bailiff, and other officers; and here vessels may lie safely in five or six fathoms water. The inhabitants have a good trade in herrings, and annually cure, between Fisgard and Newport, above 1000 barrels of them. The town sends one member to parliament.

FISHING, in general, the art of catching fish, whether by means of nets, of spears, or of the line and hook.

Fishing in the great, performed by the net, spear, or harpoon, for fish that go in shoals, has been explained in the preceding article. That performed by the rod, line, and hook, for solitary fish, is usually termed Angling: See that article; and for the particular manner of angling for the different kinds of fish, see their respective names, as Dace, Eel, Perch, under Ichthyology.

Here we shall give an account of the following:

1. The *Barbel*†, (so called on account of the barb or beard that is under his chops), though a coarse fish, gives considerable exercise to the angler's ingenuity. They swim together in great shoals, and are at their worst in April, at which time they spawn, but come soon in season; the places whither they chiefly resort, are such as are weedy and gravelly rising grounds, in which this fish is said to dig and root with his nose like a swine. In the summer he frequents the strongest, swiftest, currents of water; as deep bridges, wears, &c. and is apt to settle himself among the piles, hollow places, and moss or weeds; and will remain there immoveable; but in the winter he retires into deep waters, and helps the female to make a hole in the sands to hide her spawn in, to hinder its being devoured by other fish. He is a very curious and cunning fish; for if his baits be not sweet, clean, well scoured, and kept in sweet moss, he will not bite; but well ordered and curiously kept, he will bite with great eagerness. The best bait for him is the spawn of a salmon, trout, or any other fish; and if you would have good sport with him, bait the places where you intend to fish with it a night or two before, or with large worms cut in pieces; and the earlier in the morning or the later in the evening that you fish, the better it will be. Your rod and line must be both strong and long, with a running plummet on the line; and let a little bit of lead be placed a foot or more above the hook, to keep the bullet from falling on it; so the worm will be at the bottom, where they always bite; and when the fish takes the bait, your plummet will lie and not choke him. By the bending of your rod you may know when he bites, as also with your hand you will feel him make a strong snatch; then strike, and you will rarely fail, if you play him well; but if you manage him not dexterously, he will break your line. The best time for fishing is about nine in the morning, and the most proper season is the latter end of May, June, July, and the beginning of August.

The *Bleak*‡, is an eager fish, caught with all sorts of worms bred on trees or plants; as also with flies, paste, sheep's blood, &c. They may be angled for with half a score of hooks at once, if they can be all fastened on; he will also in the evening take a natural or artificial fly. If the day be warm and clear, there is no fly so good for him as the small fly at the top of the water, which he will take at any time of the day, especially in the evening; but if the day is cold and cloudy, gentles and caddis are the best; about two feet under water. No fish yields better sport to a young angler than the bleak. It is so eager, that it will leap out of the water for a bait.

There is another way of taking bleak, which is by whipping them in a boat, or on a bank side in fresh water in a summer's evening, with a hazel top about five or six feet long and a line twice the length of the rod. But the best method is with a drabble, thus: Tie eight or ten small hooks across a line two inches above one another; the biggest hook the lowermost, (whereby you may sometimes take a better fish), and bait them with gentles, flies, or some small red worms, by which means you may take half a dozen or more at a time.

3. For the *Bream*||, observe the following directions, which will also be of use in carp fishing.—Procure about a quart of large red worms; put them into fresh moss, well washed and dried every three or four days, feeding them with fat mould and chopped fennel, and they will be thoroughly scoured in about three weeks.

Let your lines be silk and hair, but all silk is the best; let the floats be either swan-quills or goose-quills. Let your plumb be a piece of lead in the shape of a pear, with a small ring at the little end of it; fasten the lead to the line, and the line hook to the lead, about ten or twelve inches space between lead and hook will be enough; and take care the lead be heavy enough to sink the float. Having baited your hook well with a strong worm, the worm will draw the hook up and down in the bottom, which will provoke the bream to bite the more eagerly. It will be best to fit up three or four rods or lines in this manner, and set them as will be directed, and this will afford you much the better sport. Find the exact depth of the water if possible, that your float may swim on its surface directly over the lead; then provide the following ground bait. Take about a peck of sweet gross-ground malt; and having boiled it a very little, strain it hard through a bag, and carry it to the water side where you have sounded; and in the place where you suppose the fish frequent, there throw in the malt by handfuls squeezed hard together, that the stream may not separate it before it comes to the bottom; and be sure to throw it in at least a yard above the place where you intend the hook shall lie, otherwise the stream will carry it down too far. Do this about nine o'clock at night, keeping some of the malt in the bag, and go to the place about three the next morning; but approach very warily, lest you should be seen by the fish; for it is certain that they have their centinels watching on the top of the water, while the rest are feeding below. Having baited your hook so that the worm may crawl to and fro, the better to allure the fish to bite, cast it in at the place where you find the fish to stay most, which is generally in the broadest and deepest part of the river, and so that it may rest about the midst of your bait that is on the ground. Cast in your second line so that it may rest a yard above that, and a third about a yard below it. Let your rods lie on the bank, with some stones to keep them down at the great ends; and then withdraw yourself, yet not so far but that you can have your eye

† Cy- r, Ich- gy

‡ y- Ich- y

|| See Cyprinus, Ichthyology Index.

Sports. Dict.

upon all the floats; and when you see one bitten and carried away, do not be too hasty to run in, but give time to the fish to tire himself, and then touch him gently. When you perceive the float sink, creep to the water side, and give it as much line as you can. If it is a bream or carp, they will run to the other side; which strike gently, and hold your rod at a bent a little while; but do not pull, for then you will spoil all; but you must first tire them before they can be landed, for they are very shy. If there are any carps in the river, it is an even wager that you take one or more of them; but if there are any pike or perch, they will be sure to visit the ground bait, though they will not touch it, being drawn thither by the great resort of the small fish; and until you remove them, it is in vain to think of taking the bream or carp. In this case, bait one of your hooks with a small bleak, roach, or gudgeon, about two feet deep from your float, with a little red worm at the point of your hook; and if a pike be there, he will be sure to snap at it. This sport is good till nine o'clock in the morning; and in a gloomy day, till night; but do not frequent the place too much, lest the fish grow shy.

4. The *Carp* †. A person who angles for carp must arm himself with abundance of patience, because of its extraordinary subtility and policy; they always choose to lie in the deepest places, either of ponds or rivers, where there is but a small running stream.

† See *Carp*, and *Cyprinus*.

Further, observe, that they will seldom bite in cold weather; and you cannot be too early or too late at the spot in hot weather; and if he bite, you need not fear his hold; for he is one of those leather-mouthed fish that have their teeth in their throat.

Neither must you forget, in angling for him, to have a strong rod and line; and since he is so very wary, it will be proper to entice him, by baiting the ground with a coarse paste.

He seldom refuses the red worm in March, the caddis in June, or the grashopper in June, April, and September.

This fish does not only delight in worms, but also in sweet paste; of which there is great variety; the best is made of honey and sugar, and ought to be thrown into the water some hours before you begin to angle; neither will small pellets thrown into the water two or three days before be worse for this purpose, especially if chickens guts, garbage, or blood mixed with bran and cow dung, be also thrown in.

But more particularly, as to a paste very proper for this use, you may make it in the manner following: Take a sufficient quantity of flour, and mingle it with veal, cut small, making it up with a compound of honey; then pound all together in a mortar till they are so tough as to hang upon the hook without washing off. In order to effect which the better, mingle whitish wool with it; and if you keep it all the year round, add some virgin wax and clarified honey.

Again, If you fish with gentles, anoint them with honey, and put them on your hook, with a deep scarlet dipped in the like, which is a good way to deceive the fish.

Honey and crumbs of wheat bread, mixed together, make also a very good paste.

In taking a carp either in pond or river, if the angler intends to add profit to his pleasure, he must take a peck of ale-grains, and a good quantity of any blood to mix with the grains, baiting the ground with it where he intends to angle. This food will wonderfully attract the scale-fish, as carp, tench, roach, dace, and bream.

Let him angle in a morning, plumbing his ground, and angling for carp with a strong line: the bait must be either paste or a knotted red worm; and by this means he will have sport enough.

### *Description of proper Baits for the several sorts of* FISH *referred to in the annexed Table.*

*Flies.*] 1. Stone fly, found under hollow stones at the sides of rivers, is of a brown colour, with yellow streaks on the back and belly, has large wings, and is in season from April to July. 2. Green drake, found among stones by river sides, has a yellow body striped with green, is long and slender, with wings like a butterfly, his tail turns on his back, and from May to midsummer is very good. 3. Oak-fly, found in the body of an oak or ash, with its head downwards, is of a brown colour, and excellent from May to September. 4. Palmer fly or worm, found on leaves of plants, is commonly called a *caterpillar*, and when it comes to a fly is excellent for trout. 5. Ant fly, found in ant hills from June to September. 6. The May fly is to be found playing at the river side, especially against rain. 7. The black fly is to be found upon every hawthorn after the buds are come off.

*Pastes.*] 1. Take the blood of sheep's hearts, and mix it with honey and flour worked to a proper consistence. 2. Take old cheese grated, a little butter sufficient to work it, and colour it with saffron: in winter use rusty bacon instead of butter. 3. Crumbs of bread chewed or worked with honey or sugar, moistened with gum ivy water. 4. Bread chewed, and worked in the hand till stiff.

*Worms.*] 1. The earth bob, found in sandy ground after ploughing; it is white, with a red head, and bigger than a gentle: another is found in heathy ground, with a blue head. Keep them in an earthen vessel well covered, and a sufficient quantity of the mould they harbour in. They are excellent from April to November. 2. Gentles to be had from putrid flesh: let them lie in wheat bran a few days before used. 3. Flag worms, found in the roots of flags; they are of a pale yellow colour, are longer and thinner than a gentle, and must be scowered like them. 4. Cow-turd bob, or clap bait, found under a cow turd from May to Michaelmas; it is like a gentle, but larger. Keep it in its native earth like the earth bob. 5. Caddis worm, or cod bait, found under loose stones in shallow rivers; they are yellow, bigger than a gentle, with a black or blue head, and are in season from April to July. Keep them in flannel bags. 6. Lob worm, found in gardens; it is very large, and has a red head; a streak down the back, and a flat broad tail. 7. Marsh-worms, found in marshy ground; keep them in moss ten days before you use them: their colour is a bluish red, and are a good bait from March to Michaelmas. 8. Brandling red worms, or blood worms, found in rotten dunghills and tanners bark; they are small red worms, very good for all small fish, have sometimes a yellow tail, and are called *tag-tail*.

*Fish and Insects.*] 1. Minnow. 2. Gudgeon. 3. Roach. 4. Dace. 5. Smelt. 6. Yellow frog. 7. Snail slit. 8. Grashopper.

FISHING *Fly*, a bait used in angling for divers kinds of fish. See FISHING.

The fly is either *natural* or *artificial.*

I. *Natural* flies are innumerable. The more usual for this purpose are mentioned in the preceding page.

There are two ways to fish with natural flies; either on the surface of the water, or a little underneath it.

In angling for chevin, roach, or dace, move not your natural fly swiftly when you see the fish make at it: but rather let it glide freely towards him with the stream: but if it be in a still and slow water, draw the fly slowly sidewise by him, which will make him eagerly pursue.

II. The *artificial* fly is seldom used but in blustering weather, when the waters are so troubled by the winds, that the natural fly cannot be seen, nor rest upon them. Of this artificial fly there are reckoned no less than 12 sorts, of which the following are the principal.

1. For March, the dun fly; made of dun wool, and the feathers of the partridge's wing; or the body made of black wool, and the feathers of a black drake. 2. For April, the stone fly; the body made of black wool, dyed yellow under the wings and tail. 3. For the beginning of May, the ruddy fly; made of red wool, and bound about with black silk, with the feathers of a black capon hanging dangling on his sides next his tail. 4. For June, the greenish fly; the body made of black wool, with a yellow list on either side, the wings taken off the wings of a buzzard, bound with black broken hemp. 5. The moorish fly, the body made of duskish wool, and the wings of the blackish mail of a drake. 6. The tawney fly, good till the middle of June; the body made of tawney wool, the wings made contrary one against the other of the whitish mail of a white drake. 7. For July, the wasp fly; the body made of black wool, cast about with yellow silk, and the wings of drakes feathers. 8. The steel fly; good in the middle of July; the body made with greenish wool, cast about with the feathers of a peacock's tail, and the wings made of those of the buzzard. 9. For August, the drake fly; the body made with black wool cast about with black silk; his wings of the mail of a black drake, with a black head.

The best rules for artificial fly fishing are,

1. To fish in a river somewhat disturbed with rain: or in a cloudy day, when the waters are moved by a gentle breeze: the south wind is best; and if the wind blow high, yet not so but that you may conveniently guard your tackle, the fish will rise in plain deeps; but if the wind be small, the best angling is in swift streams. 2. Keep as far from the water side as may be; fish down the stream with the sun at your back, and touch not the water with your line. 3. Ever angle in clear rivers, with a small fly and slender wings; but in muddy places, use a larger. 4. When, after rain, the water becomes brownish, use an orange fly; in a clear day, a light-coloured fly; a dark fly for dark waters, &c. 5. Let the line be twice as long as the rod, unless the river be encumbered with wood. 6. For every sort of fly, have several of the same differing in colour, to suit with the different complexions of several waters and weathers. 7. Have a nimble eye, and active hand, to strike presently with the rising of the fish; or else he will be apt to spue out the hook. 8. Let the fly fall first into the water, and not the line, which will scare the fish. 9. In slow rivers, or still places, cast the fly across the river, and let it sink a little in the water, and draw it gently back with the current.

Salmon flies should be made with their wings standing one behind the other, whether two or four. This fish delights in the gaudiest colours that can be; chiefly in the wings, which must be long, as well as the tail.

FISHING *by means of birds*, a method peculiar to the Chinese, who train certain birds for the purpose in the same manner as falcons are taught to pursue game. For this purpose they have trained a species of pelican, resembling the common corvorant, which they call the *Leu-tze*, or fishing bird. Sir George Staunton, who, when the embassy was proceeding on the southern branch of the great canal, saw those birds employed, tells us, that on a large lake, close to the east side of the canal, are thousands of small boats and rafts, built entirely for this species of fishery. On each boat or raft are ten or a dozen birds, which, at a signal from the owner, plunge into the water; and it is astonishing to see the enormous size of fish with which they return, grasped within their bills. They appeared to be so well trained, that it did not require either ring or cord about their throats to prevent them from swallowing any portion of their prey, except what their master was pleased to return to them for encouragement and food. The boat used by these fishermen is of a remarkable light make, and is often carried to the lake, together with the fishing birds, by the men who are there to be supported by it.

The same author saw the fishermen busy on the great lake Wee-chaung-hee; and he gives the following account of a very singular method practised by them for catching the fish of the lake without the aid of birds, of net, or of hooks. To the one side of a boat a flat board, painted white, is fixed, at an angle of about 45 degrees, the edge inclining towards the water. On moonlight nights the boat is so placed that the painted board is turned to the moon, from whence the rays of light striking on the whitened surface, give to it the appearance of moving water; on which the fish being tempted to leap on their element, the boatmen raising with a string the board, turn the fish into the boat.

Water-fowl are much sought after by the Chinese, and are taken upon the same lake by the following ingenious device. Empty jars or gourds are suffered to float about upon the water, that such objects may become familiar to the birds. The fisherman then wades into the lake with one of these empty vessels upon his head, and walks gently towards a bird; and lifting up his arm, draws it down below the surface of the water without any disturbance or giving alarm to the rest, several of whom he treats in the same manner, until he fills the bag he had brought to hold his prey. The contrivance itself is not so singular, as it is that the same exactly should have occurred in the new continent, as Ulloa asserts, to the natives of Carthagena, upon the lake Cienega de Tesias.

FISHING *Floats*, are little appendages to the line, serving

serving to keep the hook and bait suspended at the proper depth, to discover when the fish has hold of them, &c. Of these there are divers kinds; some made of Muscovy duck quills, which are the best for slow waters; but for strong streams, sound cork, without flaws or holes, bored through with a hot iron, into which is put a quill of a fit proportion, is preferable: pare the cork to a pyramidal form, and make it smooth.

*Fishing Hook*, a small instrument made of steel wire, of a proper form to catch and retain fish.

The fishing hook in general ought to be long in the shank, somewhat thick in the circumference, the point even and straight; let the bending be in the shank.

An Epitome of the whole art of Fishing, wherein is shown, (at one view), the harbours, seasons, and depths, for catching all sorts of fish usually angled for, also the various baits for each, so digested as to contain the essence of all the treatises ever written on the subject, exempt from the superfluities, which tend more to perplex than instruct.

| *Names.* | *Where found.* | *Season.* | *Time to ang.* | *Depth from ground.* | *Proper Baits.* | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Flies. N° | Pastes. N° | Worms. N° | Fish and Insects. N° 8. |
| Bream | Rough str. river or mid. pond | Apr. to Mich. | Sunrise to 9<br>3 to sunset | Touch ground | - | 1 3 | 1 to 7 | |
| Barbel | Gravel banks in currents under bridges | Apr. to Aug. | Very early or late | Ditto | - | 2 | 2 6 7 | - |
| Bleak | Sandy bottom, deep rivers, ships sterns | May to Oct. | All day | Six inches from bottom | 1 2 | 2 | 2 3 8 | - |
| Carp | Still deep mud bottom, pond or river | May to Aug. | Sunrise to 9<br>3 to sunset | Three inches from bottom<br>Hot weather, mid water | - | 1 3 4 | 1 2 3 4 7 | - |
| Chub or Chevin | Ditto | May to Dec. | Ditto | Ditto | 1 to 5 | 2 | 1 2 4 5 | 7 8 |
| Dace | Sandy bottom, deep rivers, ships sterns | May to Oct. | All day | Six to 12 inches from bottom | Ditto | 3 4 | 1 to 5 & 8 | - |
| Gudgeon | Gravel shoals | May to Oct. | Ditto | Near or on the ground | - | Ditto | 2 8 | - |
| Pike | Near clay banks | All the year | Ditto | Mid water | Wh. stro. and snap | Line float Hook fixt | -<br>On shore | 1 2 3 4 5 6 7 |
| Perch | River in stream { gravel or weedy bottom | May to Aug. | Sunrise to 10<br>2 to sunset | Ditto | 2 | 1 | 3 5 7 8 | 1 6 |
| | Pond deepest part { gravel or weedy bottom | Aug. to May | Mid day | Six inches from bottom | | | | |
| Pope | Deep holes in rivers | May to Oct. | All day | Ditto | 5 | - | All | - |
| Roach | Sandy bottom, deep rivers, ships sterns | May to Oct. | Ditto | Six to 12 inches | 1 2 4 5 | 3 4 | Ditto | 8 |
| Salmon | Deep rivers | Mar. to Sept. | 8 to 9, 3 to 6 | Mid way to the bottom | All large | - | 1 5 6 7 | 1 |
| Smelts | Ships sterns and docks | Apr. to Oct. | All day | Mid way to the bottom<br>Variable | All small | - | 1 2 5 | Bits of smelts |
| Trout | Purling stream and eddies of stony bottom river | Mar. to Mich. | Ditto | Cold weather, 6 inches to 9<br>Hot weather, top to mid wat. | 1 to 5 | - | 1 2 5 to 8 | 1 8 |
| Tench | Mud bottom, river or pond | All the year | Sunrise to 9<br>3 to sunset | Cold wea. 3 inches from bot.<br>Hot weather, mid water | - | 1 3 4 | 1 3 4 to 7 | - |
| Umber or Grayling | Clay bottom, swift stream | All the year | All day | Cold weather, 6 to 9 inches<br>Hot weather, top to mid wat. | 1 to 5 | - | All | 1 8 |

Sport. Dict.

For

For setting the hook on, use strong but small silk, laying the hair on the inside of your hook; for if it be on the outside, the silk will fret and cut it asunder.

There are several sizes of these fishing hooks, some big, some little: and of these, some have peculiar names; as, 1. Single hooks. 2. Double hooks; which have two bendings, one contrary to the other. 3. Snappers, or gorgers, which are the hooks to whip the artificial fly upon, or bait with the natural fly. 4. Springers, or spring hooks; a kind of double hooks, with a spring, which flies open upon being struck into any fish, and so keeps its mouth open.

*Fishing-Line*, is either made of hair twisted; or silk; or the Indian grass. The best colours are the sorrel, white, and gray; the two last for clear waters, the first for muddy ones. Nor is the pale watery green despisable; this colour is given artificially, by steeping the hair in a liquor made of alum, soot, and the juice of walnut leaves, boiled together.

*Fishing Rod*, a long slender rod or wand, to which the line is fastened, for angling.—Of these there are several sorts; as, 1. A troller, or trolling rod, which has a ring at the end of the rod, for the line to go through when it runs off a reel. 2. A whipper, or whipping rod; a top rod, that is weak in the middle, and top heavy, but all slender and fine. 3. A dropper; which is a strong rod and very light. 4. A snapper, or snap rod; which is a strong pole, peculiarly used for the pike. 5. A bottom rod; being the same as the dropper, but somewhat more pliable. 6. A sniggling or procking stick; a forked stick, having a short strong line, with a needle, baited with a lob worm: this is only for eels in their holes.

*Fishing Frog*, or *Angler*. See Lophius.

*Right of Fishing*, and property of fish. It has been held, that where the lord of the manor hath the soil on both sides of the river, it is good evidence that he hath a right of fishing; and it puts the proof upon him who claims *liberam piscariam*: but where a river ebbs and flows, and is an arm of the sea, there it is common to all, and he who claims a privilege to himself must prove it; for if the trespass is brought for fishing there, the defendant may justify, that the place where is *brachium maris, in quo unusquisque subditus domini regis habet et habere debet liberam piscariam*. In the Severn the soil belongs to the owners of the land on each side; and the soil of the river Thames is in the king, but the fishing is common to all. He who is owner of the soil of a private river, hath *separalis piscaria*; and he that hath *libera piscaria*, hath a property in the fish, and may bring a possessory action for them; but *communis piscaria* is like the case of all other commons. One that has a close pond in which there are fish, may call them *pisces suos*, in an indictment, &c. but he cannot call them *bona et catalla*, if they be not in trunks. There needs no privilege to make a fish pond, as there doth in the case of a warren. See Franchise.

Dict.

**FISSURES**, in *Geology*, certain interruptions, that in a horizontal or parallel manner divide the several strata of which the body of our globe is composed. See Geology *Index*.

*Fissure of the Bones*, in *Surgery*, is when they are divided either transversely or longitudinally, not quite through, but cracked after the manner of glass, by any external force. See Surgery.

**FISTULA**, in the ancient music, an instrument of the wind kind, resembling our flute or flageolet.

The principal wind instruments of the ancients, were the tibia and the fistula. But how they were constituted, wherein they differed, or how they were played upon, does not appear. All we know is, that the fistula was at first made of reeds, and afterwards of other matters. Some had holes, some none; some again were single pipes; others a combination of several; witness the syringa of Pan.

Fistula, in *Surgery*, a deep, narrow, and callous ulcer, generally arising from abscesses.

It differs from *sinus*, in its being callous, the latter not. See Surgery *Index*.

Fistula, in *Farriery*. See Farriery *Index*.

**FISTULARIA**, or Tobacco-Pipe Fish; a genus of fishes, belonging to the order of abdominales. See Ichthyology *Index*.

**FIT**. See Paroxysm.

Dr Cheyne is of opinion, that fits of all kinds, whether epileptic, hysteric, or apoplectic, may be cured solely by milk diet, of about two quarts of cows milk a-day, without any other medicine.

**FITCHES**, in *Husbandry*, a sort of pulse, more generally known by the name of *chick-pea*. See Cicer, Botany and Agriculture *Index*.

Fitches are cultivated either for feeding cattle, or improving the land. They make a wholesome and nourishing food, whether given in the straw or thrashed out. When sown only to improve the soil, they are ploughed in just as they begin to blossom, by which means a tough stiff clay soil is much enriched.

**FITCHET**, a name used in some places for the weasel, called also the *foumart*. See Mustela, Mammalia *Index*.

**FITCHY**, in *Heraldry*, (from the French *fiché*, i. e. *fixed*); a term applied to a cross when the lower branch ends in a sharp point: and the reason of it Mackenzie supposes to be, that the primitive Christians were wont to carry crosses with them wherever they went; and when they stopped on their journey at any place, they fixed those portable crosses in the ground for devotion's sake.

**FITZ**, makes part of the surname of some of the natural sons of the kings of England, as *Fitz-roy*; which is purely French, and signifies the "king's son."

**FITZHERBERT**, Sir Anthony, a very learned lawyer in the reign of King Henry VIII. was descended from an ancient family, and born at Norbury in Derbyshire. He was made one of the judges of the court of common pleas in 1523; and distinguished himself by many valuable works, as well as by such an honourable discharge of the duties of his office, as made him esteemed an oracle of the law. His writings are, The Grand Abridgement; The Office and Authority of Justices of Peace; the Office of Sheriffs, Bailiffs of Liberties, Escheators, Constables, Coroners, &c.; Of the Diversity of Courts; The New Natura Brevium; Of the Surveying of Lands, and The Book of Husbandry. He died in 1538.

**FITZ-STEPHEN**, William, a learned monk of Canterbury, of Norman extraction, but born of respectable parents in the city of London. He lived in the 12th century; and being attached to the service of Archbishop Becket, was present at the time of his murder.

In the year 1174, he wrote in Latin, *The Life of St Thomas, archbishop and martyr;* in which, as Becket was a native of the metropolis, he introduces a description of the city of London, with a miscellaneous detail of the manners and usages of the citizens: this is deservedly considered as a great curiosity, being the earliest professed account of London extant. Fitz-Stephen died in 1191.

**FIVES**, or VIVES. See FARRIERY.

**FIXATION**, in *Chemistry*, the rendering any volatile substance fixed, so as not to fly off upon being exposed to a great heat: hence,

**FIXED BODIES**, are those which bear a considerable degree of heat without evaporating, or losing any of their weight. Some of the most fixed bodies are diamonds, gold, &c.

*Fixed* or *Fixable Air*, an invisible and permanently elastic fluid, superior in gravity to common atmospheric air and most other aerial fluids, exceedingly destructive to animal life; produced in great quantities, naturally from combustible bodies, and artificially by many chemical processes. From its acid properties it has obtained the name of *aerial acid*, *cretaceous acid*, and *carbonic acid;* from its noxious qualities, it has been called *mephitic air*, or *mephitic gas;* and, from the circumstance of being produced in vast quantities during the combustion of charcoal, it first obtained from Van Helmont the name of *gas sylvestre*. The term *fixed air* has been given from its property of readily losing its elasticity, and fixing itself in many bodies, particularly those of the calcareous kind; and though some objected to the propriety of the term, the fluid in question is so well known by the name of fixed air, that we choose still to retain it. See CHEMISTRY *Index*. For an account of the apparatus for impregnating water with fixed air or carbonic acid, see MATERIA MEDICA *Index*.

*Fixed Stars*, are such as constantly retain the same position and distance with respect to each other; by which they are distinguished from *erratic* or *wandering* stars, which are continually shifting their situation and distance. The fixed stars are properly called *stars;* the rest have the peculiar denomination of *planet* and *comet*. See ASTRONOMY *Index*.

**FIXITY**, or FIXEDNESS, in *Chemistry*, is in a peculiar manner used for the affection opposite to volatility; i. e. the property whereby bodies bear the action of the fire, without being dissipated in fumes.

**FIXLMILLNER**, PLACIDUS, an eminent astronomer, was born at Achleiten near Linz, in Austria, on the 28th of May, 1720. He received the rudiments of his education in the monastery of Kremsmunster, of which his uncle Alexander was abbot. Here he studied during six years, and delighted so much in drawing straight and curve-line figures, that his mother called him the *almanack-maker*. He went afterward to Salzburg, where he studied a regular course of philosophy, and particularly turned his attention to mathematics under a professor Stuard, whose method of teaching that science was truly extraordinary, as he never made use of any figures, and yet conveyed such a clear idea of every proposition as made it perfectly easy. He was admitted as a novice into Kremsmunster in 1737, and the next year he took the solemn vow in presence of his uncle. After being two years in this monastery, during which time he devoted every leisure hour to the study of mathematics and philosophy, he went to Salzburg to finish his studies in divinity and jurisprudence, acquiring at that time a competent knowledge of oriental and modern languages, history and antiquities. In the year 1745, he obtained the degree of D. D. after which he received priest's orders in his own monastery, and was created professor of ecclesiastical law, which office he held for 40 years, discharging the duties belonging to it till within a few days of his death. He was also chosen dean of the higher schools, and regent of the young nobility, which he retained during life.

He wrote a commentary on the *Jus Canonicum*, notwithstanding his extensive epistolary correspondence, and the management of the whole business of the monastery; but this work was never published. He was, by the intreaties of his friends, induced to publish his *Reipublicæ sacræ origines divinæ, seu Ecclesiæ Christi exterior junctura, imperium, et hierarchia, ex primigenia ejus institutione eruta et demonstrata*. His commendable diligence procured him universal esteem, but it was his knowledge of astronomy which rendered him illustrious. His uncle Alexander fitted up an apartment for containing the instruments necessary for the dissemination of mathematical knowledge, and he also erected an observatory, which was begun in 1748, and completed in 1758, under the direction of Anselm Dering of Emsdorf, a celebrated architect. While the observatory was building, Fixlmillner led a life of retirement and severe study, his favourite subject during these ten years being astronomy. When it was finished, one Dobler, a celebrated mathematician, was appointed first astronomer; but the successors of Fixlmillner's uncle having discovered his extensive mathematical knowledge, made him an offer of the astronomical department, and the sole direction of the observatory. This place he accepted in the year 1762, still retaining his chair as professor of ecclesiastical law. He was not yet master of the learning which practical astronomy requires, to remedy which defect he attentively perused Lalande's *Exposition du Calcul Astronomique*, soon after which he obtained the large astronomical work of the same great man, and in 1766 he published his *Meridianus speculæ Astronomicæ Cremifanensis*, by which he acquired considerable reputation. Ten years after this period he gave the world his *Decennium Astronomicum*, containing many curious and important particulars respecting the theory and practice of astronomy. His *Acta Astronomica Cremifanensis*, which did not appear till after his decease, still farther increased his astronomical reputation; and he was a large contributor to many periodical publications in different countries.

He made and collected a number of observations of the planet Mercury, which were at that period both scarce and difficult, the importance of which was publicly acknowledged by Lalande, as they greatly assisted him in constructing his tables of that planet. Fixlmillner was one of the first astronomers who calculated the orbit of the new planet Uranus (Georgium Sidus), and his tables respecting it may be seen in the Berlin almanack for 1789. He also proved the truth of what was formerly conjectured, that the 34th star of Taurus, which Flamstead observed in 1690, was the new planet. It may be said of most philosophers, that they observe a nor great deal, and calculate little, but the conduct of Fixlmillner was exactly the reverse. He turned his attention to the observation of the solar spots more than any of his predecessors, which he noticed in the years 1767, 1776, 1777, 1778, and 1782, from which he deduced important inferences respecting the revolution of the sun on his axis.

He had a genius uncommonly adapted to the study of mechanics, by which he was enabled to invent a new micrometer, and a machine for grinding concentric circles. As an additional proof of his profound inventive genius, he resided in the country, by which means he was in a great measure deprived of literary assistance, yet to the very close of life he was a singular instance of the most indefatigable zeal, diligence, and perseverance. He was little subject to the influence of the turbulent passions;—perhaps less so than most other men. Like the laws of nature, which it was his chief delight to study, he was simple, uniform, and constant; and such were the mildness and integrity of his character, that he could not fail to acquire the love and esteem of mankind. His high reputation never inspired him with vanity, and he rather wished to conceal than to propagate what was written in his praise. It gave general joy to his monastic brethren to celebrate the anniversary of the fiftieth year of his residence in it, which he did not long survive. His health was very much impaired by his intense application, and he finished his career on the 27th of August 1791, in the 71st year of his age.

**FLACCUS, Caius Valerius**, an ancient Latin poet, of whom we have very imperfect accounts remaining. He wrote a poem on the Argonautic expedition; of which, however, he did not live to finish the eighth book, dying at about 30 years of age. John Baptisto Pius, an Italian poet, completed the eighth book of the Argonautics; and added two more from the fourth of Apollonius; which supplement was first added to Aldus's edition in 1523.

**FLAGS**, in the army, are small banners of distinction stuck in the baggage waggons to distinguish the baggage of one brigade from another; and of one battalion from another; that they may be marshalled by the waggon-master general according to the rank of their brigades, to avoid the confusion that might otherwise arise.

**Flag**, in the marine, a certain banner or standard, by which an admiral is distinguished at sea from the inferior ships of his squadron; also the colours by which one nation is distinguished from another. See Plate CCXVIII.

In the British navy, flags are either red, white, or blue; and are displayed from the top of the main-mast, fore-mast, or mizen-mast, according to the rank of the admiral. When a flag is displayed from the flag-staff on the main-mast, the officer distinguished thereby is known to be an admiral; when from the foremast, a vice-admiral; and when from the mizen-mast, a rear-admiral.

The first flag in Great Britain is the royal standard, which is only to be hoisted when the king or queen are on board the vessel: the second is that of the anchor of hope, which characterizes the lord high admiral, or lords commissioners of the admiralty: and the third is the union flag, in which the crosses of St George and St Andrew are blended. This last is appropriated to the admiral of the fleet, who is the first military officer under the lord high admiral.

Flag, Flagellantes.

The next flag after the union is that of the white squadron at the main-mast head; and the last, which characterizes an admiral, is the blue, at the same mast head.

For a vice-admiral, the first flag is the red, the second the white, the third the blue, at the flag staff on the fore-mast.

The same order proceeds with regard to the rear-admirals, whose flags are hoisted on the top of the mizen-mast: the lowest flag in our navy is accordingly the blue on the mizen-mast.

*To Lower or Strike the Flag*, in the marine, is to pull it down upon the cap, or to take it in, out of the respect, or submission, due from all ships or fleets inferior to those any way justly their superiors. To lower or strike the flag in an engagement is a sign of yielding.

The way of leading a ship in triumph is to tie the flags to the shrouds, or the gallery, in the hind part of the ship, and let them hang down towards the water, and to tow the vessels by the stern. Livy relates, that this was the way the Romans used those of Carthage.

*To Heave out the Flag*, is to put out or put abroad the flag.

*To Hang out the White Flag*, is to ask quarter; or it shows when a vessel is arrived on a coast, that it has no hostile intention, but comes to trade or the like. The red flag is a sign of defiance and battle.

Flag is also used for a sedge, a kind of rush.

*Corn-Flag.* See Gladiolus, Botany *Index*.

*Sweet-scented Flag.* See Acorus, Botany *Index*.

*Flag-Officers*, those who command the several squadrons of a fleet; such are the admirals, vice-admirals, and rear-admirals.

The flag officers in our pay, are the admiral, vice-admiral, and rear-admiral, of the white, red, and blue. See Admiral, Flag, and Fleet.

*Flag-Ship*, a ship commanded by a general or flag-officer, who has a right to carry a flag, in contradistinction to the secondary vessels under the command thereof.

*Flag-Stone*, a kind of sand-stone of a slaty structure, on account of which it is much employed for the purpose of paving foot-paths or the floors of apartments in which wood is unsuitable.

**FLAGELLANTES**, a set of wild fanatics who chastised and disciplined themselves with whips in public.

The sect of the Flagellantes had its rise in Italy in the year 1260; its author was one Rainier a hermit; and it was propagated from hence through almost all the countries of Europe. It was in all probability no more than the effect of an indiscreet zeal. A great number of persons of all ages and sexes made processions, walking two by two with their shoulders bare, which they whipped till the blood ran down, in order to obtain mercy from God, and appease his indignation against the wickedness of the age. They were then called the *devout*; and having established a superior, he was called the *general of the devotion*. Though the primitive Flagellantes were exemplary in point of morals,

morals, yet they were joined by a turbulent rabble who were infected with the most ridiculous and impious opinions; so that the emperors and pontiffs thought proper to put an end to this religious frenzy, by declaring all devout whipping contrary to the divine law, and prejudicial to the soul's eternal rest.

This sect revived in Germany towards the middle of the next century, and rambling through many provinces, occasioned great disturbances. They held among other things, that flagellation was of equal virtue with baptism and the other sacraments; that the forgiveness of all sins was to be obtained by it from God without the merits of Jesus Christ; that the old law of Christ was soon to be abolished, and that a new law enjoining the baptism of blood to be administered by whipping was to be substituted in its place; upon which Clement VII. by an injudicious as well as unrighteous policy, thundered out anathemas against the Flagellantes, who were burnt by the inquisitors in several places; but they were not easily extirpated. They appeared again in Thuringia and Lower Saxony in the 15th century, and rejected not only the sacraments, but every branch of external worship, and placed their only hopes of salvation in faith and flagellation, to which they added other strange doctrines concerning evil spirits. Their leader Conrad Schmidt and many others were committed to the flames by German inquisitors in and after the year 1414.

**FLAGEOLET**, or **FLAJEOLET**, a little flute, used chiefly by shepherds and country people. It is made of box or other hard wood, and sometimes of ivory; and has six holes besides that at the bottom, the mouth-piece, and that behind the neck.

**FLAIL**, an instrument for thrashing corn. It consists of the following parts. 1. The hand-staff, or piece held in the thrasher's hand. 2. The swiple, or that part which strikes out the corn. 3. The caplins, or strong double leathers, made fast to the tops of the hand-staff and swiple. 4. The middle band, being the leather thong or fish skin that ties the caplins together.

**FLAIR**, in sea language. The seamen say that the work doth flair over, when a ship is housed in near the water, so that the work hangs over a little too much, and this is let out broader aloft than the due proportion will allow.

**FLAKE**, in the cod fishery, a sort of scaffold or platform, made of hurdles, and supported by stanchions, used for drying cod fish in Newfoundland. These flakes are usually placed near the shores of fishing harbours.

**FLAKE**, in *Gardening*, a name given by the florists to a sort of carnations which are of two colours only, and have very large stripes, all of them going quite through the leaves.

*White* **FLAKE**, in *Painting*, is lead corroded by means of the pressing of grapes, or a ceruse prepared by the acid of grapes. It is brought from Italy, and far surpasses, both with regard to the purity of its whiteness and the certainty of its standing, all the ceruse or white lead made with us in common. It is used in oil or varnish painting for all purposes where a very clean white is required. The white flake should be procured in lumps as it is brought over and levigated by those who use it; because that which the colourmen sell in a prepared state is levigated and mixed up with starch, and often with white lead, and worse sophistications.

**FLAMBEAU**, or **ELAMBOY**, a luminary made of several thick wicks, covered over with wax, serving to burn at nights in the streets; as also at funeral processions, illuminations, &c.

Flambeaux differ from links, torches, and tapers.—They are made square, sometimes of white wax and sometimes of yellow. They usually consist of four wicks or branches near an inch thick, and about three feet long, made of a sort of coarse hempen yarn half twisted. They are made with the ladle much as torches or tapers are; viz. by first pouring the melted wax on the top of the several suspended wicks, and letting it run down to the bottom. This they repeat twice. After each wick has thus got its proper cover of wax, then lay them to dry; then roll them on a table, and so join four of them together by means of a red hot iron. When joined, they pour on more wax till the flambeau is brought to the size required, which is usually from a pound and a half to three pounds. The last thing is to finish their form or outside, which they do with a kind of polishing instrument of wood by running it along all the angles formed by the union of the branches.

The flambeaux of the ancients were different from ours. They were made of woods dried in furnaces or otherwise. They used divers kinds of wood for this purpose; the wood most usually was pine. Pliny says, that in his time they frequently also burnt oak, elm, and hazel. In the seventh book of the Æneid, mention is made of a flambeau of pine; and Servius on that passage remarks, that they also made them of the cornel-tree.

**FLAMBOROUGH HEAD**, in *Geography*, a cape or promontory on the eastern coast of Yorkshire, five miles east of Burlington, and 215 from London.—E. Long. 20°. N. Lat. 54. 15.—This was the *Fleamburg* of the Saxons; so called, as some think, from the lights made on it to direct the landing of Ina, who in 547 joined his countrymen in these parts with a large reinforcement from Germany, and founded the kingdom of Northumberland. In the time of Edward the Confessor, Flamborough was one of the manors of Harold, earl of the West Saxons, afterwards king of England. On his death, the Conqueror gave it to Hugh Lupus; who, in perpetual alms, bestowed it on the monastery of Whitby.—The town is on the north side, and consists of about 150 small houses, entirely inhabited by fishermen; few of whom, as is said, die in their beds, but meet their fate in the element they are so conversant in. The cliffs of the Head are of a tremendous height and amazing grandeur. Beneath are several vast caverns; some closed at the end, others pervious, formed with a natural arch. In some places the rocks are insulated, and of a pyramidal figure, soaring up to a vast height. The bases of most are solid, but in some pierced through and arched. The colour of all these rocks is white, from the dung of the innumerable flocks of migratory birds, which quite cover the face of them, filling every little projection, every hole that will give them leave to rest.

**FLAME**, is a general name for every kind of luminous vapour, provided the light it emits hath any considerable degree of intensity. The name *flame*, however, is most generally applied to such as are of a conical figure, like those arising from our common fires; without this they are commonly called *luminous vapours*, or simple *lights*.

According to Sir Isaac Newton, flame is only *red-hot smoke*, or the vapour of any substance raised from it by fire, and heated to such a degree as to emit light copiously. This definition seems to be the most accurate and expressive of any. It is certain, that bodies are capable of emitting flame only in proportion to the quantity of vapour that rises from them. Thus wood, coals, &c. which emit a great quantity of vapour, flame violently; while lead, tin, &c. which emit but a small fume, can scarce be perceived to flame at all.

This rule, however, is by no means to be depended upon in all cases. Some vapours *seem* to be in their own nature uninflammable, and capable of extinguishing flame; as those of water, the mineral acids, sal-ammoniac, arsenic, &c.: while others take fire on the slightest approach of a flaming substance; such as ether, spirit of wine, &c. These last-mentioned substances also exhibit a remarkable phenomenon; namely, that they cannot be made to flame without the approach of some substance actually in flames beforehand. Thus, spirit of wine poured on a red-hot iron, though instantly dissipated in vapour, will not flame; but if a burning candle touch its surface, the whole is set in a flame at once. The case is otherwise with oils, especially those of the grosser kind; for the vapours will readily be changed into flame by the mere increase of heat, without the approach of any flaming substance.

There is, however, no kind of vapour, perhaps, that is incapable of being converted into flame, provided it is exposed to a sufficient degree of heat. Thus the vapour of water made to pass through burning coals produces an exceedingly strong and bright flame.—It is remarkable, that this kind of vapour seems to be more powerful than almost any other in absorbing heat, and detaining it in a latent state. When any quantity of aqueous vapour is condensed, more heat will be separated from it than would have been sufficient to heat an equal bulk of iron red hot.—It is most probably to this property which all vapours have of absorbing heat, and detaining it in a latent state, that we are to attribute the phenomena of flame, and also the exceeding great elasticity of steam. It is certain, that vapours, of water at least, have a much greater power of absorbing and retaining heat, than the water from which they are raised. In open vessels, water cannot be heated more than to 212 degrees of Fahrenheit's thermometer; but in Papin's digester, where the vapour is forcibly confined, it has been heated to 400 of the same degrees; and, no doubt, might have been heated a great deal more, had the vessels been strong enough to bear the expansile force of the steam. On opening the vessels, however, the excess of heat was found to have resided entirely in the vapour; for the water in the vessel very soon sunk down to 212, while the steam issued forth with great violence.

From these experiments it appears, that the steam of water, after it has absorbed as much heat in the latent state as it can contain, continues to absorb or detain among its particles, an unlimited quantity of sensible heat; and if the steam could be confined till this quantity became great enough to be visible by emission of light, there cannot be the least doubt that the vapour would then be converted into flame.

In what manner the heat is detained among the particles of steam, is perhaps impossible to be explained; but to this heat we must undoubtedly ascribe the violent expansive force of steam of every kind. It seems probable, that when smoke is converted into flame, the latent heat with which the vapour had combined, or rather that which made an essential part of it, breaks forth, and adds to the quantity of sensible heat which is already present. This seems probable, from the sudden explosion with which all flames break out. If a vessel full of oil is set over the fire, a smoke or vapour begins to arise from it; which grows gradually thicker and thicker; and at last begins to shine in some places very near the surface of the oil, like an electric light, or sulphur just kindled. At this time the oil is very hot, as well as the steam which issues from it. But this last is continually giving off its sensible heat into the atmosphere; so that at the distance of an inch or two from the surface of the oil, the heat of the steam will not exceed 400 degrees of Fahrenheit, or perhaps may not be so much; but if a burning candle is held in the steam for a moment, the whole is immediately converted into flame, with something like an explosion; after which the oil burns quietly until it is all consumed. The flame, as soon as it appears, is not only much hotter than the steam from whence it was produced, but even than the oil which lies below it. Whence, then, has this sudden and great increase of heat arisen? It could not be the *sensible* heat of the vapour, for that was greatly inferior; nor could it be communicated from the oil, for that could communicate no more than it had to itself. The candle, indeed, would communicate a quantity of heat to the vapour which touched its flame; but it is impossible that this quantity should extend permanently over a surface perhaps 100 times larger than the flame of the candle, in such a manner as to make every part of that surface equally hot with the flame of the candle itself; for this would be to suppose it to communicate 100 times more heat than really was in it. The heat therefore must have originally resided in the vapour itself; and as, in the freezing of water, its latent heat is extricated and becomes sensible, and the water thereupon loses its fluidity; so, in the ascension of vapour, the latent heat breaks forth with a bright flash, and the vapour is then totally decomposed, and converted into soot, ashes, or water, according to the different nature of the substances which produce it, or according to the intensity of the heat.—Several other hypotheses have been invented to solve the phenomena of burning and flaming bodies; for an account of which, see IGNITION and HEAT, CHEMISTRY *Index*.

Flames are of different colours, according to the substances from which they are produced. Thus, the flame of sulphur and spirit of wine is blue; the flame of nitre and zinc, of a bright white; that of copper, of a greenish blue, &c.—These varieties afford an opportunity of making a number of agreeable representations in fireworks, which could not be done if the flame produced from every different substance was of the same colour. See PYROTECHNICS.

**FLAMEN**, in Roman antiquity, the name of an order of priests, instituted by Romulus or Numa: authors not being agreed on this head.

They were originally only three, viz. the *Flamen Dialis, Flamen Martialis*, and *Flamen Quirinalis*. The Flamen Dialis was sacred to Jupiter, and a person of the highest consequence and authority in the state. He discharged several religious duties which properly belonged to the kings, and was honoured with many eminent privileges beyond all other officers, but was obliged to observe several superstitious restraints. The Flamen Martialis was sacred to Mars, and was ordained to inspect the rites of that god. The Flamen Quirinalis was sacred to, and superintended the rites of, Quirinus Romulus. The Flamines last mentioned, though of high authority, were much inferior to the Flamen Dialis. All three were chosen by the people, and consecrated by the Pontifex Maximus. In latter times several priests of the same order and name were added to them, but inferior in power. The whole number at last amounted to 15; the three first of whom were senators, and called *Flamines majores*; the other 12 taken from among the people, being denominated *Flamines minores*.—Some authors tell us the Romans had a Flamen for every deity they worshipped. The greater Flamines wore the robe edged with purple, like the great magistrates; had an ivory chair, and a seat in the senate. They wore a little band of thread about their heads, whence their name is said to be derived, *quasi Filamines*.—The wife of the Flamen Dialis was called *Flaminica*, and wore a flame-coloured habit, on which was painted a thunderbolt, and above her head-dress she had green oak boughs, to indicate that she belonged to Jupiter the thunderer, to whom the oak was sacred. The Flamines wore each of them a hat or cap called *Flammeum*, or *Apex*.

**FLAMINGO**, in *Ornithology*. See PHOENICOPTERUS, ORNITHOLOGY *Index*.

**FLAMINIUS**, or **FLAMININUS**, T. Q. a celebrated Roman, raised to the consulship in the year of Rome 554, though under the age of 30. He was trained in the art of war against Hannibal; and he showed himself capable in every respect to discharge with honour the great office with which he was intrusted. He was sent at the head of the Roman troops against Philip king of Macedon, and in his expedition he met with uncommon success. The Greeks gradually declared themselves his firmest supporters; and he totally defeated Philip on the confines of Epirus, and made all Locris, Phocis, and Thessaly, tributary to the Roman power. He granted peace to the conquered monarch, and proclaimed all Greece free and independent at the Isthmian games. This celebrated action procured the name of Patrons of Greece to the Romans, and insensibly paved their way to universal dominion. Flaminius behaved among them with the greatest policy; by his ready compliance to their national customs and prejudices, he gained uncommon popularity, and received the name of father and deliverer of Greece. He was afterwards sent ambassador to King Prusias, who had given refuge to Hannibal; and there his prudence and artifice hastened out of the world a man who had long been the terror of the Romans. Flaminius was found dead in his bed, after a life spent in the greatest glory, in which he had imitated with success the virtues of his model Scipio.

**FLAMINIUS**, or **FLAMINIO**, *Mark Antony*, one of the best Latin poets in the 16th century, of Imola in Italy, son and grandson of very learned men. The pope had chosen him secretary to the council in 1545; but he refused that employment, because, favouring the new opinions, he would not employ his pen in an assembly where he knew these opinions were to be condemned.—He paraphrased 38 of the psalms in Latin verse, and also wrote notes on the Psalms; and some letters and poems which are esteemed. He died at Rome in 1550.

**FLAMSTED**, a town of Hertfordshire in England, five miles from St Albans and Dunstable, stands on the river Verlam, and was of old called Verlamstede. The land in the vicinity is a clay so thickly mixed with flints, that, after a shower, nothing appears but a heap of stones; and yet it bears good corn even in dry summers. This fertility is imputed to a warmth in the flint, which preserves it from cold in the winter; and to its closeness, which keeps it from the scorching rays of the sun in the summer. Edward VI. when an infant, was brought hither for his health; and, it is said, the bedstead he lay on, which is curiously wrought, is still preserved in the manor house near the town.

**FLAMSTEED**, John, an eminent English astronomer, and the first who obtained the appointment of astronomer-royal, was born at Derby in the year 1646. He was educated at the free school of Derby, where he was head scholar at 14 years of age, at which period his constitution, naturally tender and delicate, was much tried by a severe illness. When some of his companions went to the university, the state of his health prevented him from accompanying them. He afterwards met with a book *De Sphæra*, written by John Sacrobosco, which was perfectly suited to the natural turn of his genius, and therefore he perused it with uncommon satisfaction, translating as much of it into English as he thought could be necessary for him; and from the *Astronomia Carolinæ* of Strut he learned the method of calculating eclipses, and ascertaining the places of the planets. Mr Hatton, a mathematician, sent him Kepler's *Tabulæ Rudolphinæ*, and *Riccioli's Almagestum Novum*, together with some other astronomical works to which he was as yet a stranger. In 1669 he calculated an eclipse of the sun, which had been omitted in the Ephemerides for the following year, together with five appulses of the moon to fixed stars, and sent them to Lord Brouncker, president of the Royal Society, who submitted them to the examination of that learned body, by which they were greatly applauded, and he received a letter of thanks from Mr Oldenburg the secretary. He likewise received a letter of thanks from Mr Collins, one of the members. In 1670 he was invited to come up to London by his father, that he might become personally acquainted with his learned correspondents, of which he gladly accepted, and had an interview with Mr Oldenburg and Mr Collins, by the latter of whom he was introduced to Sir Jonas Moore, who became the warm friend and patron of Mr Flamsteed. In consequence of this journey he became acquainted with many astronomical instruments, and was presented by Sir Jonas Moore with Townley's micrometer, who also assisted him in procuring glasses at a moderate rate for the construction of telescopes. On his way home again he returned by Cambridge, where he paid a visit to the celebrated Dr

Barrow and Sir Isaac, then Mr Newton, and entered a student of Jesus college.

In the year 1672, he made large extracts from the letters of Gascoigne and Crabtree, by which his knowledge of dioptrics was very much improved; and during the same year he made a number of celestial observations when the weather would permit, which were afterwards published in the Philosophical Transactions. In 1673 he composed a treatise on the true and apparent diameters of the planets, when at their greatest and least distance from the earth, which even the great Newton did not scruple to borrow, and made some use of it in his Principia in 1685. He published an Ephemeris in 1674, in which he exposed the folly and absurdity of astrology, and the same year he drew up a table of the tides for the use of the king, with an astronomical account of their ebbing and flowing, which Sir Jonas Moore assured him would be well received by his majesty. Sir Jonas received from Mr Flamsteed a pair of barometers, with directions how to use them, which he presented to the king and the duke of York, to whose notice he embraced every opportunity of introducing Mr Flamsteed.

Having taken the degree of M. A. at Cambridge, he formed the resolution of entering into holy orders, when Sir Jonas wrote to him to come to London, where he had an appointment for him very different from that of the church. But as he found that nothing could make him abandon the resolution he had formed, he obtained a situation for him which was perfectly consistent with the character of a clergyman. This was the new office of astronomer to the king, with a salary of 100l. per annum. He received ordination at Ely-house by Bishop Gunning, in Easter 1675; and on the 10th of August in the same year the foundation stone of the royal observatory at Greenwich was laid, which received the designation of Flamsteed house, in honour of the first astronomer royal. Till this edifice was erected, he made his observations in the queen's house at Greenwich, and in 1681 his Doctrine of the Sphere was published by Sir Jonas Moore in his System of the Mathematics. Notwithstanding his extraordinary merit, he never rose higher in the church than to the living of Burslow in Surrey, although he was deservedly esteemed by the greatest men in the nation. He corresponded with the great Newton, Dr Halley, Mr W. Molyneux, Dr Wallis, and many others; and M. Cassini and he imparted their discoveries to each other with the utmost confidence and cordiality. But none of his works contributed so much to render his fame immortal as his "Historia Cælestis Britannica," in three vols. folio. Mr Flamsteed was suddenly carried off by a strangury on the 31st of December 1719; and notwithstanding the extreme delicacy of his constitution and incessant labours, he reached the 73d year of his age.

**FLANDERS**, a province of the Netherlands, bounded by the German sea and the United Provinces on the north, by the province of Brabant on the east, by Hainault and Artois on the south, and by another part of Artois and the German sea on the west; being about 60 miles long and 50 broad.

Flanders is a perfectly champaign country, with not a rising ground or hill in it, and watered with many fine rivers and canals. Its chief commodities are fine lace, linen, and tapestry.

In this country some important arts were invented and improved. Weaving in general was greatly improved, and that of figures of all sorts in linen was invented; also the art of dyeing cloths and stuffs, and of oil colours; the curing of herrings, &c. The manufactures of this country are not now in the flourishing state they were formerly; yet silk, cotton, and woollen stuffs, &c. are still manufactured here in great quantities. This province had counts of its own from the ninth century to the year 1369, when it went by marriage to the dukes of Burgundy; and afterwards from them, by marriage also, to the house of Austria. France, in 1667, seized the southern part; and the States General obtained the northern. It was overrun by the French in 1794, but was united to the new kingdom of the Netherlands in 1814.

For a more particular history of Flanders, see the article NETHERLANDS.

**FLANEL**, or FLANNEL, a kind of slight, loose, woollen stuff, composed of a woof and warp, and wove on a loom with two treddles, after the manner of baize.

Dr Black assigns as a reason why flanel and other substances of the kind keep the body warm, that they compose a rare and spongy mass, the fibres of which touch each other so lightly, that the heat moves slowly through the interstices, which being filled only with air, and that in a stagnant state, give little assistance in conducting the heat. From the experiments of Count Rumford, it appears, that there is no relation betwixt the power which the substances usually worn as clothing have of absorbing moisture, and that of keeping the body warm. Having provided a quantity of each of these substances mentioned below, he exposed them, spread out upon clean china plates, for the space of 24 hours to the warm and dry air of a room which had been heated by a German stove for several months, and during the last six hours had raised the thermometer to 85° of Fahrenheit; after which he weighed equal quantities of the different substances with a very accurate balance. They were then spread out upon a china plate, and removed into a very large uninhabited room upon the second floor, where they were exposed 48 hours upon a table placed in the middle of the room, the air of which was at 45° of Fahrenheit. At the end of this space they were weighed, and then removed into a damp cellar, and placed on a table in the middle of the vault, where the air was at the temperature of 45°, and which by the hygrometer seemed to be fully saturated with moisture. In this situation they were suffered to remain three days and three nights; the vault being all the time hung round with wet linen cloths, to render the air as completely damp as possible. At the end of three days they were weighed, and the weights at the different times were found as in the following table.

| | | Weight after being dried in the hot room. | Weight after coming out of the cold room. | Weight after remaining 72 h. in the vault. |
|---|---|---|---|---|
| Sheep's wool | | Parts 1000 | 1084 | 1163 |
| Beaver's fur | | | 1072 | 1125 |
| The fur of a Russian hare | | | 1065 | 1115 |
| Eider down | | | 1067 | 1112 |
| Silk | Raw single thread | | 1057 | 1107 |
| | Ravellings of white taffety. | | 1054 | 1103 |
| Linen | Fine lint | | 1046 | 1102 |
| | Ravellings of fine linen | | 1044 | 1082 |
| Cotton wool | | | 1043 | 1089 |
| Ravellings of silver lace | | | 1000 | 1000 |

On these experiments our author observes, that though linen, from the apparent ease with which it receives dampness from the atmosphere, seems to have a much greater attraction for water than any other; yet it would appear from what is related above, that those bodies which receive water in its unelastic form with the greatest ease, or are most easily wet, are not those which in all cases attract the moisture of the atmosphere with the greatest avidity. "Perhaps (says he), the apparent dampness of linen to the touch, arises more from the ease with which that substance parts with the water it contains, than from the quantity of water it actually holds: in the same manner as a body appears hot to the touch, in consequence of its parting freely with its heat; while another body which is really at the same temperature, but which withholds its heat with great obstinacy, affects the sense of feeling much less violently. It is well known that woollen clothes, such as flanels, &c. worn next the skin, greatly promote insensible perspiration. May not this arise principally from the strong attraction which subsists between wool and the watery vapour which is continually issuing from the human body? That it does not depend entirely on the warmth of that covering, is clear; for the same degree of warmth produced by wearing more clothing of a different kind, does not produce the same effect. The perspiration of the human body being absorbed by a covering of flanel, it is immediately distributed through the whole thickness of that substance, and by that means exposed, by a very large surface, to be carried off by the atmosphere; and the loss of this watery vapour which the flanel sustains on the one side by evaporation, being immediately restored from the other, in consequence of the strong attraction between the flanel and this vapour, the pores of the skin are disencumbered, and they are continually surrounded by a dry and salubrious atmosphere."

Our author expresses his surprise, that the custom of wearing flanel next the skin should not have prevailed more universally. He is confident it would prevent a number of diseases; and he thinks there is no greater luxury than the comfortable sensation which arises from wearing it, especially after one is a little accustomed to it. "It is a mistaken notion (says he), that it is too warm a clothing for summer. I have worn it in the hottest climates, and at all seasons of the year; and never found the least inconvenience from it. It is the warm bath of perspiration confined by a linen shirt, wet with sweat, which renders the summer heats of southern climates so unsupportable; but flanel promotes perspiration, and favours its evaporation; and evaporation, as is well known, produces positive cold.

It has been observed that new flanel, after some time wearing, acquires the property of shining in the dark, but loses it on being washed. *Philosophical Transactions*, N° 483. § 7.

**FLANK**, or **Flanc**, in the manege, is applied to the sides of a horse's buttock, &c. In a strict sense, the flanks of a horse are the extremes of the belly, where the ribs are wanting, and are below the loins.

The flanks of a horse should be full, and at the top of each a feather. The distance between the last rib and haunch-bone, which is properly the flank, should be short, which they term *well coupled*, such horses being most hardy, and fit to endure labour.

A horse is said to have no flank if the last of the short ribs be at a considerable distance from the haunch-bone; as also when the ribs are too much straitened in their compass.

**Flank**, in *War*, is used by way of analogy for the side of a battalion, army, &c. in contradistinction to the *front* and *rear*.

*To attack the enemy in flank*, is to discover and fire upon them on the side. See File.

**Flank**, in *Fortification*, is a line drawn from the extremity of the face towards the inside of the work.

Or, flank is that part of a bastion which reaches from the curtain to the face, and defends the opposite face, the flank, and the curtain. See Fortification.

*Oblique* or *Second* **Flank**, or **Flank** *of the Curtain*, is that part of the curtain from whence the face of the opposite bastion can be seen, being contained between the lines rasant and fichant, or the greater and less lines of defence; or the part of the curtain between the flank and the point where the fichant line of defence terminates.

*Covered*, *Low*, or *Retired* **Flank**, is the platform of the casement which lies hid in the bastion; and is otherwise called the Orillon.

*Fichant* **Flank**, is that from whence a cannon playing, fires directly on the face of the opposite bastion.

*Rasant* or *Razant* **Flank**, is the point from whence the line of defence begins, from the conjunction of which with the curtain, the shot only raseth the face of the next bastion, which happens when the face cannot be discovered but from the flank alone.

**FLAT**, in sea-language, denotes a level ground lying at a small depth under the surface of the sea, and is also called a *shoal* or *shallow*.

*Flat-Bottomed Boats* are such as are made to swim in shallow water, and to carry a great number of troops, artillery, ammunition, &c. They are constructed with a 12-pounder, bow-chase, and an 18 pounder, stern-chase; their keel is from 90 to 100 feet, and from 12 to 24 feet beam: they have one mast, a large square main-sail, and a jib-sail; are rowed by 18 or 20 oars, and can carry 400 men each. The gun takes up one bow, and a bridge the other, over which the troops are to march. Those that carry horses have the fore-part of the boat made to open when the men are to mount and ride over a bridge.

**FLATS**, in *Music*. See Interval.

**FLATUS**, **Flatulence**, in *Medicine;* vapours generated in the stomach and intestines, chiefly occasioned by a weakness of these parts. They occasion distensions, uneasy sensation, and sickness, and often a considerable degree of pain. See Medicine *Index*.

**FLAVEL**, **John**, an eminent non-conformist minister, was educated at University-college, in Oxford; and became minister first of Deptford, and afterwards of Dartmouth in Devonshire, where he resided the greatest part of his life, much respected and admired for his preaching; although he was persecuted on account of his principles, when in 1685, several of the aldermen of the town, attended by the rabble, carried about a ridiculous effigy of him, to which were affixed the Bill of Exclusion and the Covenant. Upon this occasion, he thought it prudent to withdraw from the town; not knowing what treatment he might meet with from a riotous mob, headed by magistrates who were themselves among the lowest of mankind. Part of his Diary, printed with his Remains, must give the reader a high idea of his piety. He died in 1691, aged 61; and after his death, his works, which consisted of many pieces of practical divinity, were printed in two volumes folio. Among these, the most famous are his "Navigation Spiritualized, or a New Compass for seamen, consisting of 32 points of pleasant observations and serious reflections," of which there have been several editions in 8vo; and his "Husbandry Spiritualized, &c. with occasional meditations upon beasts, birds, trees, flowers, rivers and several other objects," of which also there have been many editions in 8vo.

**FLAX**, in *Botany*. See Linum, Botany *Index*.

The following particulars with regard to the manner of raising flax, have been some years past warmly recommended by the trustees for fisheries, manufactures, and improvements in Scotland.

*Of the choice of the Soil, and preparing the ground for Flax.* A skilful flax-raiser always prefers a free open deep loam; and all grounds that produced the preceding year a good crop of turnip, cabbage, potatoes, barley, or broad clover, or have been formerly laid down rich, and kept for some years in pasture.

A clay soil, the second or third crop after being limed, will answer well for flax; provided, if the ground be still stiff, that it be brought to a proper mould, by tilling after harvest to expose it to the winter frosts.

All new grounds produce a strong crop of flax, and pretty free of weeds. When a great many mole heaps appear upon new ground, it answers the better for flax, after one tilling.

Flax seed ought never to be sown on grounds that are either too wet or dry; but on such as retain a natural moisture: and such grounds as are inclined to weeds ought to be avoided, unless prepared by a careful summer fallow.

If the linseed be sown early, and the flax not allowed to stand for seed, a crop of turnip may be got after the flax that very year; the second year a crop of bear or barley may be taken; and the third year, grass seeds are sometimes sown along with the linseed. This is the method mostly practised in and about the counties of Lincoln and Somerset, where great quantities of flax and hemp are every year raised, and where these crops have long been capital articles. There, old ploughed grounds are never sown with linseed, unless the soil be very rich and clean. A certain worm, called in Scotland the *coup worm*, abounds in grounds newly broken up, and greatly hurts every crop but flax. In small enclosures surrounded with trees or high hedges, the flax, for want of free air, is subject to fall before it be ripe; and the droppings of rain and dew from the trees prevent the flax, within the reach of the trees, from growing to any perfection.

Of preceding crops, potatoes and hemp are the best preparation for flax. In the fens of Lincoln, upon proper ground of old tillage, they sow hemp, dunging well the first year; the second year, hemp without dung; the third year, flax without dung; and that same year, a crop of turnip eaten on the ground by sheep; the fourth year, hemp with a large coat of dung; and so on for ever.

If the ground be free and open, it should be but once ploughed; and that as shallow as possible, not deeper than 2½ inches. It should be laid flat, reduced to a fine garden mould by much harrowing, and all stones and sods should be carried off.

Except a little pigeons dung for cold or sour ground, no other dung should be used preparatory for flax; because it produces too many weeds, and throws up the flax thin and poor upon the stalk.

Before sowing, the bulky clods should be broken, or carried off the ground; and stones, quickenings, and every other thing that may hinder the growth of the flax should be removed.

*Of the choice of Linseed.* The brighter in colour, and heavier the seed is, so much the better; that which when bruised appears of a light or yellowish green, and fresh in the heart, oily and not dry, and smells and tastes sweet, and not fusty, may be depended upon.

Dutch seed of the preceding year's growth, for the most part, answers best; but it seldom succeeds if kept another year. It ripens sooner than any other foreign seed. Philadelphia seed produces fine lint and few bolls, because sown thick, and answers best in wet cold soils. Riga seed produces coarser lint, and the greatest quantity of seed. Scots seed, when well winned and kept, and changed from one kind of soil to another, sometimes answers pretty well; but should be sown thick, as many of its grains are bad, and fail. It springs well, and its flax is sooner ripe than any other; but its produce afterwards is generally inferior to that from foreign seed.

A kind has been lately imported called *Memmel seed;* which looks well, is short and plump, but seldom grows above eight inches, and on that account ought not to be sown.

*Of sowing Linseed.* The quantity of linseed sown should be proportioned to the condition of the soil; for if the ground be in good heart, and the seed sown thick, the crop will be in danger of falling before it is ready for pulling. From 11 to 12 pecks Linlithgow measure of Dutch or Riga seed, is generally sufficient for one Scots acre; and about 10 pecks of Philadelphia seed, which, being the smallest grained, goes farthest. Riga linseed, and the next year's produce of it, is preferred in Lincolnshire.

The time for sowing linseed is from the middle of March to the end of April, as the ground and season answer; but the earlier the seed is sown, the less the crop interferes with the corn harvest.

Late sown linseed may grow long, but the flax upon the stalk will be thin and poor.

After sowing, the ground ought to be harrowed till the seed is well covered, and then, (supposing the soil, as before mentioned, to be free and reduced to a fine mould) it ought to be rolled.

When a farmer sows a large quantity of linseed, he may find it proper to sow a part earlier and part later, that in the future operations of weeding, pulling, watering, and grassing, the work may be the easier and more conveniently gone about.

It ought always to be sown on a dry bed.

*Of Weeding Flax.* It ought to be weeded when the crop is about four inches long. If longer deferred, the weeders will so much break and crook the stalks, that they will never perhaps recover their straightness again; and when the flax grows crooked, it is more liable to be hurt in the rippling and swingling.

Quicken grass should not be taken up; for, being strongly rooted, the pulling of it always loosens a deal of the lint.

If there is an appearance of a settled drought, it is better to defer the weeding, than by that operation to expose the tender roots of the flax to the drought.

How soon the weeds are got out, they ought to be carried off the field, instead of being laid in the furrows, where they often take root again, and at any rate obstruct the growth of the flax in the furrows.

*Of Pulling Flax.* When the crop grows so short and branchy, as to appear more valuable for seed than flax, it ought not to be pulled before it be thoroughly ripe; but if it grows long and not branchy, the seed should be disregarded, and all the attention given to the flax. In the last case it ought to be pulled after the bloom has fallen, when the stalk begins to turn yellow, and before the leaves fall, and the bolls turn hard and sharp-pointed.

When the stalk is small, and carries few bolls, the flax is fine: but the stalk of coarse flax is gross, rank, branchy, and carries many bolls.

When the flax has fallen, and lies, such as lies ought to be immediately pulled, whether it has grown enough or not, as otherwise it will rot altogether.

When parts of the same field grow unequally, so that some parts are ready for pulling before other parts; only what is ready should be pulled, and the rest should be suffered to stand till ready.

The flax-raiser ought to be at pains to pull and keep by itself, each different kind of lint which he finds in his field; what is both long and fine, by itself; what is both long and coarse, by itself; what is both short and fine, by itself; what is both short and coarse, by itself; and in like manner every other kind by itself that is of the same size and quality. If the different kinds be not thus kept separate, the flax must be much damaged in the watering and the other succeeding operations.

What is commonly called *under-growth* may be neglected as useless.

Few persons that have seen pulled flax, are ignorant of the method of laying it in handfuls across each other; which gives the flax sufficient air, and keeps the handfuls separate and ready for the rippler.

*Of Stacking up Flax during the Winter, and Winning the Seed.* If the flax be more valuable than the seed, it ought by no means to be stacked up; for its own natural juice assists it greatly in the watering; whereas, if kept long unwatered, it loses that juice, and the harle adheres so much to the boon, that it requires longer time to water, and even the quality of the flax becomes thereby harsher and coarser. Besides, the flax stacked up over year, is in great danger from vermine and other accidents; the water in spring is not so soft and warm as in harvest; and near a year is thereby lost of the use of the lint: but if the flax be so short and branchy as to appear most valuable for seed, it ought, after pulling, to be stooked and dried upon the field, as is done with corn; then stacked up for winter, rippled in spring; and after sheeling, the seed should be well cleaned from bad seeds, &c.

*Of Rippling Flax.* After pulling, if the flax is to be regarded more than the seed, it should be allowed to lie some hours upon the ground to dry a little, and so gain some firmness, to prevent the skin or harle, which is the flax, from rubbing off in the rippling; an operation which ought by no means to be neglected, as the bolls, if put into the water along with the flax, breed vermine there, and otherwise spoil the water. The bolls also prove very inconvenient in the grassing and breaking.

In Lincolnshire and Ireland, they think that rippling hurts the flax; and therefore, in place of rippling, they strike the bolls against a stone.

The handfuls for rippling should not be great, as that endangers the lint in the rippling comb.

After rippling, the flax-raiser will perceive, that he is able to assort each size and quality of the flax by itself more exactly than he could before.

*Of Watering Flax.* A running stream wastes the lint, makes it white, and frequently carries it away. Lochs, by the great quantity and motion of the water, also waste and whiten the flax, though not so much as running streams. Both rivers and lochs water the flax quicker than canals.

But all flax ought to be watered in canals, which should be digged in clay ground if possible, as that soil retains the water best: but if a firm retentive soil cannot be got, the bottom or sides of the canal, or both the bottom and sides, may be lined with clay; or instead of lining the sides with clay, which might fall down, a ditch may be dug without the canal, and filled with clay, which will prevent both extraneous water from entering, and the water within from running off.

A canal of 40 feet long, six broad, and four deep, will generally water the growth of an acre of flax.

It ought to be filled with fresh soft water from a river or brook, if possible, two or three weeks before the flax is put in, and exposed all that time to the heat of the sun. The greater way the river or brook has run, the softer, and therefore the better, will the water be. Springs, or short runs from hills, are too cold, unless the water is allowed to stand long in the canal. Water from coal or iron is very bad for flax. A little of the powder of galls thrown into a glass of water, will

will immediately discover if it comes from minerals of that kind, by turning it into a dark colour, more or less tinged in proportion to the quantity of vitriol it contains.

The canal ought not to be under shade: which, besides keeping the sun from softening the water, might make part of the canal cooler than other parts, and so water the flax unequally.

The flax-raiser will observe, when the water is brought to a proper heat, that small plants will be rising quickly in it, numbers of small insects and reptiles will be generating there, and bubbles of air rising on the surface. If no such signs appear, the water must not be warm enough, or is otherwise unfit for flax.

Moss holes, when neither too deep nor too shallow, frequently answer well for watering flax, when the water is proper, as before described.

The proper season for watering flax is from the end of July to the end of August.

The advantage of watering flax as soon as possible after pulling, has been already mentioned.

The flax being sorted after rippling, as before mentioned, should next be put in beets, never larger than a man can grasp with both his hands, and tied very slack with a band of a few stalks. Dried rushes answer exceedingly well for binding flax, as they do not rot in the water, and may be dried and kept for use again.

The beets should be put into the canals slopewise, or half standing upon end, the root end uppermost. Upon the crop ends, when uppermost, there frequently breeds a deal of vermine, destructive of the flax, which is effectually prevented by putting the crop end downmost.

The whole flax in the canal ought to be carefully covered from the sun with divots; the grassy side of which should be next the flax, to keep it clean. If it is not thus covered, the sun will discolour the flax, though quite covered with water. If the divots are not weighty enough to keep the flax entirely under water, a few stones may be laid above them. But the flax should not be pressed to the bottom.

When the flax is sufficiently watered, it feels soft to the gripe, and the *harle* parts easily with the *boon* or *show*, which last is then become brittle, and looks whitish. When these signs are found, the flax should be taken out of the water, beet after beet; each gently rinsed in the water, to cleanse it of the nastiness which has gathered about it in the canal; and as the lint is then very tender, and the beet slackly tied, it must be carefully and gently handled.

Great care ought to be taken that no part be over done; and as the coarsest waters soonest, if different kinds be mixed together, a part will be rotted, when the rest is not sufficiently watered.

When lint taken out of the canal is not found sufficiently watered, it may be laid in a heap for 12, 18, or 24 hours, which will have an effect like more watering; but this operation is nice, and may prove dangerous in unskilful hands.

After the flax is taken out of the canal, fresh lint should not be put a second time into it, until the former water be run off, and the canal cleaned, and supplied with fresh water.

*Of Grassing* FLAX. Short heath is the best field for grassing flax; as, when wet, it fastens to the heath, and is thereby prevented from being blown away by the wind. The heath also keeps it a little above the earth, and so exposes it the more equally to the weather. When such heath is not to be got, links or clean old lea ground is the next best. Long grass grounds should be avoided, as the grass growing through the lint frequently spots, tenders, or rots it; and grounds exposed to violent winds should also be avoided.

The flax, when taken out of the water, must be spread very thin upon the ground: and being then very tender, it must be gently handled. The thinner it is spread the better, as it is then the more equally exposed to the weather. But it ought never to be spread during a heavy shower, as that would wash and waste the harle too much, which is then excessively tender; but soon after becomes firm enough to bear the rains, which, with the open air and sunshine, cleans, softens, and purifies the harle to the degree wanted, and makes it blister from the boon. In short, after the flax has got a little firmness by being a few hours spread in dry weather, the more rain and sunshine it gets the better.

If there be little danger of high winds carrying off the flax, it will be much the better of being turned about once a-week. If it is not to be turned, it ought to be very thin spread. The spreading of flax and hemp requires a deal of ground, and enriches it greatly.

The skilful flax-raiser spreads his first row of flax at the end of the field opposite to the point from whence the most violent wind commonly comes, placing the root-ends foremost; he makes the root-ends of every other row overlap the crop ends of the former row three or four inches, and binds down the last row with a rope; by which means the wind does not easily get below the lint to blow it away; and as the crop ends are seldom so fully watered as the root ends, the aforesaid overlapping has an effect like giving the crop ends more watering. Experience only can fully teach a person the signs of flax being sufficiently grassed: then it is of a clearer colour than formerly; the harle is blistered up, and easily parts with the boon, which is then become very brittle. The whole should be sufficiently grassed before any of it is lifted; for if a part be lifted sooner than the rest, that which remains is in great danger from the winds.

A dry day ought to be chosen for taking up the flax; and if there is no appearance of high wind, it should be loosed from the heath or grass, and left loose for some hours, to make it thoroughly dry.

As a great quantity of flax can scarcely be all equally watered and grassed, and as the different qualities will best appear at lifting the flax off the grass; therefore at that time each different kind should be gathered together, and kept by itself; that is, all of the same colour, length, and quality.

The smaller the beets lint is made up in, the better for drying, and the more convenient for stacking, housing, &c. and in making up these beets, as in every other operation upon flax, it is of great consequence that the lint be laid together as it grew, the root ends together, and the crop ends together.

*Follows an estimate of the Expence, Produce, and Profit of a Scots Acre of* FLAX.—*supposing the season favourable, that no accidental losses happen, and that the farmer is neither unskilful nor negligent.*

| | *A medium crop.* | *A great crop.* | *An extra crop.* |
|---|---|---|---|
| Ground rent, labouring the ground, and leading the flax | L. 2 10 0 | L. 3 10 0 | L. 5 0 0 |
| Linseed from 2l. to 4l. per hogshead, the medium 3s. 4d. per peck — — | 1 16 8<br>for 11 pecks. | 1 10 0<br>for 9 pecks. | 1 6 8<br>for 8 pecks. |
| Clodding and sowing — — | 0 2 0 | 0 2 0 | 0 2 0 |
| Weeding — — — | 0 12 0 | 0 8 0 | nothing. |
| Pulling, rippling, putting in, and covering in the water — — — | 0 14 0 | 0 15 0 | 1 0 0 |
| Taking out of the water, grassing, and stacking | 0 8 0 | 0 12 0 | 0 18 0 |
| Breaking and scutching, at 2s. per stone — | 3 0 0<br>for 30 stones. | 4 0 0<br>for 40 stones. | 6 0 0<br>for 60 stones. |
| Total expence | L. 9 2 8 | L. 10 17 0 | L. 14 6 8 |
| Produce at 10s. per stone — — | L. 15 0 0<br>for 30 stones. | L. 20 0 0<br>for 40 stones. | L. 30 0 0<br>for 60 stones. |
| Linseed sold for oil at 1s. per peck — | 0 16 0 | 0 18 0 | 1 0 0 |
| The chaff of the bolls is well worth the expence of drying the seed; as it is good food, when boiled and mixed with bear, for horses. | | | |
| Total produce | L. 15 16 0 | L. 20 18 0 | L. 31 0 0 |
| Balance for profit — — | L. 6 14 4 | L. 10 1 0 | L. 16 13 4 |

The above estimate being made several years ago, the expence and profit are now different; but the proportions of each are probably the same. There is nothing stated here as expence of the canal in which the flax is watered; because that varies much according to circumstances.

It is a certain fact, that the greater the crop is, the better is the quality of the same kind of flax.

The advantage of having both a crop of flax and a crop of turnip the same year—or of sowing grass seeds along with the linseed—and of reducing the ground to a fine garden mould, free of weeds, ought to be attended to.

*For Cambric and fine Lawn.* The ground must be a rich light soil, rather sandy, but cannot be too rich.

It ought to be ploughed in September, or the beginning of October, first putting a little hot rotten dung upon it. In January it ought to have a second ploughing, after a hard frost; and when you intend to sow it, plough it a third time, or rather hoe it, reducing the clods very fine; but make no furrows: the land must be made level like a garden; but never work the land when wet.

The seed should be sown the beginning of April, and about double the quantity that is generally sown by our farmers; if the land be very rich, it will require rather more than double.

As soon as sown (if the weather be dry) it will be necessary to roll the ground.

The lint must be weeded very clean when about three inches high; directly after which you must set forked sticks, of about one and a half inch thick (which ought to be prepared before), every four or five feet, according to the length of the poles you are to lay upon them; they should be well fixed in the ground, the forked part to receive the poles about six or seven inches above the lint; each row of poles should be two, three, or four feet asunder, according to the length of the brushwood you are to lay upon them.

The poles ought to be from 10 to 15 feet long, and strong enough to support the brush across the poles; take the longest brushwood you can get, the more branchy the better, very thick, filling up the vacancies with smaller brush, and any of the branches that rise higher than 18 or 20 inches ought to be lopt off to make the brush lie as level as possible: any sort of brush will do except oak, as that tinges the lint.

Your lint must be pulled as soon as the seed is fully formed, which is a few days after it is out of the bloom, before the lint turn yellow.

It must be pulled above the brushwood, and every handful laid upon it as soon as possible: if it is fine weather, leave it four or five hours in that manner: then carry it to a screen near a barn, to put it under a cover in case of rain; there it must be spread four or five days, and always put in the barn at night, or when it appears to rain: the bundles must be opened in the barn, or made hollow, to prevent it from heating.

These operations must be performed until the lint is perfectly dry, and out of danger of heating; taking care all the time to keep the roots as even as possible, and if possible keep it from rain or wet: if you cannot prevent it from being wet, it will be better to leave it on the grass till dry; because when once wet, the putting it under cover before dry will make it turn black; a thing which must be prevented at all events.

If any of the lint upon the border, or through the piece of ground, be coarser than another, it must be separated from the rest.

The utmost care must be taken to preserve the lint entire or unbroken; for this reason they beat off the seed with a round mell or bittle.

The most proper ground is summer fallow, or after potatoes or lea; if possible near a wood, to prevent the expence of carrying brush.

As soon as the seed is off, if you intend to water it that season, it must be tied in bundles about as large as you can grasp with your two hands.

The water proper for it, is a very small rivulet or soft spring free of any mineral matter; taking care that no flood or foul water enters your pit; which must be at least five feet deep, about nine or ten broad at the top, and seven or eight at the bottom; the length will depend on the quantity of flax you have to water. A very small stripe of water, when clear, should always be running in and off from your pit when the lint is in it.

The pit ought to be made three or four months before it be used.

You must drive poles about four inches thick, with a hook inclining downwards, in this form 7, all along the sides of the pit, above five feet asunder. The hooks must be level with, or rather under, the surface of the water. A long pole, the whole length of the pit, must be fixed into these hooks on each side; and cross poles put under that, to keep the lint under water; but the cross poles are not used till the lint is put in. You must order it so, that all the lint should be three or four inches under water. You next bring your lint to the sides of the pit; then put your sheaves head to head, causing each to overlap the other about one-third, and take as many of these as make a bundle of two or two and a half feet broad, laying the one above the other, till it is about four or four and a half feet high; then you tie them together in the middle, and at each root end: after this you wrap your bundle in straw, and lay it in the water, putting the thin or broad side undermost, taking care that none of your lint touch the earth; after it is fully pressed under water, put in your cross poles to keep it under. The bundles ought to lie in the pit a foot separate from each other. This renders it easy to take out; for, if the bundles entangle, they will be too heavy to raise.

The time of watering depends so much upon the weather, and softness or hardness of the water, that it is impossible to fix any certain time. This must be left to the skill of the farmer. If the flax be intended for spinning yarn soft and fit for cambric, it ought to be spread upon short grass for four or five days before you put it into the water; but if for lawns, lace, or thread, it is best to dry it outright. In either case avoid as much as possible to let it get rain; as much rain blanches and washes out the oil, which is necessary to preserve the strength.

The great property of this flax is to be fine and long. Thick sowing raises all plants fine and slender; and when the ground is very rich, it forces them to a great length. Pulling green prevents that coarse hardness which flax has when let stand till it be full ripe, and gives it the fine silky property. The brushwood, when the flax springs up, catches it by the middle, and prevents it from lying down and rotting; infallible consequences of sowing thick upon rich ground. It likewise keeps it straight, moist, and soft at the roots; and by keeping it warm, and shaded from the sun, greatly promotes its length. The keeping it from rain, heating, taking proper care of your water, preserves the colour, and prevents those bars in cloth so much complained of by bleachers.

Plate CCXVIII. fig. 1. and 2.

*Flax-Dressing*. For many ages it was the practice to separate the boon or core from the flax, which is the bark of the plant, by the following simple *hand methods*. First, for breaking the boon, the stalks in small parcels were beat with a mallet; or, more dexterously, the *break* (Plate CCXVIII. fig. 1. and 2.) was used thus: The flax being held in the left hand across the three *under teeth* or *swords* of the break (*A*, fig. 1. and *a*, fig. 2.), the *upper teeth* (*B*, fig. 1. and *b*, fig. 2.) were with the right hand quickly and often forced down upon the flax, which was artfully shifted and turned with the left hand. Next, for clearing the flax of the broken boon: the workman with his left hand held the flax over the *stock* (fig. 3. and 4.), while with his right hand he struck or thrashed the flax with the *scutcher* (fig. 5.).

These methods of breaking and scutching the flax being slow and very laborious, a *water-mill* was invented in Scotland about the year 1750; which, with some improvements, makes great dispatch, and in skilful and careful hands gives satisfaction. It has been generally constructed to break the boon by three dented rollers, placed one above the other. The middle one of which, being forced quickly round, takes the other two along with it, and one end of the handfuls of the flax being by the workman directed in between the upper and middle rollers, the flax is immediately drawn in by the rollers; a curved board or plate of tin behind the rollers directs the flax to return again between the middle and undermost rollers;—and thus the operation is repeated until the boon be sufficiently broke. Great weights of timber or stone at the ends of levers, press the upper and under rollers towards the middle one.

The scutching is next carried on by the mill in the following manner: Four arms, something like the hand-scutchers before described, project from a perpendicular axle; a box around the axle encloses these projecting scutchers; and this box is divided among the workmen, each having sufficient room to stand and handle his flax, which, through slits in the upper part and sides of the box, they hold in to the stroke of the scutchers; which, moving round horizontally, strike the flax across or at right angles, and so thrash out or clear it to the boon.

The breaking of the flax by *rollers* is scarcely subject to any objection, but that it is dangerous to workmen not sufficiently on their guard, who sometimes allow the rollers to take hold of their fingers, and thereby their whole arm is instantly drawn in: thus many have lost their arms. To avoid this danger, a break, upon the general principles of the hand-break before described, has been lately adapted to water-machinery, and used in place of rollers. The horizontal stroke of the scutchers was long thought too severe and wasteful of the flax; but very careful experiments have discovered that the waste complained of must be charged to the unskilfulness or negligence of the workmen, as in good hands the mill carries away nothing but what, if not so scutched off, must be taken off in the heckling, with more loss both of time and flax. But to obviate this objection of the violence of the *horizontal scutchers*, an imitation of hand-scutching has lately been applied to water. The scutchers then project from a horizontal axle, and move like the arms of a check reel, striking the flax neither across nor perpendicularly down, but sloping in upon the parcel exactly as the flax is struck by the hand-scutcher. The sloping stroke is got by raising the scutching stock some inches higher than the centre of the axle; and by raising or lowering the stock over which the flax is held, or screwing it nearer to or farther from the scutchers, the workman can temper or humour the stroke almost as he pleases.

A lint mill, with horizontal scutchers upon a perpendicular axle, requires a house of two stories, the rollers or break being placed in the ground story, and the scutchers in the loft above; but a mill with vertical scutchers on a horizontal axle, requires but one ground story for all the machinery.

Another method of breaking and scutching flax, more expeditious than the old hand methods, and more gentle than water-mills, has also been invented in Scotland. It is much like the break and scutcher, giving the sloping stroke last described, moved by the foot. The treddle is remarkably long, and the scutchers are fixed upon the rim of a fly wheel. These foot machines are very useful where there are no water-mills, but they are far inferior to the mills in point of expedition.

The next operation that flax undergoes after scutching is heckling. The *heckle* (fig. 6.) is firmly fixed to a bench before the workman, who strikes the flax upon the teeth of the heckle, and draws it through the teeth. To persons unacquainted with that kind of work this may seem a very simple operation; but, in fact, it requires as much practice to acquire the slight of heckling well, and without wasting the flax, as any other operation in the whole manufacture of linen. They use coarser and wider teethed heckles, or finer, according to the quality of the flax; generally putting the flax through two heckles, a coarser one first, and next a fine one.

*Flax for Cambric and fine Lawn, Thread, and Lace*, is dressed in a manner somewhat different. It is not scutched so thoroughly as common flax; which from the scutch proceeds to the heckle, and from that to the spinner: whereas, this fine flax, after a rough scutching, is scraped and cleansed with a blunt knife upon the workman's knee covered with his leather apron; from the knife it proceeds to the spinner, who, with a brush made for the purpose, straights and dresses each parcel just before she begins to spin it.

The following observations on this subject, first published in the Gentleman's Magazine for June, 1787, seem worthy of particular attention.

*Of the watering of Flax by a new method, so as to shorten labour, to add probably to the strength of the flax, and to give it a much finer colour, which would render the operation of bleaching safer and less tedious.*

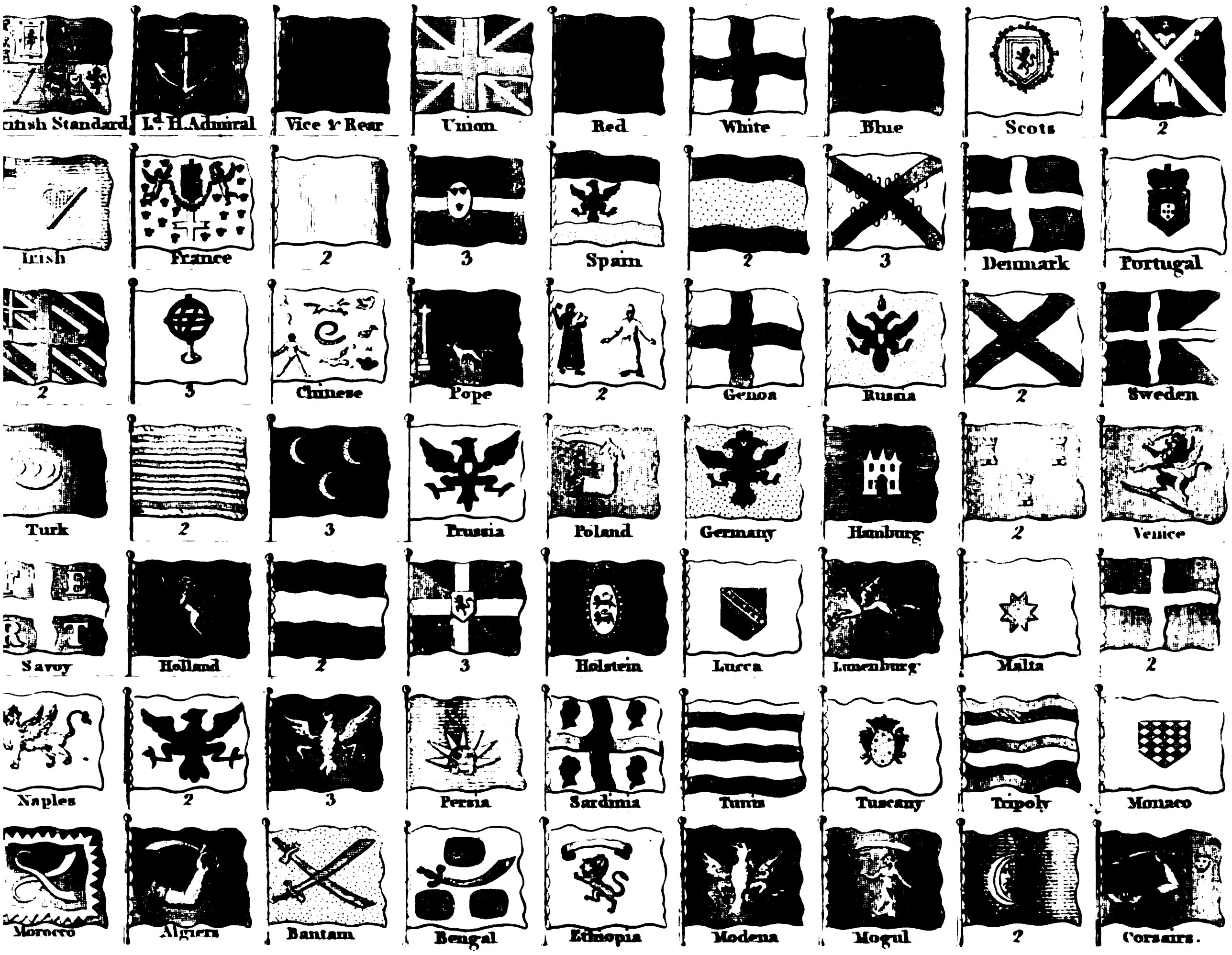
"Though the following reflections have for their object an improvement in the very essential article of watering of flax, yet I must advertise the reader, that they are only theory, and must depend entirely for their truth and justification upon future experiments, skilfully and judiciously made. Should repeated trials prove the advantage of the new method proposed, we may venture to affirm, that it would be an improvement that would increase the national income in the agricultural branch many thousand pounds annually, would add greatly to the perfection of the linen manufacture, and over and above would suppress a very disagreeable nuisance, which the present method of watering flax occasions during some part of the summer in every flax-growing country.

"The intention of watering flax, is, in my opinion, to make the boon more brittle or friable, and, by soaking, to dissolve that gluey kind of sap that makes the bark of plants and trees adhere in a small degree to the woody part. The bark of flax is called the *harle*; and when separated from the useless woody part, the *boon*, this harle itself is called flax. To effect this separation easily, the practice has long prevailed, of soaking the flax in water to a certain degree of fermentation, and afterwards drying it. For this soaking some prefer rivulets that have a small current, and others stagnant water in ponds and lakes. In both methods the water acts as in all other cases of infusion and maceration; after two or three weeks it extracts a great many juices of a very strong quality, which in ponds give the water an inky tinge and offensive smell; and in rivulets mix in the stream and kill the fish. Nay, if this maceration be too long continued, the extracted and fermented sap will completely kill the flax itself. For if, instead of two or three weeks, the new flax were to lie soaking in the water four or five months, I presume it would be good for nothing but to be thrown upon the dunghill; both harle and boon would in time be completely rotted; yet the harle or flax, when entirely freed from this sap, and manufactured into linen, or into ropes, might lie many months under water without being much damaged; as linen, it may be washed and steeped in scalding water twenty times without losing much of its strength; and as paper, it acquires a kind of incorruptibility.

"It appears then essential to the right management of new flax, to get rid of this pernicious vegetable sap, and to macerate the boon; but from the complaints made against both the methods of watering now in use, there is reason to think that there is still great room for improvement in that article. In rivulets, the vegetable sap, as it is dissolved, is carried off by the current to the destruction of the fish. This prevents the flax from being stained; but the operation is tedious, and not complete, from the uncertainty of knowing when it is just enough, and not too much, or perhaps from neglect. In ponds, the inky tinge of the water often serves as a kind of dye to the flax, which imbibes it so strongly, that double the labour in bleaching will hardly bring the linen made of such flax to an equality in whiteness with linen made of flax untinged. This seems to be equally unwise, as though we were to dye cotton black first, in order to whiten it afterwards. These ponds, besides, become a great nuisance to the neighbourhood; the impregnated water is often of such a pernicious quality, that

# FLAGS.

*PLATE CCXVIII.*



# FLAX.

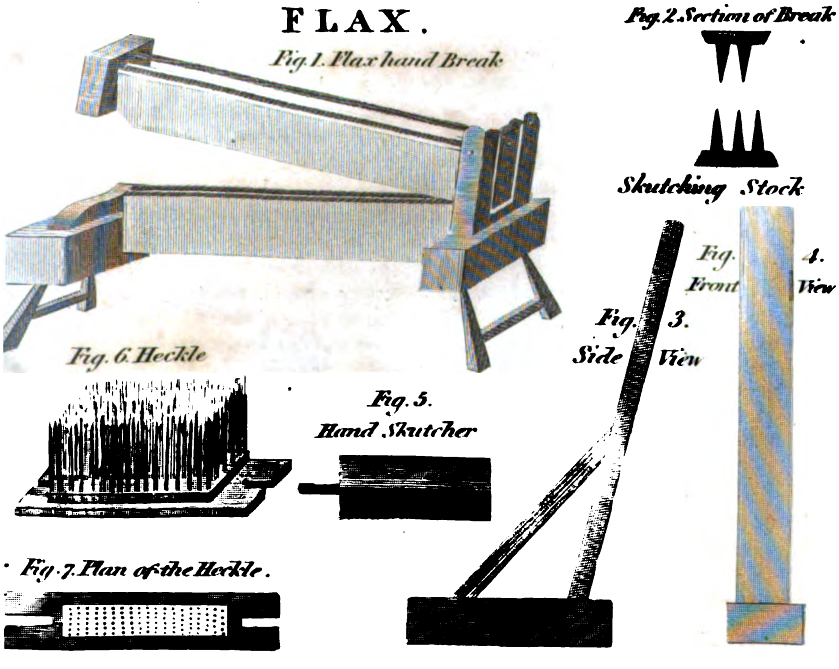


*Fig. 1. Flax hand Break*

*Fig. 2. Section of Break*

*Skutching Stock*

*Fig. 3. Side View*

*Fig. 4. Front View*

*Fig. 5. Hand Skutcher*

*Fig. 6. Heckle*

*Fig. 7. Plan of the Heckle.*

# FLOATING BODIES.

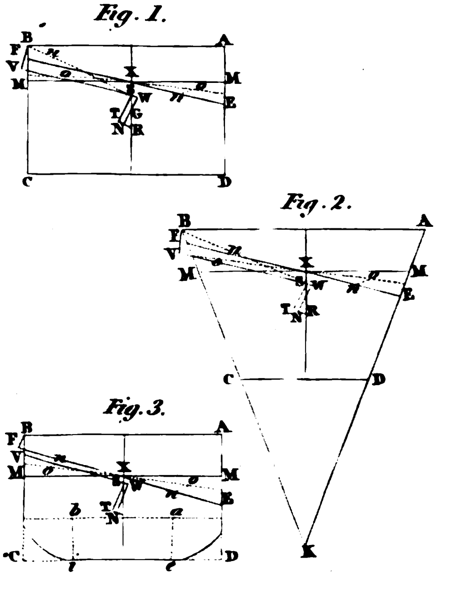


*Fig. 1.*

*Fig. 2.*

*Fig. 3.*

T. Clerk sculpt.

cattle, however thirsty, will not drink of it; and the effluvia of it may perhaps be nearly as infectious as it is offensive. If this effluvia is really attended with any contagious effects in our cold climate, a thing worth the inquiring into, how much more pernicious must its effects have been in the hot climate of Egypt, a country early noted for its great cultivation of flax?

"I have often thought that the process of watering might be greatly improved and shortened by plunging the new flax, after it is rippled, into scalding water; which, in regard to extracting the vegetative sap, would do in five minutes more than cold water would do in a fortnight, or perhaps more than cold water could do at all, in respect to the clearing the plant of sap. Rough almonds, when thrown into scalding water, are blanched in an instant; but perhaps a fortnight's macerating those almonds in cold water would not make them part so easily with their skins, which are the same to them as the harle is to the flax. Were tea leaves to be infused in cold water a fortnight, perhaps the tea produced by that infusion would not be so good to the taste, or so strongly tinged to the eye, as what is effected by scalding water in five minutes. By the same analogy, I think, flax or any small twig would be made to part with its bark much easier and quicker by being dipped in boiling water, than by being steeped in cold water.

"This reflection opens a door for a great variety of new experiments in regard to flax. I would therefore recommend to gentlemen cultivators and farmers, to make repeated trials upon this new system, which would soon ascertain whether it ought to be adopted in practice or rejected. One thing, I think, we may be certain of, that if the Egyptians watered their flax in our common manner, they undoubtedly watered it in *very warm water*, from the great heat of their climate, which would probably make them neglect to think of water heated by any other means than that of the sun. A good general practice can only be established upon repeated trials. Though one experiment may fail, another with a little variation may succeed; and the importance of the object desired to be obtained will justify a good degree of perseverance in the prosecution of the means. In this view, as the Chinese thread is said to be very strong, it would be worth while to be acquainted with the practice of that distant nation, in regard to the rearing and manufacturing of flax, as well as with the methods used by the Flemings and the Dutch.

"Boiling water perhaps might at once clear the new flax from many impurities, which when not removed till it be spun into yarn, are then removed with difficulty, and with loss of substance to the yarn. Why should not the longitudinal fibres of the flax, before they be spun into yarn, be made not only as *fine* but as *clean* as possible? Upon the new system proposed, the act of bleaching would begin immediately after the rippling of the flax; and a little done then might perhaps save much of what is generally done after the spinning and weaving. To spin dirty flax with a view of cleaning it afterwards, appears to be the same impropriety as though we were to reserve part of the dressing given to leather till after it is made into a glove.

"Should the plunging of the flax into the boiling water not suffice to make the boon brittle enough, as I am inclined to think it would not, then the common watering might be added; but in that case probably half the time usually given to this watering would suffice, and the flax might then be laid in clear rivulets, without any apprehension of its infecting the water and poisoning the fish, or of being discoloured itself; for the boiling water into which it had been previously put, would have extracted all the poisonous vegetative sap, which I presume is what chiefly discolours the flax or kills the fish.

"On the supposition that the use of boiling water in the preparation of flax may be found to be advantageous and profitable, I can recollect at present but one objection against its being generally adopted. Every flax-grower, it may be said, could not be expected to have conveniences for boiling water sufficient for the purpose; the consumption of water would be great; and some additional expence would be incurred. In answer to this I shall observe, that I presume any additional expence would be more than reimbursed by the better marketable price of the flax; for otherwise any new improvement, if it will not quit cost, must be dropt, were it even the searching after gold. In a large caldron a great deal of flax might be dipt in the same water, and the consumption perhaps would not be more than a quart to each sheaf. Even a large household pot would be capable of containing one sheaf after another; and I believe the whole objection would be obviated, were the practice to prevail with us, as in Flanders and Holland, that the flax-grower and the flax-dresser should be two distinct professions.

"I shall conclude with recommending to those who are inclined to make experiments, not to be discouraged by the failure of one or two trials.—Perhaps the flax, instead of being just plunged into the scalding water, ought to be kept in it five minutes, perhaps a quarter of an hour, perhaps a whole hour. Should five minutes or a quarter of an hour, or an hour, not be sufficient to make the boon and harle easily separate, it might perhaps be found expedient to boil the flax for more than an hour; and such boiling when in this state might in return save several hours boiling in the article of bleaching. It is not, I think, at all probable that the boiling of the flax with the boon in it would prejudice the harle; for in the course of its future existence, it is made to be exposed 20 or 40 times to this boiling trial; and if not detrimental in the one case, it is to be presumed it would not be detrimental in the other. Perhaps after boiling, it would be proper to pile up the flax in one heap for a whole day, or for half a day, to occasion some fermentation; or perhaps immediately after the boiling, it might be proper to wash it with cold water. The great object, when the flax is pulled, is to get the harle from the boon with as little loss and damage as possible; and if this is accomplished in a more complete manner than usual, considerable labour and expence will be saved in the future manufacturing of the flax. On this account I think much more would be gained than lost, were the two or three last inches of the roots of the stems to be chopped off, or clipped off, previous to the flax being either watered or boiled. When the flax is watered, care should be taken not to spread it out to dry, when there is a hazard of its being exposed in its wet state to frost."

To what we have now said we shall add the following short account of the flax husbandry of Ireland, in a letter which appeared in the Farmers Magazine, vol. vii. page 35.

" Having for several years (says the writer) been engaged in the culture of flax, I devoted a part of last summer to a tour through the manufacturing districts of Ireland. Here that branch of husbandry has long been established over a large extent of the country, and conducted with very considerble success. As some of the processes in this culture, which are followed with advantage, are either unknown to the Scots farmers, or are performed in a very awkward and inefficient manner, it might, I conceive, prove of no small benefit, were some of your intelligent corespondents induced to lay before them a plain sketch of the peculiar management observed by the Irish peasantry in this important article. I am the more desirous it should appear in your pages, because a periodical work on husbandry, conducted by a practical farmer, appears before the public with manifest advantage, and is received with that sort of deference which is due to experience and authority. The discussions of actual cultivators regarding the objects of their own profession, however new they may as yet be in the annals of agriculture, are far more likely to prove useful, that the writings of those volunteers in this favourite science, who are merely speculative and theoretical. I freely confess to you, Sir, that I found with pleasure your work widely circulated in the sister kingdom; and that the cause uniformly given for its popularity, was a degree of confidence placed in the practical skill of its conductor.

" During my progress through Ireland, the several processes of *steeping*, *drying*, and *skutching*, were in hand, and I think I found a peculiarity of management in these sufficient to affect the success of the whole business, and to confer a decided superiority on the produce of an acre of flax in Ireland over that in Scotland, both in quantity and value. It is no uncommon thing for a farmer in this country, who wishes to make up a sum for his rent, to sell a part of his *lint on the foot*, as it is termed; and for this he will commonly receive from 30 to 40 guineas per acre.

" 1. *The method of Steeping*.—As soon as the crop has attained the proper degree of ripeness, (which is somewhat below your standard of maturity), the flax is pulled, and carried to a stagnant pool, dug for this purpose, moderately deep. It is allowed to remain there only from *five to seven* days, according to the temperature of the weather. After the fermentation in the steeping process has been carried to a degree sufficient to produce the requisite laxity of fibre, the flax is taken out of the pool, and spread *very thinly* on the stubble of the hay meadow. There, instead of remaining till it is merely dried, it is continued for three or four weeks, till the grower conceives it ready for skutching. This blenching process, if I am allowed to call it so, which, in Scotland, is either unknown, or continued merely till the crop is dried, has many advantages; the most obvious one is, that it enables the farmer, every time he examines it, to ascertain exactly (by rubbing on his hand) the precise point at which the fermentation has arrived, and thus to perceive the tenacity and strength of his flax; while the adhesion of the fibre has been sufficiently weakened, to admit of the skutcher cleansing it completely of the woody parts. It is, I am apprehensive, only the practical flax farmer who is able to judge of the importance and delicacy of this part of the husbandry. It is so remarkable, that of two acres of flax, under precisely the same seed and culture, and of equal fertility, it frequently happens that the one shall yield a produce thrice the value of the other, merely from superior accuracy in ascertaining the proper time of continuing the steeping and blenching processes. In Scotland, therefore, I suspect the practice is faulty and defective; because there the whole process of fermentation is completed by steeping alone; whereas, in Ireland, it is begun only in the steep, and completed by blenching on the meadow, to that precise point which the safety of the produce requires.

" 2. *Smoking and Drying*.—The Irish peasant seems to possess another advantage, almost equally decisive, in his mode of drying the flax, before he submits it to the skutcher or beater. After the lint has remained a sufficient length of time on the blenching green, it is gathered up a second time into sheafs, (beats, provincially), and seems tolerably dry. In this state it is deemed by the Scots growers fully prepared for the flax-mill; but far otherwise by the Irish farmer, who never submits it to the hands of the beaters till it has undergone a thorough smoking over a peat fire. For this purpose, he raises, at the back of a ditch, a small hurdle thinly wrought with osiers, and places it on four posts of wood, at the height of four feet above the level of the ground. A pretty strong fire of peats being kindled below, the heat and smoke pervade every part of the flax, which is placed perpendicularly above the hurdle. This process is continued, and fresh quantities of flax regularly added, till the whole crop is brought to a state of dryness, which, in this moist climate, can never be effected by the sun and the weather alone: by this operation a degree of brittleness and friability is produced on the straw, which greatly facilitates the ensuing work, and admits of an easy separation of the fibre from the wood. It is evident, that the less friction required in skutching, the less waste or diminution must be occasioned in clearing the flax; and consequently, the greater must be the grower's produce from the mill. This part of the process is equally delicate with that described above, and requires, if possible, still greater attention on the part of the workmen, since it is clear that, by a careless management of the fire, the whole crop may be destroyed.

" 3. *Cleansing and Dressing*.—The flax husbandry of Ireland derives no small benefit from the application of hand-labour in the beating and skutching of lint, thus superseding the use of the mill. The most careful and expert workmen are not always able to temper the velocity of machinery so exactly, as to preserve flax that has been oversteeped or blenched to excess; while the steady and regulated *impetus* of the hand skutch can easily be modified, as the circumstances of each case may require; a matter of obvious advantage, because the best flax-mills seldom produce an equal quantity of lint, nor equally clean, with that which is obtained by the hand. Besides this, the price of labour in this part of the united kingdom, still continues so moderate, as to preclude any considerable degree of saving in expence

pence by the use of machinery. In proof of this, the flax millers in Scotland, I find, are charging this season from three to four shillings for dressing a stone of flax; while, at the place I am now writing, the same quantity is dressed by the hand for thirteenpence, or one British shilling. In Scotland, where hands are scarce, and the price of labour consequently high, I certainly would not recommend the disuse of the flax-mill; on the contrary, I am persuaded that it is chiefly owing to our superior machinery, and excellent implements of husbandry, that we are at all enabled to maintain a competition with our neighbours in the present state of our skill in flax husbandry, and subjected to the disadvantage of paying double price for labour.

"4. *Preservation of Flax-seed.*—The last peculiarity of management, which I shall at present notice as advantageous to the flax husbandry of Ireland, is the invention of a flax barn for the preservation of seed. Enjoying a climate perhaps still more moist and unsteady than that of Great Britain, the farmers here were, for a long series of years, unable to supply themselves with this article, and were obliged to commission seed annually from America and the Baltic, to supply the increased demands of an extended culture, to the large amount of 200,000l. sterling. The annual expenditure of cash long continued to operate as a drain on the stock of the laborious farmer, and prevented the accumulation of his capital; an evil of the most serious magnitude, under which the Irish peasantry still labour, and from which, till very lately, they had not even a prospect of relief. By the practice in universal use, if the farmer stored up his lint in the barn-yard with the rest of his crop in harvest, he might, it is true, preserve his seed; but in doing so, he uniformly lost his flax to a far greater value from overdryness, when wrought in the spring.

"If, on the other hand, he attempted to separate his seed during the lint harvest by means of the rippling-comb, he had no means of preventing it from being almost invariably destroyed by the wetness of the climate. Various methods had been attempted to overcome this difficulty, but without success; till Robert Tennant, Esq. of Strangmore, linen-inspector, near Dungannon, contrived the plan of a flax-barn, which seems perfectly competent to the preservation of seed. It has already been erected, and has proved successful on a small scale; the seed cured in it remained during the winter perfectly fresh, and nothing seems wanting to complete this improvement in our flax husbandry, but a larger capital in the hands of a few of our farmers. This flax barn is constructed on wooden posts, roofed on the top, but left perfectly open at each side; it is supplied with various stages of floors of basket-work, placed regularly at two feet distance above each other. Thus, the air, having free access to the seed on all sides, preserves it fresh and well-coloured for any length of time.

"This contrivance was suggested to Mr Tennant, it is said, almost casually, by noticing the great effect produced on cloth, by drying-houses in bleachfields. He had in fact been employed by the Linen Board of Ireland, in teaching the new process of bleaching to the manufacturers, by means of the oxymuriate of lime; and, in the course of seven or eight years, this method of whitening linen has been established over the whole kingdom, with the exception of hardly a single field. Lord Northland and Mr Foster, who invited this gentleman from Scotland, and patronized him in this part of the kingdom, have enjoyed the satisfaction of beholding a more essential improvement effected in the linen manufacture, in the short space already mentioned, than had ever taken place in a century before.

"It was my intention, when I began this letter, to have presented you a more minute description of a flax farm, and to have laid before your readers, a more detailed account of the flax husbandry of Ireland in general. I find, however, that I have already exceeded the ordinary bounds prescribed to the contributors to your useful work; therefore conclude, with expressing a hope, that the few hints already offered, will incline some of your correspondents to treat of a subject certainly of sufficient importance to merit attention. For a branch of husbandry cannot be deemed contemptible, which affords sustenance to upwards of two millions of people; and which, at the same time, adds to the general resources of the empire, no less a sum than seven millions sterling annually. These circumstances, too, I trust, will plead my excuse for holding up a portion of Irish husbandry to the imitation of your numerous readers among the cultivators of Scotland, who are at present justly celebrated for their agricultural knowledge in every part of the world."

*Flax made to resemble Cotton.* In the Swedish Transactions for the year 1747, a method is given of preparing flax in such a manner as to resemble cotton in whiteness and softness, as well as in coherence. For this purpose a little sea water is to be put into an iron pot or an untinned copper kettle, and a mixture of equal parts of birch ashes and quicklime strewed upon it: A small bundle of flax is to be opened and spread upon the surface, and covered with more of the mixture, and the stratification continued till the vessel is sufficiently filled. The whole is then to be boiled with sea water for ten hours, fresh quantities of water being occasionally supplied in proportion to the evaporation, that the water may never become dry. The boiled flax is to be immediately washed in the sea by a little at a time, in a basket, with a smooth stick at first while hot; and when grown cold enough to be borne by the hands, it must be well rubbed, washed with soap, laid to bleach, and turned and watered every day. Repetitions of the washing with soap expedite the bleaching; after which the flax is to be beaten, and again well-washed; when dry it is to be worked and carded in the same manner as common cotton, and pressed betwixt two boards for 48 hours. It is now fully prepared and fit for use. It loses in this process near one half its weight, which is abundantly compensated by the improvement made in its quality.

The filamentous parts of different vegetables have been employed in different countries for the same mechanic uses as hemp and flax among us. See FILAMENT.

*Earth-Flax.* See AMIANTHUS, BOTANY *Index*.

*New Zealand Flax Plant.* See PHORMIUM, BOTANY *Index*.

*Toad-Flax.* See LINARIA, BOTANY *Index*.

FLEA. See PULEX, ENTOMOLOGY *Index*.

*Flea-Bane*. See CONYZA, BOTANY *Index*.

*Flea-Bitten*, that colour of a horse which is white or gray, spotted all over with dark reddish spots.

FLEAM, in *Surgery* and *Farriery*, an instrument for letting blood of a man or horse. A case of fleams, as it is called by farriers, comprehends six sorts of instruments; two hooked ones, called *drawers*, and used for cleansing wounds; a pen knife; a sharp-pointed lancet for making incisions; and two fleams, one sharp and the other broad pointed. These last are somewhat like the point of a lancet, fixed in a flat handle, and no longer than is just necessary to open the vein.

FLECHIER, ESPRIT, bishop of Nismes, one of the most celebrated preachers of his age, and the publisher of many panegyrics and funeral orations, was born at Perne in Avignon in 1632. He was nominated to the bishopric of Lavaur in 1685, and translated to Nismes in 1687. At this latter place he founded an academy, and took the presidentship upon himself: his own palace was indeed a kind of academy, where he applied himself to train up orators and writers, who might serve the church, and do honour to the nation. He published, besides his panegyrics and funeral orations, 1. A History of the Emperor Theodosius, that of Cardinal Ximenes, and that of Cardinal Commendon. 2. Several Sermons. 3. Miscellaneous Works. 4. Letters, &c. He died in 1710.

FLECKNOE, RICHARD, an English poet in the reign of Charles II. more remarkable for Mr Dryden's satire on him than for any works of his own. He is said to have been originally a Jesuit, and to have had good English connexions in the Catholic interest. When Dryden lost the place of poet laureat on the Revolution, its being conferred on Flecknoe, for whom he had a settled aversion, gave occasion to his poem entitled *Mac Flecknoe;* one of the best written satires in our language, and from which Pope seems to have taken the hint for his Dunciad. Flecknoe wrote some plays; but could never get more than one of them acted, and that was damned.

FLEECE, the covering of wool shorn off the bodies of sheep. See WOOL.

*Golden* FLEECE. See ARGONAUTS, and GOLDEN *Fleece*

FLEET, commonly implies a company of ships of war, belonging to any prince or state: but sometimes it denotes any number of trading ships employed in a particular branch of commerce.

The admirals of his Britannic majesty's fleet are divided into three squadrons, viz. the red, the white, and the blue. When any of these officers are invested with the command of a squadron or detachment of men of war, the particular ships are distinguished by the colours of their respective squadron: that is to say, the ships of the red squadron wear an ensign whose union is displayed on a red field; the ensigns of the white squadron have a white field; and those of the blue squadron a blue field; the union being common to all three. The ships of war, therefore, are occasionally annexed to any of the three squadrons, or shifted from one to another.

Of whatsoever number a fleet of ships of war is composed, it is usually divided into three squadrons; and these, if numerous, are again separated into divisions. The admiral, or principal officer, commands the centre; the vice admiral, or second in command, superintends the van guard; and the operations of the rear are directed by the rear admiral, or the officer next in rank. See the article DIVISION.

The disposition of a fleet, while proceeding on a voyage, will in some measure depend on particular circumstances; as the difficulty of the navigation, the necessity of dispatch, according to the urgency or importance of the expedition, or the expectation of an enemy in the passage. The most convenient order is probably to range it into three lines or columns, each of which is parallel to a line close hauled according to the tack on which the line of battle is designed to be formed. This arrangement is more useful than any; because it contains the advantages of every other form, without their inconveniences. The fleet being thus more enclosed will more readily observe the signals, and with greater facility form itself into the line of battle, a circumstance which should be kept in view in every order of sailing. See *Naval* TACTICS.

FLEET, is also a noted prison in London, where persons are committed for contempt of the king and his laws, particularly of his courts of justice; or for debt, where any person will not or is unable to pay his creditors.

There are large rules and a warden belonging to the Fleet prison; which had its name from the fleet or fleet of the river or ditch, on the side whereof it stands.

FLEETWOOD, WILLIAM, a very learned English bishop in the beginning of the 18th century, of an ancient family in Lancashire. He distinguished himself during King William's reign, by his *Inscriptionum Antiquarum Sylloge*, by several sermons he preached on public occasions, and by his Essay on Miracles. He was designed by King William to a canonry of Windsor. The grant did not pass the seals before the king's death; but the queen gave it him, and he was installed in 1702. In 1703, he took a resolution to retire; and in 1707, published, without his name, his *Chronicon Pretiosum*. In 1708, he was nominated by the queen to the see of St Asaph. The change of the queen's ministry gave him much regret. In 1715, he published a pamphlet entitled, "The 13th chapter of the Romans vindicated from the abusive senses put upon it." In 1714, he was translated to the bishopric of Ely; and died in 1723, aged 67. He published several other sermons and tracts, and was a man of great learning and exemplary piety.

FLEMINGIANS, or FLANDRIANS, in ecclesiastical history, a sect of rigid Anabaptists, who acquired this name in the 16th century, because most of them were natives of Flanders, by way of distinction from the WATERLANDIANS. In consequence of some dissensions among the Flemingians relating to the treatment of excommunicated persons, they were divided into two sects, distinguished by the appellations of *Flandrians* and *Frieslanders*, who differed from each other in their manners and discipline. Many of these in process of time came over to the moderate community of the Waterlandians, and those who remained separate are still known by the name of the old Flemingians or Flandrians; but they are comparatively few in number. These maintain the opinion of Menno with respect to the incarnation of Christ; alleging, that his body

body was produced by the creating power of the Holy Ghost, and not derived from his mother Mary.

FLEMISH, or the FLEMISH TONGUE, is that which we otherwise call *Low Dutch*, to distinguish it from the *German*, whereof it is a corruption and a kind of dialect. See GERMAN.

It differs from the *Walloon*, which is a corruption of the French language. The Flemish is used through all the provinces of the Netherlands.

*FLEMISH Bricks*, a neat, strong, yellow kind of bricks, brought from Flanders, and commonly used in paving yards, stables, &c. being preferable for such purposes to the common bricks. See the article BRICKS.

FLESH, in *Anatomy*, a compound substance, consisting of the various softer solids of the animal body, and so denominated in contradistinction to bones. See ANATOMY, *passim*.

FLESH is also used, in *Theology*, in speaking of the mysteries of the incarnation and eucharist. "The word was made *flesh*," *Verbum caro factum est*.

The Romanists hold, that the bread in the sacrament of the supper is turned into the real flesh of Jesus Christ. See TRANSUBSTANTIATION.

FLESH is sometimes also used by botanists for the soft pulpy substance of any fruit, enclosed between the outer rind or skin and the seeds or stone; or for that part of a root, fruit, &c. fit to be eaten.

*FLESH-Colour*. See CARNATION.

FLETA, the name given to an unknown writer who lived about the end of the reign of Edward II. and beginning of Edward III. and who being a prisoner in the Fleet, wrote there an excellent treatise on the common law of England.

FLETCHER. See *BEAUMONT and Fletcher*.

FLETCHER, *Andrew*, of Salton, a celebrated Scots patriot and political writer, was descended from an ancient family who trace their origin to one of the followers of William the Conqueror. He was the son of Sir Robert Fletcher of Salton and Innerpeffer, and born in the year 1650. The tuition of our author was committed by his father, on his deathbed, to Mr (afterwards Bishop) Burnet, then his parish minister; by whose care he received a pious, learned, and polite education. Endowed with uncommon genius, and possessed of virtues and abilities peculiarly suited to the times in which he lived, Mr Fletcher quickly shone forth the ornament of his country, and the champion of its freedom. Having in the course of his classical studies and historical reading been impressed with an enthusiastic admiration both of ancient and modern republics, he had early contracted an ardent love of liberty, and an aversion to arbitrary rule. Hence his spirit the more readily took alarm at certain measures in the reign of Charles II. Being knight of the shire for Lothian to that parliament where the duke of York was commissioner, he openly opposed the designs of that prince and the bill of accession. He had a share with Lord Viscount Stair in framing the test act, by which the duke of York complained that he lost Scotland. On these accounts he became peculiarly obnoxious to the duke; and was at last obliged to flee to Holland, to avoid the fatal consequences of prosecutions which on various pretence were commenced against him. Being cited before the privy council and justiciary courts, and not appearing, he was declared traitor, and his estate confiscated.

Fletcher.

In Holland, he and Mr Baillie of Jerviswood were the only persons whom the earl of Argyle consulted concerning the designs which were then in agitation. In 1681 they came over to England, in order to concert matters with their party in that country; and were the only two who were intrusted so far as to be admitted to the secrets of Lord Russel's council of six. Mr Fletcher managed his part of the negotiation with so much address, that administration could find no pretext for seizing him; nor could they fix upon him those articles on account of which Mr Baillie was condemned; to whose honour let it be remembered, that although offered a pardon on condition of his accusing his friend, he persisted in rejecting the proposal with indignation.

Mr Fletcher having joined the duke of Monmouth upon his landing, received a principal command under him; but the duke was deprived of his services on the following occasion, as related by Sir John Dalrymple. Being sent upon an expedition, and not esteeming "times of danger to be times of ceremony, he had seized for his own riding the horse of a country gentleman [the mayor of Lynne] which stood ready equipped for its master. The master, hearing this, ran in a passion to Fletcher, gave him opprobrious language, shook his cane, and attempted to strike. Fletcher, though rigid in the duties of morality, having been accustomed to foreign service both by sea and land, in which he had acquired high ideas of the honour of a soldier and a gentleman, and of the affront of a cane, pulled out his pistol, and shot him dead on the spot. The action was unpopular in countries where such refinements were not understood. A clamour was raised against it among the people of the country: in a body they waited upon the duke with their complaints; and he was forced to desire the only soldier, and almost the only man of parts, in his army, to abandon him. With Fletcher all Monmouth's chance of success in war left him." But, in a manuscript memoir belonging to the family, we have the following notice concerning Mr Fletcher's connection with Monmouth, in which his separation from that prince is very differently accounted for: "To Lord Marischal Mr Fletcher explained the motives which first induced him to join, and afterwards abandon, the duke of Monmouth. The former he ascribed to the duke's manifesto in Scotland relating to religion, and in England to liberty. For the latter he accounted by the disgust produced in his own mind and that of his associates, when the duke declared himself king, and broke faith with all who embarked with him on his principles. He complained heavily of the account commonly given of the death of the mayor of Lynne: and mentioned to Lord Marischal, in proof of the contrary, that he did not leave the duke till he came to Taunton, where he was proclaimed king, several weeks after the death of the mayor of Lynne."

*Memoirs of Great Britain and Ireland.*

Seeing all the efforts of himself and his friends in favour of liberty frustrated at Taunton, he endeavoured to secure his own personal freedom by taking his passage in the first ship bound to a foreign country. It was his misfortune to land in Spain; where he was immediately arrested, cast into prison, and guarded by three

*Memoirs of the family of Salton, MS.*

three different bands of soldiers, till a vessel should be prepared to carry him a victim in chains to the court of London. But on the morning before the ship could sail, whilst he looked pensive through the bars that secured the window of his room, he was hailed by a venerable personage who made signs to speak with him. The prison doors he found open; and whilst his friendly conductor waved to him to follow him, he passed through three different guards of soldiers all fast asleep. Without being permitted to offer his thanks to his deliverer, he found himself obliged to prosecute with all speed the journey, in which he was directed by a person concerning whom he could never collect any information; and in disguise he proceeded in safety through Spain. He felt a peculiar pleasure in relating to his friends instances of the care of Providence which he had experienced during his exile; and entertained them often with narratives of this kind, which he always mingled with religious reflections. Of these, another may be here mentioned. Happening in the evening to pass the skirt of a wood at a few miles distance from a city where he intended to lodge, he came to a place where two roads met. After he had entered upon the road on the right, he was accosted by a female of a respectable figure, who warned him to turn back, and take the road to the left; for that in the other there was danger which he could not escape if he continued to proceed. His friendly monitor suddenly retired into the wood, out of which she had issued no less unexpectedly. Having arrived at the city, the inhabitants were soon after alarmed by an account of the robbery and murder of several travellers who that evening had fallen into the hands of a banditti upon the very way in which he had intended to travel. From these and other instances of preservation from dangers, the devotion of his mind, habituated from his infancy to an intercourse with heaven, led him to conclude that he was in a peculiar manner the care of Providence, and that in critical cases his understanding received its direction from a supernatural impulse.

During his exile, he maintained a frequent and extensive correspondence with the friends of liberty at home; and he partly employed himself in making a curious collection of books, which compose the best private library in Scotland. But his genius also prompted him to engage in more active employments. He repaired to Hungary, and served several campaigns as a volunteer under the duke of Lorrain with great reputation. At length, understanding that the great design then projected in Holland, and upon the issue of which he considered the liberties of Britain to be suspended, had attained a considerable degree of maturity, he hastened thither; where his counsels and address were of eminent service. He came over with King William; and in zeal, activity, penetration, and political skill, proved inferior to none of the leaders in the Revolution.

Such, however, was his magnanimity, that from a survey of King William's papers, it appears that while others laboured to turn this grand event to the emolument of themselves and the aggrandisement of their family, Mr Fletcher asked nothing. His estate had been forfeited, and his house abandoned to military discretion; his fortune was greatly shattered, and his family reduced to circumstances of distress. Nothing was given him in recompense of all his sufferings. On the contrary, he, together with the duke of Hamilton, was distinguished by marks of royal and ministerial dislike. Still, whatever private resentment he might entertain, it appeared that his ruling principle was the good of his country; and that to this grand object of his heart he was willing to sacrifice all personal considerations. For when, in 1692, the abdicated king meditated an invasion, Mr Fletcher addressed a letter (preserved in Sir John Dalrymple's collection) to the duke of Hamilton, in which every argument is employed with skill and energy to engage his grace to forget his injuries, and in the present crisis to employ the extensive influence and authority he then possessed in the cause of freedom and of his country. This letter produced its full effect; and the duke returned to his duty, from which he had in part begun to deviate.

To follow our author through all the mazes of his political life subsequent to the Revolution, is beyond our purpose, and would exceed our limits. One or two circumstances more shall therefore suffice. Being elected a member for the parliament 1683, he showed an uniform zeal for the interest of his country. The thought of England's domineering over Scotland was what his generous soul could not endure. The indignities and oppression which Scotland lay under galled him to the heart; so that in his learned and elaborate discourses, he exposed them with undaunted courage and pathetical eloquence. In that great event, the Union, he performed essential service. He got the act of security passed, which declared that the two crowns should not pass to the same head till Scotland was secured in her liberties civil and religious. Therefore Lord Godolphin was forced into the Union, to avoid a civil war after the queen's demise. Although Mr Fletcher disapproved of some of the articles, and indeed of the whole frame of the Union; yet, as the act of security was his own work, he had all the merit of that important transaction.

We must not omit mentioning, that in the ardour of his political career Mr Fletcher forgot not the interests of the place that gave him birth. He esteemed the education of youth one of the noblest objects of government. On this subject he wrote a treatise, still extant, most characteristic of himself; and he established at Salton a foundation for the same purpose, of great utility while it lasted.

This great man died at London 1716, aged 66. His remains were conveyed to Scotland, and deposited in the family vault at Salton.

That Mr Fletcher received neither honours nor emoluments from King William, may perhaps be in part attributed to himself; a circumstance, however, which must add greatly to the lustre of his character. His uncomplying virtue, and the sternness of his principles, were ill calculated to conciliate courtly favour. He was so zealous an assertor of the liberties of the people, that he was too jealous of the growing power of all princes; in whom he thought ambition so natural, that he was not for trusting the best of kings with the power which ill ones might make use of against their subjects; he was of opinion that all princes were made by, and for the benefit of, the people; and that they should have no power but that of doing good. This, which

which made him oppose King Charles, and invade King James, led him also to oppose the giving so much power to King William, whom he would never serve after his establishment. So we are told by the author of Short Political Characters, a MS. in the library of the late T. Rawlinson, Esq.—Mr Lockhart, in his Memoirs, p. 72. expresses a belief that his aversion to the English and to the Union was so great, that, in revenge to them, he was inclined to side with the abdicated family: "But (adds he) as that was a subject not fit to be entered upon with him, this is only a conjecture from some inuendos I have heard him make; but so far is certain, he liked, commended, and conversed with high-flying Tories, more than any other set of men; acknowledging them to be the best countrymen, and of most honour, integrity, and ingenuity." It seems difficult to reconcile this with Mr Fletcher's avowed principles and the general tenor of his conduct. May we suppose, that chagrin, if not at the neglect or the ill treatment which he had himself received from government since the Revolution, yet at the public measures relating to his native country, might have occasioned him to relent in his sentiments with regard to the exiled family?—In the family memoirs already quoted, we are informed, That, "Lord Marischal held Mr Fletcher's character in high admiration;" and that, "when governor of Neufchatel, where Rousseau resided about the year 1766, he prevailed with this very extraordinary genius to write the life of a man whose character and actions he wished to have transmitted to posterity with advantage. For this purpose his lordship applied to an honourable relation of Mr Fletcher's for materials: which by him were transmitted to Lord Marischal: but the design failed through Rousseau's desultory and capricious disposition." This anecdote must appear incompatible with the known loyalty and attachments of the Earl Marischal, unless we suppose him to have been privy to some such sentiments of Mr Fletcher as those alluded to by Mr Lockhart; for how could we suppose him anxious to promote a composition, in which the task would be to celebrate principles diametrically opposite to his own, and to applaud actions subversive of that royal family in whose cause he had ventured his life, and forfeited his fortune, and foregone his country!—But however these circumstances may be reconciled, as the integrity, disinterestedness, and public spirit of Mr Fletcher, have been universally acknowledged, there is reason to believe, that all his sentiments and actions were founded in honour, and that he never once pursued a measure further than he judged it to be for the interest of his country.

Mr Fletcher was master of the English, Latin, Greek, French, and Italian languages; and well versed in history, the civil law, and all kinds of learning. In his travels, he had not only acquired considerable knowledge in the art of war, but also became versant in the respective interests of the several princes and states of Europe. In private life, he was affable to his friends, and free from all manner of vice. He had a penetrating, clear, and lively apprehension; but is said to have been too much wedded to opinions, and impatient of contradiction.—He possessed an uncommon elevation of mind, accompanied with a warmth of temper, which would suffer him to brook from no rank among men, nor in any place, an indignity. Of this he exhibited a singular proof in the Scots parliament. The earl of Stair, secretary of state and minister for Scotland, having in the heat of debate used an improper expression against Mr Fletcher, he seized him by his robe, and insisted upon public and immediate satisfaction. His lordship was obliged instantly to beg his pardon in presence of parliament.

Mr Fletcher was by far the finest speaker in the parliament of Scotland; the earl of Stair alone rivalled him. The latter was famed for a splendid, the former for a close and nervous, eloquence. He formed his style on the models of antiquity; and the small volume of his works, Sir John Dalrymple observes, though imperfectly collected, is one of the very few classical compositions in the English language.

**FLETEWOOD**, William, an eminent English lawyer and recorder of London, in the reign of Queen Elizabeth. He was very zealous in suppressing mass-houses, and committing popish priests; but once rushing in upon mass at the Portuguese ambassador's house, he was committed to the Fleet for breach of privilege, but soon released. Mr Wood says, "He was a learned man, and a good antiquary, but of a marvellous merry and pleasant conceit." He was a good popular speaker, and wrote well upon subjects of government. His principal works are, 1. *Annalium tam regum Edwardi V. Richardi III. et Henrici VII. quam Henrici VIII.* 2. A Table of the Reports of Edmund Plowden. 3. The Office of a Justice of Peace. He died about the year 1593.

**FLEVILLEA**, a genus of plants belonging to the diœcia class. See Botany *Index*.

**FLEURI**, Claude, an able French critic and historian, was born at Paris in 1640. He applied himself to the law, was made advocate for the parliament of Paris, and attended the bar nine years; he then entered into orders, and was made preceptor to the princes of Conti. In 1689, the king made him sub-preceptor to the dukes of Burgundy, Anjou, and Berry; and in 1706, when the education of these young princes was completed, the king gave him the priory of Argenteville belonging to the Benedictines in the diocese of Paris. In 1716, he was chosen counsellor to Louis XV. and died in 1723. He was the author of a great number of esteemed French works; the principal of which are, 1. An ecclesiastical history, in 20 volumes, the last of which ends with the year 1414. 2. The manners of the Israelites and Christians. 3. Institutions of ecclesiastical law. 4. An historical catechism. 5. On the choice and method of study. 6. The duties of masters and servants, &c.

**FLEXIBLE**, in *Physics*, a term applied to bodies capable of being bent or diverted from their natural figure or direction.

**FLEXOR**, in *Anatomy*, a name applied to several muscles, which are so called from their office, which is to bend the parts to which they belong; in opposition to the *extensors*, which open or stretch them. See Anatomy, *Table of the Muscles*.

**FLIGHT**, the act of a bird in flying; or the manner, duration, &c. thereof.

Almost every kind of bird has its particular flight; the eagle's flight is the highest; the flight of the sparrow-hawk and vulture is noble, and fit for high enterprise and combat. The flight of some birds is low, weak, and transient; the flight of the partridge and pheasant is but of short continuance; that of the dove is laboured; that of the sparrow undulatory, &c.

The augurs pretend to foretel future events from the flight of birds. See Augury.

Flight. In melting the lead ore in the works at Mendip, there is a substance which flies away in the smoke which is called the flight. The workmen find it sweetish upon their lips, if their faces happen to be in the way of the smoke, which they avoid as much as possible. This, falling on the grass, kills cattle that feed thereon; and being gathered and carried home, kills rats and mice in their houses; that which falls on the sand, they gather and melt upon a flag hearth into shot and sheet lead.

**FLINT**, a species of simple stones, chiefly composed of siliceous earth. See Mineralogy *Index*.

*Breaking of Flints*. The art of cutting, or rather breaking flint stones into uniform figures, is by some supposed to be one of the arts now lost. That it was known formerly, appears from the ancient Bridewell at Norwich, from the gate of the Augustin friars at Canterbury, that of St John's Abbey at Colchester, and the gate near Whitehall, Westminster. But that the art is not lost, and that the French know it, appears from the platform on the top of the royal observatory at Paris; which, instead of being leaded, is paved with flint cut or broken into regular figures.

*Gun Flints*. For the method of manufacturing, see Mineralogy *Index*.

Flints, in the glass trade. The way of preparing flints for the nicest operations in the glass trade is this. Choose the hardest flints, such as are black and will resist the file, and will grow white when calcined in the fire. Cleanse these of the white crust that adheres to them, then calcine them in a strong fire, and throw them while red hot into cold water; wash off the ashes that may adhere to them, and powder them in an iron mortar, and sift them through a very fine sieve; pour upon this powder some weak aquafortis, or the phlegm of aquafortis, to dissolve and take up any particles of iron it may have got from the mortar; stir this mixture several times, then let it rest, and in the morning pour off the liquor, and wash the powder several times with hot water and afterwards dry it for use. You will thus have a powder for making the purest glass as perfectly fine and faultless as if you had used rock-crystal itself.

The washing off the ferruginous particles with aquafortis is not necessary when the glass intended to be made is to be tinged with iron afterwards; but when meant to be a pure white, this is the method that will secure success.

Flint, the chief town of Flintshire, in North Wales. It is commodiously seated on the river Dee; and is but a small place, though it sends one member to parliament. It was formerly noted for its castle, where Richard II. took shelter on his arrival from Ireland; but having quitted it, he was taken prisoner by the duke of Lancaster. The castle now is in a ruinous condition. This castle stands close to the sea on a rock, which in various parts forms several feet of its foundation. It covers about three quarters of an acre. The assizes are still held in the town. It is 195 miles north-west of London. Population 1433 in 1811.

**FLINTSHIRE**, a county of Wales, bounded on the north-east and east by an arm of the sea, which is properly the mouth of the river Dee; on the north-west by the Irish sea; and on the south-south-west and west by Denbighshire. It is the least of all the counties in Wales, being but 33 miles in length and 9 in breadth. It is divided into five hundreds; in which are two market towns and 28 parishes; and the population in 1811 was 46,518. The greatest part of this county lies in the diocese of St Asaph, and the rest belongs to that of Chester. It sends two members to parliament, one for the county and one for Flint; and pays one part of the land tax. The air is cold, but healthful. It is full of hills, intermixed with a few valleys, which are very fruitful, producing some wheat and plenty of rye. The cows, though small, yield a great quantity of milk in proportion to their size, and are excellent beef. The mountains are well stored with lead, coal, and millstones. This county also produces good butter, cheese, and honey. See Flintshire, Supplement.

**FLIP**, a sort of sailors drink, made of malt liquor, brandy, and sugar mixed.

**FLOAT**, a certain quantity of timber bound together with rafters athwart, and put into a river to be conveyed down the stream; and even sometimes to carry burdens down a river with the stream.

*Float-Boards*, those boards fixed to water wheels of under-shot mills, serving to receive the impulse of the stream, whereby the wheel is carried round. See the articles Wheel and Mill.

It is no advantage to have too great a number of float-boards; because, when they are struck by the water in the best manner that it can be brought to come against them, the sum of all the impulses will be but equal to the impulse made against one float-board at right-angles, by all the water coming out of the penstock through the opening, so as to take place on the float-board. The best rule in this case is to have just so many, that each of them may come out of the water as soon as possible, after it has received and acted with its full impulse. As to the length of the float-board, it may be regulated according to the breadth of the mill. See Mill.

*Floats for Fishing*. See *Fishing Floats*.

**FLOATAGES**, all things floating on the surface of the sea or any water; a word much used in the commissions of water bailiffs.

**FLOATING** bodies are those which swim on the surface of a fluid, the most interesting of which are ships and vessels employed in war and commerce. It is known to every seaman, of what vast moment it is to ascertain the stability of such vessels, and the positions they assume when they float freely on the surface of the water. To be able to accomplish this, it is necessary to understand the principles on which that stability and these positions depend. This has been done with great ingenuity by Mr Atwood, of whose reasoning the following is a summary account, taken from the Philosophical Transactions for 1796.

A floating body is pressed downwards by its own weight in a vertical line passing through its centre of gravity; and it is supported by the upward pressure of a fluid, which acts in a vertical line that passes through the centre of gravity of the part which is under the water;

water; and without a coincidence between these two lines, in such a manner as that both centres of gravity may be in the same vertical line, the solid will turn on an axis, till it gains a position in which the equilibrium of floating will be permanent. From this it is obviously necessary to find what proportion the part immersed bears to the whole, to do which the specific gravity of the floating body must be known, after which it must be found by geometrical methods, in which positions the solid can be placed on the surface of the fluid, so that both centres of gravity may be in the same vertical line, when any given part of the solid is immersed under the surface. These things being determined, something is still wanting, for positions may be assumed in which the circumstances now mentioned concur, and yet the solid will assume some other position wherein it will permanently float. If the specific gravity of a cylinder be to that of the fluid on which it floats as 3 to 4, and its axis to the diameter of the base as 2 to 1: if it be placed on the fluid with its axis vertical, it will sink to a depth equal to a diameter and a half of the base; and while its axis is preserved in a vertical position by outward force, the centres of gravity of the whole solid and immersed part will remain in the same vertical line; but when the external force is removed, it will deviate from its upright position, and will permanently float with its axis horizontal. If we suppose the axis to be half the diameter of the base, and placed vertically, the solid will sink to the depth of three-eighths of its diameter, and in that position it will float permanently. If the axis be made to incline to the vertical line, the solid will change its position till it permanently settles with its axis perpendicular to the horizon.

Whether a solid floats permanently, or oversets when placed on the surface of a fluid, provided the centre of gravity of the solid and that of the immersed part be in the same vertical line, it is said to be in a position of equilibrium, of which there are three kinds; the equilibrium of stability, in which the solid permanently floats in a given position; the equilibrium of instability, in which the solid spontaneously oversets, if not supported by external force; and the equilibrium of indifference, or the insensible equilibrium, in which the solid rests on the fluid indifferent to motion, without tendency to right itself when inclined, or to incline farther.

If a solid body floats permanently on the surface of a fluid, and external force be applied to turn it from its position, the resistance opposed to this inclination is termed the *stability of floating*. Some ships at sea yield to a given impulse of the wind, and suffer a greater inclination from the perpendicular than others. As this resistance to heeling, duly regulated, has been considered of importance in the construction of vessels, many eminent mathematicians have laid down rules for ascertaining the stability of ships from their known dimensions and weight, without recurring to actual experiment. Bouguer, Euler, Chapman, and others, have laid down theorems for this purpose, founded on the supposition that the inclinations of ships from their quiescent positions are evanescent, or very small in a practical point of view. But ships at sea have been found to heel 10°, 20°, or 30°, and therefore it may be doubted how far such rules are applicable in practice. If statics can be applied to naval architecture, it seems necessary that the rules should be extended to these cases in which the angles of inclination are of any magnitude, likely to occur in the practice of navigation. A solid body placed on the surface of a lighter fluid, at such a depth as corresponds to the relative gravities, cannot alter its position by the joint action of its own weight and the pressure of the fluid, except by turning on some horizontal axis passing through the centre of gravity; but, as many axes may be drawn through this point of the floating body, in a direction parallel to the horizon, and the motion of the solid regards only one axis, this must be determined by the figure of the body and the particular nature of the case. When this axis of motion is ascertained, and the specific gravity of the solid found, the positions of permanent floating will be determined, by finding the several positions of equilibrium through which the solid may be conceived to pass, while it turns round the axis of motion; and by determining in which of these positions the equilibrium is permanent, and in which of them it is momentary.

The whole of Mr Atwood's valuable paper relates to the theory of naval architecture, in so far as it is dependent on the laws of pure mechanics. If the proportions and dimensions adopted in the construction of individual vessels are obtained by exact geometrical measurement, and observations are made on the performance of these vessels at sea; a sufficient number of experiments of this nature, judiciously varied, are the proper grounds on which theory may be effectually applied, in reducing to system those hitherto unperceived causes, which contribute to give the greatest degree of excellence to vessels of every description. Naval architecture being reckoned among the practical branches of science, every voyage may be viewed in the light of an experiment, from which useful truths are to be deduced. But inferences of this nature cannot well be obtained, except by acquiring a thorough knowledge of all the proportions and dimensions of each part of the ship, and by making a sufficient number of observations on the qualities of the vessel, in all the varieties of situation to which a ship is commonly subject in the practice of navigation.

The following is an ingenious investigation of the same subject by Mr English, which we give in his own words.

"However operose and difficult (says he) the calculations necessary to determine the stability of nautical vessels may, in some cases, be, yet they all depend, says this author, upon the four following simple and obvious theorems, accompanied with other well known stereometrical and statical principles.

"*Theorem* 1. Every floating body displaces a quantity of the fluid in which it floats, equal to its own weight; and consequently the specific gravity of the fluid will be to that of the floating body, as the magnitude of the whole is to that of the part immersed.

"*Theorem* 2. Every floating body is impelled downward by its own essential power, acting in the direction of a vertical line passing through the centre of gravity of the whole; and is impelled upward by the re-action of the fluid which supports it, acting in the direction of a vertical line passing through the centre of gravity of the part immersed; therefore, unless these two lines are coincident, the floating body thus impelled must revolve round an axis, either in motion or at rest, until the equilibrium is restored.

"*Theorem* 3. If by any power whatever a vessel be deflected from an upright position, the perpendicular distance between two vertical lines passing through the centres of gravity of the whole, and of the part immersed respectively, will be as the stability of the vessel, and which will be positive, nothing, or negative, according as the metacentre is above, coincident with, or below, the centre of gravity of the vessel.

" *Theorem* 4. The common centre of gravity of any system of bodies being given in position, if any one of these bodies be moved from one part of the system to another, the corresponding motion of the common centre of gravity, estimated in any given direction, will be to that of the aforesaid body, estimated in the same direction, as the weight of the body moved is to that of the whole system.

" From whence it is evident, that in order to ascertain the stability of any vessel, the position of the centres of gravity of the whole, and of that part immersed, must be determined; with which, and the dimensions of the vessel, the line of floatation, and angle of deflection, the stability or power either to right itself or overturn, may be found.

" In ships of war and merchandise, the calculations necessary for the purpose become unavoidably very operose and troublesome; but they may be much facilitated by the experimental method pointed out in the New Transactions of the Swedish Academy of Sciences, first quarter of the year 1787, page 48.

" In river and canal boats, the regularity and simplicity of the form of the vessel itself, together with the compact disposition and homogeneal quality of the burden, render that method for them unnecessary, and make the requisite calculations become very easy. Vessels of this kind are generally of the same transverse section throughout their whole length, except a small part in prow and stern, formed by segments of circles or other simple curves; therefore a length may easily be assigned such, that any of the transverse sections being multiplied thereby, the product will be equal to the whole solidity of the vessel. The form of the section ABCD is for the most part either rectangular, as in fig. 1. Plate CCXVIII. trapezoidal as in fig. 2. or mixtilineal as in fig. 3. in all which MM represents the line of floatation when upright, and EF that when inclined at any angle MXE; also G represents the centre of gravity of the whole vessel, and R that of the part immersed.

" If the vessel be loaded quite up to the line AB, and the specific gravity of the boat and burden be the same, then the point G is simply the centre of gravity of the section ABCD; but if not, the centres of gravity of the boat and burden must be found separately, and reduced to one by the common method, namely, by dividing the sum of the momenta by the sum of weights, or areas, which in this case are as the weights. The point R is always the centre of gravity of the section MMCD, which, if consisting of different figures, must also be found by dividing the sum of the momenta by the sum of the weights as common. These two points being found, the next thing necessary is to determine the area of the two equal triangles MXE, MXF, their centres of gravity *o*, *o*, and the perpendicular projected distance *n n* of these points on the water line EF. This being done, through R and parallel to EF draw RT = a fourth proportional to the whole area MMCD, either triangle MXE or MXF, and the distance *n n*; through T, and at right angles to RT or EF, draw TS meeting the vertical axis of the vessel in S the metacentre; also through the points G, B, and parallel to ST, draw NGW and BV; moreover through S, and parallel to EF, draw WSV, meeting the two former in V and W; then SW is as the stability of the vessel, which will be positive, nothing, or negative, according as the point S is above, coincident with, or below, the point G. If now we suppose W to represent the weight of the whole vessel and burden (which will be equal to the section MMCD multiplied by the length of the vessel), and P to represent the required weight applied at the gunwale B to sustain the vessel at the given angle of inclination; we shall always have this proportion: as VS : SW :: W : P; which proportion is general, whether SW be positive or negative; it must only in the latter case be supposed to act upward to prevent an overturn.

" In the rectangular vessel, of given weight and dimensions, the whole process is so evident, that any farther explanation would be unnecessary. In the trapezoidal vessel, after having found the points G and R, let AD, BC be produced until they meet in K. Then, since the two sections MMCD, EFDC are equal; the two triangles MMK, EFK are also equal; and therefore the rectangle $EK \times KF = KM \times KM = \overline{KM}^2$; and since the angle of inclination is supposed to be known, the angles at E and F are given. Consequently, if a mean proportional be found between the sines of the angle at E and F, we shall have the following proportions:

" As the mean proportional thus found : sine ∠F :: KM : KF, and in the said mean proportional : sine ∠F :: KM : KE; therefore ME, MF become known; from whence the area of either triangle MXE or MXF, the distance *n n*, and all the other requisites, may be found.

" In the mixtilineal section, let AB = 9 feet = 108 inches, the whole depth = 6 feet = 72 inches, and the altitude of MM the line of floatation 4 feet or 48 inches; also let the two curvilineal parts be circular quadrants of two feet, or 24 inches radius each. Then the area of the two quadrants = 904·7808 square inches, and the distance of their centres of gravity from the bottom = 13·8177 inches very nearly, also the area of the included rectangle *a b i e* = 1440 square inches, and the altitude of its centre of gravity 12 inches; in like manner, the area of the rectangle AB *c d* will be found = 5184 square inches, and the altitude of its centre of gravity 48 inches: therefore we shall have

| | | | |
|---|---|---|---|
| Momentum of the two quad. } | =904·7807 | × 13·8177 | = 12501·98966016. |
| Moment. of the rectan. *a b i e* } | =1440· | × 12 | = 17280. |
| Moment. of the rectan. AB *c d* } | =5184· | × 48 | = 248832· |
| | 7528·7808 | | 278613·98966016 |

" Now the sum of the momenta, divided by the sum of the areas, will give $\frac{278613{\cdot}98966016}{7528{\cdot}7808} = 37{\cdot}006$ inches, the altitude of G, the centre of gravity of the section.

section ABCD above the bottom. In like manner, the altitude of R, the centre of gravity of the section MMCD, will be found to be equal $\frac{123093·98966016}{4936·7808}$ = 24·934 inches; and consequently their difference, or the value of GR = 12·072 inches, will be found.

Suppose the vessel to heel 15°, and we shall have the following proportion; namely, As radius : tangent of 15° :: MX = 54 inches : 14·469 inches = ME or MF; and consequently the area of either triangle MXE or MXF = 390·663 square inches. Therefore, by theorem 4th, as 4936·7808 : 390·663 :: 72 = *n n* = $\frac{2}{3}$ AB : 5·6975 inches = RT; and, again, as radius : sine of 15° :: 12·072 = GR : 3.1245 inches = RN; consequently RT—RN = 5·6975—3·1245 = 2·573 inches = SW, the stability required.

“ Moreover, as the sine of 15° : radius :: 5.6975 = RT : 22·013 = RS, to which if we add 24·934, the altitude of the point R, we shall have 46·947 for the height of the metacentre, which taken from 72, the whole altitude, there remains 25·053; from which, and the half width = 54 inches, the distance BS is found = 59·529 inches very nearly, and the angle SBV = 80°—06′—42″; from whence SV = 58·645 inches.

Again: Let us suppose the mean length of the vessel to be 40 feet, or 480 inches, and we shall have the weight of the whole vessel equal to the area of the section MMCD = 4936·7808 multiplied by 480 = 2369654·784 cubic inches of water, which weighs exactly 85708 pounds avoirdupoise, allowing the cubic foot to weigh 62.5 pounds.

“ And, finally, as SV : SW (*i. e.*) as 58·645 : 2·573 :: 85708 : 3760 +, the weight on the gunwale which will sustain the vessel at the given inclination. Therefore a vessel of the above dimensions, and weighing 38 tons 5 cwts. 28lbs. will require a weight of one ton 13 cwt. 64lbs. to make her incline 15°.

“ In this example the deflecting power has been supposed to act perpendicularly on the gunwale at B; but if the vessel is navigated by sails, the centre velique must be found; with which and the angle of deflection, the projected distance thereof on the line SV may be obtained; and then the power calculated as above, necessary to be applied at the projected point, will be that part of the wind's force which causes the vessel to heel. And conversely, if the weight and dimensions of the vessel, the area and altitude of the sails, the direction and velocity of the wind be given, the angle of deflection may be found *.”

*Floating Bridge.* See Bridge.

*Flock Paper.* See Paper.

FLOOD, a deluge or inundation of waters. See Deluge.

Flood is also used in speaking of the tide. When the water is at lowest, it is called *ebb;* when rising, *young flood;* when at highest, *high flood;* when beginning to fall, *ebb water.*

*Flood-mark*, the mark which the sea makes on the shore at flowing water and the highest tide, it is also called *high-water mark.*

FLOOK of an anchor. See Anchor.

FLOOKING, among miners, a term used to express a peculiarity in the load of a mine. The load or quantity of ore is frequently intercepted in its course by the crossing of a vein of earth or stone, or some different metallic substance; in which case the load is moved to one side, and this transient part of the load is called a *flooking.*

FLOOR, in building, the underside of a room, or that part we walk on.

Floors are of several sorts; some of earth, some of brick, others of stone, others of boards, &c.

For brick and stone Floors, see Pavement.

For boarded Floors, it is observable that the carpenters never floor their rooms with boards till the carcass is set up, and also enclosed with walls, lest the weather should injure the flooring. Yet they generally rough-plane their boards for the flooring before they begin any thing else about the building, that they may set them by to dry and season, which is done in the most careful manner. The best wood for flooring is the fine yellow deal well seasoned, which when well laid, will keep its colour for a long while; whereas the white sort becomes black by often washing, and looks very bad. The joints of the boards are commonly made plain, so as to touch each other only; but, when the stuff is not quite dry, and the boards shrink, the water runs through them whenever the floor is washed, and injures the ceiling underneath. For this reason they are made with feather edges, so as to cover each other about half an inch, and sometimes they are made with grooves and tenons: and sometimes the joints are made with dove tails; in which case the lower edge is nailed down, and the next drove into it, so that the nails are concealed. The manner of measuring floors is by squares of 10 feet on each side, so that taking the length and breadth, and multiplying them together and cutting off two decimals, the content of a floor in square will be given. Thus 18 by 16 gives 288 or 2 squares and 88 decimal parts.

*Earthen Floors*, are commonly made of loam, and sometimes, especially to make malt on, of lime and brook sand, and gun dust or anvil dust from the forge.

Ox blood and fine clay, tempered together, Sir Hugh Plat says, make the finest floor in the world.

The manner of making earthen floors for plain country habitations is as follows: Take two-thirds of lime and one of coal ashes well sifted, with a small quantity of loam clay; mix the whole together, and temper it well with water, making it up into a heap: let it lie a week or ten days, and then temper it over again. After this heap it up for three or four days, and repeat the tempering very high, till it becomes smooth, yielding, tough, and gluey. The ground being then levelled, lay the floor therewith about 2½ or 3 inches thick, making it smooth with a trowel: the hotter the season is the better; and when it is thoroughly dried, it will make the best floor for houses, especially malt houses.

If any one would have their floors look better, let them take lime made of rag stones, well tempered with whites of eggs, covering the floor about half an inch thick with it, before the under-flooring is too dry. If this be well done, and thoroughly dried, it will look when rubbed with a little oil as transparent as metal or glass. In elegant houses, floors of this nature are made of stucco, or of plaster of Paris beaten and sifted, and mixed with other ingredients.

*Floor of a Ship*, strictly taken, is only so much of her bottom as she rests on when aground.

Such ships as have long, and withal broad floors, lie on the ground with most security, and are not apt to heel, or tilt on one side; whereas others, which are narrow in the floor, or in the sea phrase, *cranked by the ground*, cannot be grounded without danger of being overturned.

*Floor Timbers*, in a ship, are those parts of a ship's timbers which are placed immediately across the keel, and upon which the bottom of the ship is framed; to these the upper parts of the timbers are united, being only a continuation of floor timbers upwards.

**FLORA**, the reputed goddess of flowers, was, according to Lactantius, only a lady of pleasure, who having gained large sums of money by prostituting herself, made the Roman people her heir, on condition that certain games called *Floralia* might be annually celebrated on her birth-day. Some time afterwards, however, such a foundation appearing unworthy the majesty of the Roman people, the senate, to ennoble the ceremony, converted Flora into a goddess, whom they supposed to preside over flowers; and so made it a part of religion to render her propitious, that it might be well with their gardens, vineyards, &c. But Vossius (*de Idol.* lib. i. c. 12.) can by no means allow the goddess Flora to have been the courtezan above mentioned: he will rather have her a Sabine deity, and thinks her worship might have commenced under Romulus. His reason is, that Varro, in his fourth book of the Latin tongue, ranks Flora among the deities to whom Tatius king of the Sabines offered up vows before he joined battle with the Romans. Add, that from another passage in Varro it appears, that there were priests of Flora, with sacrifices, &c. as early as the times of Romulus and Numa.

The goddess Flora was, according to the poets, the wife of Zephyrus. Her image in the temple of Castor and Pollux was dressed in a close habit, and she held in her hand the flowers of pease and beans: but the modern poets and painters have been more lavish in setting off her charms, considering that no parts of nature offered such innocent and exquisite entertainment to the sight and smell, as the beautiful variety which adorns, and the odour which embalms, the floral creation.

**FLORALES** ludi, or Floral Games, in antiquity, were games held in honour of Flora, the goddess of flowers.—They were celebrated with shameful debaucheries. The most licentious discourses were not enough, but the courtezans were called together by the sound of a trumpet, made their appearance naked, and entertained the people with indecent shows and postures: the comedians appeared after the same manner on the stage. Val. Maximus relates, that Cato being once present in the theatre on this occasion, the people were ashamed to ask for such immodest representations in his presence; till Cato, apprised of the reservedness and respect with which he inspired them, withdrew, that the people might not be disappointed of their accustomed diversion. There were several other sorts of shows exhibited on this occasion; and, if we may believe Suetonius in *Galba*, c. 6. and Vopiscus in *Carinus*, these princes presented elephants dancing on ropes on these occasions.

The ludi florales, according to Pliny, lib. xviii. c. 29. were instituted by order of an oracle of the Sibyls, on the 28th of April; not in the year of Rome IↃXVI. as we commonly read it in the ancient editions of that author; nor in IↃXIV. as F. Hardouin has corrected it, but, as Vossius reads it, in 513: though they were not regularly held every year till after 580. They were chiefly held in the night time, in the Patrician street: some will have it there was a circus for the purpose on the hill called Hortulorum.

**FLORALIA**, in antiquity, a general name for the feasts, games, and other ceremonies, held in honour of the goddess Flora. See Flora and Florales *Ludi*.

**FLORENCE**, the capital of the duchy of Tuscany, and one of the finest cities in Italy. It is surrounded on all sides but one with high hills, which rise insensibly, and at last join with the lofty mountains called the *Apennines*. Towards Pisa, there is a vast plain of 40 miles in length; which is so filled with villages and pleasure houses, that they seem to be a continuation of the suburbs of the city. Independent of the churches and palaces of Florence, most of which are very magnificent, the architecture of the houses in general is in a good taste; and the streets are remarkably clean, and paved with large broad stones chiseled so as to prevent the horses from sliding. The city is divided into two unequal parts by the river Arno, over which there are no less than four bridges in sight of each other. That called the *Ponte dell Trinità*, which is uncommonly elegant, is built entirely of white marble, and ornamented with four beautiful statues representing the Seasons. The quays, the buildings on each side, and the bridges, render that part of Florence through which the river runs by far the finest. Every corner of this beautiful city is full of wonders in the arts of painting, statuary, and architecture. The streets, squares, and fronts of the palaces, are adorned with a great number of statues; some of them by the best modern masters, Michael Angelo, Bandinelli, Donatello, Giovanni di Bologna, Benvenuto Cellini, and others. Some of the Florentine merchants formerly were men of vast wealth, and lived in a most magnificent manner. One of them, about the middle of the fifteenth century, built that noble fabric, which, from the name of its founder, is still called the *Palazzo Pitti*. The man was ruined by the prodigious expence of this building, which was immediately purchased by the Medici family, and has continued ever since to be the residence of the sovereigns. The gardens belonging to this palace are on the declivity of an eminence. On the summit there is a kind of fort, called *Belvedere*. From this, and from some of the higher walks, you have a complete view of the city of Florence, and the beauteous vale of Arno, in the middle of which it stands. This palace has been enlarged since it was purchased from the ruined family of Pitti. The furniture is rich and curious, particularly some tables of Florentine work, which are much admired. The most precious ornaments, however, are the paintings. The walls of what is called the *Imperial Chamber*, are painted in fresco, by various painters; the subjects are allegorical, and in honour of Lorenzo of Medicis, distinguished

stinguished by the name of the *Magnificent*. The famous gallery attracts every stranger. One of the most interesting parts of it, in the eyes of many, is the series of Roman emperors, from Julius Cæsar to Gallienus, with a considerable number of their empresses, arranged opposite to them. This series is almost complete; but wherever the bust of an emperor is wanting, the place is filled up by that of some other distinguished Roman. The celebrated Venus of Medici, which has been removed to Paris, is thought to be the standard of taste in female beauty and proportion, and stood formerly in a room called the *Tribunal*. The inscription on its base mentions its being made by Cleomenes an Athenian, the son of Apollodorus. It is of white marble, and surrounded by other masterpieces of sculpture, some of which are said to be the works of Praxiteles and other Greek masters. In the same room are many valuable curiosities, besides a collection of admirable pictures by the best masters. There are various other rooms, whose contents are indicated by the names they bear; as, the Cabinet of Arts, of Astronomy, of Natural History, of Medals, of Porcelain, of Antiquities; the Saloon of the Hermaphrodite, so called from a statue which divides the admiration of the amateurs with that in the Borghese villa at Rome, though the excellence of the execution is disgraced by the vileness of the subject; and the Gallery of Portraits, which contains the portraits of the most eminent painters (all executed by themselves) who have flourished in Europe during the three last centuries. Our limits will not admit of a detail of the hundredth part of the curiosities and buildings of Florence. We must not, however, omit mentioning the chapel of St Lorenzo, as being perhaps the finest and most expensive habitation that ever was reared for the dead; it is incrusted with precious stones, and adorned by the workmanship of the best modern sculptors. Mr Addison remarked, that this chapel advanced so very slowly, that it is not impossible that the family of Medicis may be extinct before their burial place is finished. This has actually taken place: the Medici family is extinct, and the chapel remains still unfinished.

Florence is a place of some strength, and contains an archbishop's see and an university. The number of inhabitants is calculated at 80,000. They boast of the improvements they have made in the Italian tongue, by means of their Academia della Crusca; and several other academies are now established at Florence. Though the Florentines affect great state, yet their nobility and gentry drive a retail trade in wine, which they sell from their cellar windows, and sometimes they even hang out a broken flask, as a sign where it may be bought. They deal, besides wine and fruits, in gold and silver stuffs. The Jews are not held in that degree of odium, or subjected to the same humiliating distinctions here, as in most other cities of Europe; and it is said that some of the richest merchants are of that religion.

As to the manners and amusements of the inhabitants, Dr Moore informs us, that besides the *conversazionis*, which they have here as in other towns of Italy, a number of the nobility meet every day at a house called the *Casino*. This society is pretty much on the same footing with the clubs in London. The members are elected by ballot. They meet at no particular hour, but go at any time that is convenient. They play at billiards, cards, and other games, or continue conversing the whole evening, as they think proper. They are served with tea, coffee, lemonade, ices, or what other refreshments they choose; and each person pays for what he calls for. There is one material difference between this and the English clubs, that women as well as men are members. The company of both sexes behave with more frankness and familiarity to strangers as well as to each other, than is customary in public assemblies in other parts of Italy. The opera is a place where the people of quality pay and receive visits, and converse as freely as at the Casino above mentioned. This occasions a continual passing and repassing to and from the boxes, except in those where there is a party of cards formed; it is then looked on as a piece of ill manners to disturb the players. From this it may be guessed, that here, as in some other towns in Italy, little attention is paid to the music by the company in the boxes, except at a new opera, or during some favourite air. But the dancers command a general attention: as soon as they begin, conversation ceases; even the card-players lay down their cards, and fix their eyes on the *ballette*. Yet the excellence of Italian dancing seems to consist in feats of strength, and a kind of jerking agility, more than in graceful movement. There is a continual contest among the performers, who shall spring highest. You see here none of the sprightly alluring gaiety of the French comic dancers, or of the graceful attitudes and smooth flowing motions of the performers in the serious opera at Paris. It is surprising that a people of such taste and sensibility as the Italians, should prefer a parcel of athletic jumpers to elegant dancers. On the evenings on which there is no opera, it is usual for the genteel company to drive to a public walk immediately without the city, where they remain till it begins to grow duskish. E. Long. 12. 24. N. Lat. 43. 34.

**Florence**, an ancient piece of English gold coin. Every pound weight of standard gold was to be coined into 50 Florences, to be current at six shillings each; all which made in tail 15 pounds; or into a proportionate number of half Florences, or quarter pieces, by indenture of the mint: 18 Edw. III.

**FLORENTIA**, in *Ancient Geography*, a town of Etruria, on the Arnus; of great note in Sylla's wars. Now called *Florenza* or *Firenza* by the Italians; *Florence* in English. E. Long. 11. Lat. 43. 30.

**FLORENTINE marble.** See Citadinesca.

**FLORESCENTIA** (from *floresco*, "to flourish or bloom"); the act of flowering, which Linnæus and the sexualists compare to the act of generation in animals; as the ripening of the fruit in their opinion resembles the birth. See Flower.

**FLORID style**, is that too much enriched with figures and flowers of rhetoric.

**FLORIDA**, a province of North America, bounded on the south by the gulf of Mexico, on the north by Georgia and Alabama, on the east by the sea, and on the west by Alabama. It was first discovered, in 1497, by Sebastian Cabot, a Venetian, then in the English service; whence a right to the country was claimed by the kings of England; and this province, as well as Georgia, was included in the charter granted by Charles II. to Carolina.

rolina. In 1512, however, Florida was more fully discovered by Ponce de Leon, an able Spanish navigator, but who undertook his voyage from the most absurd motives that can be well imagined.—The Indians of the Caribbee islands had among them a tradition, that somewhere on the continent there was a fountain whose waters had the property of restoring youth to all old men who tasted them. Ponce de Leon, who set out with this extravagant view as well as others, rediscovered Florida; but returned to the place from whence he came, visibly more advanced in years than when he set out. For some time this country was neglected by the Spaniards, and some Frenchmen settled in it: But by orders of Philip II. of Spain, a force was fitted out; the French intrenchments were forced, and most of the people killed. The prisoners were hanged on trees; with this inscription, "Not as Frenchmen, but as Heretics."

This cruelty was soon after revenged by Dominic de Gourgues, a skilful and intrepid seaman of Gascony, an enemy to the Spaniards, and passionately fond of hazardous expeditions and of glory. He sold his estate; built some ships; and with a select band of adventurers like himself embarked for Florida. He drove the Spaniards from all their posts with incredible valour and activity; defeated them in every rencounter: and by way of retaliation, hung the prisoners on trees, with this inscription, "Not as Spaniards, but as Assassins." This expedition was attended with no other consequences; Gourgues blew up the forts he had taken, and returned home, where no notice was taken of him. It was conquered in 1539 by the Spaniards under Ferdinand de Soto, not without a great deal of bloodshed; as the natives were very warlike and made a vigorous resistance. The settlement, however, was not fully established till the year 1565; when the town of St Augustine, the capital of the colony while it remained in the hands of the Spaniards, was founded. In 1586, this place was taken and pillaged by Sir Francis Drake. It met with the same fate in 1665, being taken and plundered by Captain Davis and a body of bucaniers. In 1702, an attempt was made upon it by Colonel More, governor of Carolina. He set out with 500 English and 700 Indians: and having reached St Augustine, he besieged it for three months; at the expiration of which, the Spaniards having sent some ships to the relief of the place, he was obliged to retire. In 1740 another attempt was made by General Oglethorpe; but he being outwitted by the Spanish governor, was forced to raise the siege with loss; and Florida continued in the hands of the Spaniards till the year 1763, when it was ceded by treaty to Great Britain.—During the American war, which terminated in 1783, it was again reduced by his Catholic majesty, and it remained subject to Spain till 1818, when General Jackson alleging that support had been given by the Spaniards to some hostile Indian tribes, seized Pensacola and St Marks, the only fortified posts in the country except St Augustine. The province was since ceded by treaty to the United States, and the treaty after much delay has at length been ratified (1821.)

Florida is about 400 miles in length, from north to south, and occupies an area of about 50,000 square miles. The country is in general flat, and without hills. The soil is good, but overrun with pines and brushwood. The climate is considered better than that of the neighbouring state of Georgia. The whole white inhabitants and slaves probably do not exceed 12,000 or 15,000. See FLORIDA, SUPPLEMENT.

**FLORILEGIUM**, FLORILEGE, a name the Latins have given to what the Greeks call *ανθολογια*, *anthology*; viz. a collection of choice pieces, containing the finest and brightest things in their kind.

FLORILEGE, is also particularly used for a kind of breviary, in the Eastern church, compiled by Arcadius, for the conveniency of the Greek priests and monks, who cannot carry with them, in their travels and pilgrimages, all the volumes wherein their office is dispersed. The florilegium contains the general rubrics, psalter, canticles, the horologium, and the office of the feriæ, &c.

**FLORIN**, is sometimes used for a coin, and sometimes for a money of account.

Florin, as a coin, is of different values, according to the different metals and different countries where it is struck. The gold florins are most of them of a very coarse alloy, some of them not exceeding thirteen or fourteen carats, and none of them seventeen and a half. See *MONEY Table*.

Florin, as a money of account, is used by the Italian, Dutch, and German merchants and bankers, but admits of divisions in different places. Ibid.

**FLORINIANI**, or FLORIANI, a sect of heretics, of the second century, denominated from its author Florinus, or Florianus, a priest of the Roman church, deposed along with Blastus for his errors. Florinus had been a disciple of St Polycarp, along with Irenæus. He made God the author of evil; or rather asserted, that the things forbidden by God are not evil, but of his own appointing. In which he followed the errors of Valentinus, and joined himself with the Carpocratians. They had also other names given them. Philastrius says, they were the same with the *Carpophorians*. He adds that they were also called *soldiers*, *milites*, *quia de militaribus fuerunt*. St Irenæus calls them *Gnostics*; St Epiphanius *Phibionites*; and Theodoret, *Barborites*, on account of the impurities of their lives. Others call them *Zaccheans*; others *Coddians*, &c. though for what particular reasons, it is not easy to say, nor perhaps would be worth while to inquire.

**FLORIS**, FRANCIS, an eminent historical painter, was born at Antwerp in 1520. He followed the profession of a statuary till he was twenty years of age; when preferring painting, he entered the school of Lambert Lombard, whose manner he imitated very perfectly. He afterwards went to Italy, and completed his studies from the most eminent masters. The great progress he made in historical painting, at his return procured him much employment; and his countrymen complimented him with the flattering appellation of *the Flemish Raphael*. He got much money, and might have rendered his acquaintance more worthy of the attention of the great, had he not debased himself by frequent drunkenness. He died in 1570, aged 50.

**FLORIST**, a person curious or skilled in flowers: their kinds, names, characters, culture, &c. It is also applied to an author who writes what is called the flora of any particular place, that is, a catalogue of the plants and trees which are found spontaneously growing there.

**FLORUS**, **Lucius Annæus**, a Latin historian, of the same family with Seneca and Lucan. He flourished in the reigns of Trajan and Adrian; and wrote an abridgement of the Roman history, of which there have been many editions. It is composed in a florid and poetical style; and is rather a panegyric on many of the great actions of the Romans, than a faithful and correct recital of their history. He also wrote poetry, and entered the lists against the emperor Adrian, who satirically reproached him with frequenting taverns and places of dissipation.

**FLORY**, **Flowery**, or *Fleury*, in *Heraldry*, a cross that has flowers at the end circumflex and turning down; different from the *potence*, in as much as the latter stretches out more like that which is called *patee*.

**FLOS**, **Flower**. See **Flower**, **Botany** *Index*.

*Fœmineus Flos*, a flower which is furnished with the pointal or female organs of generation, but wants the stamina or male organ. Female flowers may be produced apart from the male, either on the same root or on distinct plants. Birch and mulberry are examples of the first case, willow and poplar of the second.

*Masculus Flos*, a male flower. By this name Linnæus and the sexualists distinguish a flower which contains the stamen, reckoned by the sexualists the male organ of generation; but not the stigma or female organ. All the plants of the class diœcia of Linnæus have male and female flowers upon different roots; those of the class monœcia bear flowers of different sexes on the same root. The plants, therefore, of the former are only male and female: those of the latter are androgynous; that is, contain a mixture of both male and female flowers.

**Flos**, in *Chemistry*, the most subtile part of bodies, separated from the more gross parts by sublimation in a dry form.

**FLOTA**, or **Flotta**, *fleet*; a name the Spaniards give particularly to the ships which they send annually from Cadiz to the port of Vera Cruz, to fetch thence the merchandises gathered in Mexico for Spain. It consists of the captains, admiral, and patach, or pinnace, which go on the king's account; and about 16 ships, from 400 to 1000 tons, belonging to particular persons. They set out from Cadiz about the month of August, and are 18 or 20 months before they return. Those sent to fetch the commodities prepared in Peru are called *galleons*.

The name *flotilla* is given to a number of ships which get before the rest in their return, and give information of the departure and cargo of the flota and galleons.

**FLOTSON**, or **Flotsom**, goods that by shipwreck are lost, and floating upon the sea; which, with jetson and lagan, are generally given to the lord admiral: but this is the case only where the owners of such goods are not known. And here it is to be observed that *jetson* signifies any thing that is cast out of a ship when in danger, and afterwards is beat on the shore by the water, notwithstanding which the ship perishes. *Lagan* is where heavy goods are thrown overboard, before the wreck of the ship, and sink to the bottom of the sea.

**FLOUNDER**, **Fluke**, or *But*. See **Pleuronectes**, **Ichthyology** *Index*.

Flounders may be fished for all day long, either in a swift stream, or in the still deep water; but best in the stream, in the months of April, May, June, and July: the most proper baits are all sorts of worms, wasps, and gentles.

**FLOUR**, the meal of wheat-corn, finely ground and sifted. See **Meal**.

The grain itself is not only subject to be eaten by insects in that state; but, when ground into flour, it gives birth to another race of destroyers, who eat it unmercifully, and increase so fast in it, that it is not long before they wholly destroy the substance. The finest flour is most liable to breed these, especially when stale or ill prepared. In this case, if it be examined in a good light, it will be observed to be in continual motion, and on a nicer inspection there will be found in it a great number of little animals of the colour of the flour, and very nimble. If a little of this flour is laid on the plate of the double microscope, the insects are very distinctly seen in great numbers, very brisk and lively, continually crawling over one another's backs, and playing a thousand antic tricks together; whether in diversion or in search of food, is not easy to be determined. These animals are of an oblong and slender form; their heads are furnished with a kind of trunk or hollow tube, by means of which they take in their food, and their body is composed of several rings. They do vast mischief among magazines of flour laid up for armies and other public uses. When they have once taken possession of a parcel of this valuable commodity, it is impossible to drive them out; and they increase so fast, that the only method of preventing the total loss of the parcel is to make it up into bread as soon as can be done. The way to prevent their breeding in the flour is to preserve it from damp: nothing gets more injury by being put up damp than flour; and yet nothing is more frequently put up so. It should be always carefully and thoroughly dried before it is put up, and the barrels also dried into which it is to be put; then, if they are placed in a room tolerably warm and dry, they will keep it well. Too dry a place never does flour any hurt, though one too moist almost always spoils it.

Flour, when carefully analyzed, is found to be composed of three very different substances. The first and most abundant is pure *starch*, or white fecule, insoluble in cold, but soluble in hot water, and of the nature of mucous substances; which, when dissolved, form water glues. The second is the *gluten*, most of whose properties have been described under the article **Bread**. The third is of a mild nature, perfectly soluble in cold water, of the nature of *saccharine* extractive mucous matters. It is susceptible of the spirituous fermentation, and is found but in small quantity in the flour of wheat. See **Bread**, **Gluten**, **Starch**, and **Sugar**, **Chemistry** *Index*.

**FLOWER**, **Flos**, among botanists and gardeners, the most beautiful part of trees and plants, containing the organs or parts of fructification. See **Botany** *Index*.

Flowers, designed for medical use, should be plucked when they are moderately blown, and on a clear day before noon: for conserves, roses must be taken in the bud.

FLOWERS, in antiquity. We find flowers in great request at the entertainments of the ancients, being provided by the master of the feast, and brought in before the second course; or, as some are of opinion, at the beginning of the entertainment. They not only adorned their heads, necks, and breasts, with flowers, but often bestrewed the beds whereon they lay, and all parts of the room with them. But the head was chiefly regarded. See GARLAND.

Flowers were likewise used in the bedecking of tombs. See BURIAL.

*Eternal FLOWER.* See XERANTHEMUM,
*Everlasting FLOWER.* See GNAPHALIUM,
*FLOWER-Fence.* See POINCIANA,
*Sun-FLOWER.* See HELIANTHUS,
*Sultan-FLOWER.* See CYANUS,
*Trumpet-FLOWER.* See BIGNONIA,
*Wind-FLOWER.* See ANEMONE,
BOTANY *Index.*

*FLOWER-de-lis*, or *Flower-de-luce*, in *Heraldry*, a bearing representing the lily called the *queen of flowers*, and the true hieroglyphic of royal majesty; but of late it is become more common, being borne in some coats one, in others three, in others five, and in some *semee* or spread all over the escutcheon in great numbers.

The arms of France are, three flowers-de-lis or, in a field azure.

*FLOWER-de-Luce.* See IRIS, BOTANY *Index*.

FLOWERS, in *Heraldry*. They are much used in coats of arms; and in general signify hope, or denote human frailty and momentary prosperity.

FLOWERS, in *Chemistry*. By this name are generally understood bodies reduced into very fine parts, either spontaneously, or by some operation of art; but the term is chiefly applied to volatile solid substances, reduced into very fine parts, or into a kind of meal by sublimation.—Some flowers are nothing else than the bodies themselves, which are sublimed entire, without suffering any alteration or decomposition; and other flowers are some of the constituent parts of the body subjected to sublimation.

*Colours of FLOWERS.* See the article COLOUR (*of Plants.*)

*Colours extracted from FLOWERS.* See COLOUR-*Making*.

*Preserving of FLOWERS.* The method of preserving flowers in their natural beauty through the whole year has been much sought after by many people. Some have attempted it by gathering them when dry and not too much opened, and burying them in dry sand; but this, though it preserves their figure well, takes off from the liveliness of their colour. Muntingius prefers the following method to all others. Gather roses, or other flowers, when they are not yet thoroughly open, in the middle of a dry day; fill the vessel up to the top with them; and when full sprinkle them over with some good French wine, with a little salt in it; then set them by in a cellar, tying down the mouth of the pot. After this they may be taken out at pleasure; and, on setting them in the sun, or within reach of the fire, they will open as if growing naturally; and not only the colour, but the smell also will be preserved.

The flowers of plants are by much the most difficult parts of them to preserve in any tolerable degree of perfection; of which we have instances in all the collections of dried plants, or *horti sicci*. In these the leaves, stalks, roots, and seeds of the plants, appear very well preserved; the strong texture of these parts making them always retain their natural form, and the colours in many species naturally remaining. But where these fade, the plant is little the worse for use as to the knowing the species by it. But it is very much otherwise in regard to flowers; these are naturally by much the most beautiful parts of the plants to which they belong; but they are so much injured in the common way of drying, that they not only lose, but change their colours one into another, by which means they give a handle to many errors; and they usually also wither up, so as to lose their very form and natural shape. The primrose and cowslip kinds are very eminent instances of the change of colours in the flowers of dried specimens; for those of this class of plants easily dry in their natural shape; but they lose their yellow, and, instead of it, acquire a fine green colour, much superior to that of the leaves in their most perfect state. The flowers of all the violet kind lose their beautiful blue, and become of a dead white: so that in dried specimens there is no difference between the blue-flowered violet and the white-flowered kinds.

Sir Robert Southwell has communicated to the world a method of drying plants, by which this defect is proposed to be in a great measure remedied, and all flowers preserved in their natural shape, and many in their natural colours.—For this purpose two plates of iron are to be prepared of the size of a large half sheet of paper, or larger, for particular occasions; these plates must be made so thick as not to be apt to bend; and there must be a hole made near every corner for receiving a screw to fasten them close together. When these plates are prepared, lay in readiness several sheets of paper, and then gather the plants with their flowers when they are quite perfect. Let this be always done in the middle of a dry day; and then lay the plant and its flower on one of the sheets of paper doubled in half, spreading out all the leaves and petals as nicely as possible. If the stalk is thick, it must be pared or cut in half, so that it may lie flat; and if it is woody, it may be peeled, and only the bark left. When the plant is thus expanded, lay round about it some loose leaves and petals of the flower, which may serve to complete any part that is deficient. When all is thus prepared, lay several sheets of paper over the plant, and as many under it; then put the whole between the iron plates, laying the papers smoothly on one, and laying the other evenly over them; screw them close, and put them into an oven after the bread is drawn, and let them lie there two hours. After that, make a mixture of equal parts of aquafortis and common brandy; shake these well together, and when the flowers are taken out of the pressure of the plates, rub them lightly over with a camel's hair pencil dipped in this liquor; then lay them upon fresh brown paper, and covering them with some other sheets, press them between this and other papers with a handkerchief till the wat of these liquors is dried wholly away. When the plant is thus far prepared, take the bulk of a nutmeg of gum dragon; put this into a pint of fair water cold, and let it stand 24 hours; it will in this time be wholly dissolved: then dip a fine hair pencil in this liquor, and with it daub over the back sides of the leaves, and lay them carefully down on half a sheet of white paper fairly expanded, and press them down with some more papers over these. When the gum-water is fixed, let the presser and papers be removed, and the whole work is finished. The leaves retain their verdure in this case, and the flowers usually keep their natural colours. Some care, however, must be taken, that the heat of the oven be not too great. When the flowers are thick and bulky, some art may be used to pare off their backs, and dispose the petals in a due order; and after this, if any of them are wanting, their places may be supplied with some of the supernumerary ones dried on purpose; and if any of them are only faded, it will be prudent to take them away, and lay down others in their stead: the leaves may be also disposed and mended in the same manner.

Another method of preserving both flowers and fruit found throughout the whole year is also given by the same author. Take saltpetre, one pound; Armenian bole, two pounds; clean common sand, three pounds: mix all well together. Then gather fruit of any kind that is not fully ripe, with the stalk to each; put these in, one by one, into a wide-mouthed glass, laying them in good order. Tie over the top with an oil-cloth, and carry them into a dry cellar, and set the whole upon a bed of the prepared matter of four inches thick in a box. Fill up the remainder of the box with the same preparation; and let it be four inches thick, all over the top of the glass, and all round its sides. Flowers are to be preserved in the same sort of glasses, and in the same manner: and they may be taken up after a whole year as plump and fair as when they were buried.

*Artificial* Flowers of the Chinese. See Tong-tsao.

Flowers, in the animal economy, denote women's monthly purgations or menses.—Nicod derives the word in this sense, from *fluere*, q. d. *fluors*. Others will have the name occasioned hence, that women do not conceive till they have had their flowers; so that these are a sort of forerunners of their fruit.

Flowers, in *Rhetoric*, are figures or ornaments of discourse, by the Latins called *flosculi*.

FLOWERING *of Bulbous Plants*. These plants will grow and flower in water alone, without any earth, and make a very elegant appearance. We daily see this practised in single roots; but there is a method of doing it with several roots in the same vessel. Take a common small garden pot; stop the hole at the bottom with a cork, and lute in the cork with putty that no water can get through; then fit a board to the top of the pot, and bore six or seven holes in it at equal distances, to place the bulbs in; and as many smaller ones nearer them to receive sticks, which will serve to tie up the flowers. Then fill up the pot with water to the board; and place tulips, jonquils, narcissuses, and the like plants in the root upon the holes, so that the bottom of the roots may touch the water: thus will they all flower early in the season, and be much more beautiful than any pot of gathered flowers, and will last many weeks in their full perfection. After the season of flowering is over, the roots will gradually shrink through the holes of the board, and get loose into the water: but, instead of being spoiled there, they will soon increase in size; so that they cannot return through the holes, and will produce several offsets. It is natural to try from this the consequence of keeping the roots under water during the whole time of their blowing; and in this way they have been found to succeed very well, and flower even stronger and more beautifully than when in the ground. They may thus, also, with proper care in the degree of heat in the room, be kept flowering from before Christmas till March or April. It is not easy, in this last manner, to manage the keeping the boards under water, for which reason it is better to procure some sheet-lead of about four pounds to the foot, and cut this to the size of the mouth of the pot. In this there should be bored holes for the bulbs, and other holes for the sticks: and, in order to keep the sticks quite firm, it is proper to have another plate of lead shaped to the bottom of the pot, with holes in it, answering to those of the upper plate made for the sticks. The sticks will by this means be always kept perfectly steady; and the roots, being kept under water by the upper plate of lead, will flower in the most vigorous and beautiful manner imaginable. Some have thought of adding to the virtues of the water by putting in nitre in small quantities, and others have added earth and sand at the bottom; but it has always been found to succeed better without any addition.

It may be more agreeable to some to use glass jars in this last method with the leads, instead of earthen pots. The bulbs succeed full as well in these; and there is this advantage, that the progress of the roots is seen all the while, and they are managed better as to the supply of water.

By repeated experiments in this way on dried bulbs, and on those taken fresh out of the ground, the former have been found to succeed the best. For those taken fresh out of the ground being full of moisture, will not so soon, upon changing their element, be nourished fully by a new one; and the fibres which they had struck in the ground, always rot when put into the water, and new ones must be formed in their places; so that it requires more time for them to come to flowering. The bulbs themselves will not rot in this manner; but they will never be so strong as those which were put into the water dry, which gradually fill themselves with moisture from it, and regularly plump up. The best method of managing the whole process is this: Place the bulbs at first only on the surface of the water; for thus they will strike out their fibres most strongly. When they have stood thus six weeks, pour in the water so high as to cover them entirely, and keep them thus till they have done flowering.

Sometimes the roots will become mouldy in several parts while they stand above the water, and the cleaning them of it is to no purpose; for it will eat and spread the farther, and frequently eat through two or three of their coats. In this case they must be immediately covered with water; when the mould will be stopped,

stopped, and the roots become sound, and flower as well as those which never had any such distemper. If the roots are suffered to remain in water all the year, they will not decay: but will flower again at their proper season, and that as vigorously as those which have been taken out and dried. The old fibres of those roots never rot till they are ready to push forth new ones. It is found by experience, that the hyacinth, and many other plants, grow to a greater degree of perfection when thus in water than when in the ground. There is a peculiar species of hyacinth called *Keyser's jewel;* this never, or very rarely, produces seed-vessels in the common way of flowering in the ground; but it will often produce some pods when blown in water.

Mr Miller has intimated, in the Philosophical Transactions, that bulbs set in glasses grow weaker, and should be renewed every other year: but it is found, that, when managed in this manner, and kept under water, at the time of taking them up, they are as large, and some of them larger, than when planted; and if these be dried at a proper season, they will flower, year after year, as well as fresh ones.

Ranunculus and anemone roots have been found to shoot up their stalks very well in this way; but the flowers are usually blasted, which seems to arise from want of free air. Pinks will flower very well in this manner; auriculas also may, with care, be brought to flower, but not strongly. Roses, jessamines, and honeysuckles, may also be made to flower this way, and will thrive and send out suckers; the best pieces to plant, are suckers cut off about three inches under ground, without any fibres. The succulent plants may also be raised this way; for instance, the opuntia or Indian fig. If a fragment of a leaf of this plant be cut, and laid by to dry for a month till it is an absolute skin, as soon as it is put in this manner into water, it begins to plump up, and soon sends out fibrous roots, and produces new leaves as quickly as it would do in the ground.

This is the more singular in these sort of plants, because in their natural state in the ground, they cannot bear much water. This method of growing in water is not peculiar to the bulbous-rooted ones, but others may even be raised from seed by it. A bean or pea, set in this manner, will grow up to its proper standard, and will flower and produce pods which will ripen their seed. The smaller seeds may be also raised in this manner, by the help of wool to support them.

No vegetable transplanted out of the earth into water will thrive kindly; but any plant, whether raised from the root or seed in water, may be transplanted to the earth, and will succeed very well. It may be possible, therefore, from this method of raising plants in water, to come at a better way than is usually practised of raising some roots in the earth which are subject to rot there; such as anemonies, ranunculuses, and hyacinths. A bulb dropped by chance upon the ground, will strike out both stronger and more numerous fibres than those which are planted in the usual way in the ground. On this principle, it may be proper to take out the earth of the bed where the bulbs are to stand at the time of planting them, to such a depth as they are to be placed under it when set for flowering. The bulbs are then to be set in their places, on the surface of this low ground; and to stand there till they have shot out their fibres and their head: then the earth is to be added over them by degrees, till they are covered as high above the head as they are in the usual manner of planting them; thus they would be preserved from the danger of rotting; and their fibres would be much stronger, and consequently they would draw more nourishment, and flower better than in the common way. The common method of planting these roots renders them liable to be destroyed by either extreme of a wet or a dry season. In the first case, they immediately rot by the abundance of moisture they receive; and, in the second, they become dry as a stick and mouldy, so that they are infallibly rotted by the first rain that falls afterwards.

The directions necessary to the success of the bulbs planted in water are these. When the leaden false bottoms are fixed down tight within two or three inches of the bottom of the vessel (which is only designed to hold the sticks steady which are to support the leaves and stalks), then lay on the lead upon which the bulbs are to rest, placing the notched part opposite to that in the false bottom, as near as the sticks, when placed, will suffer it; then place the bulbs one in each hole, and fill up with water to the upper lead. The bottom of the bulb will then touch the water; and as the water diminishes in quantity, keep it supplied with more up to the same height for a month or six weeks; in which time the bulbs will have shot strong fibres. Then fill up the water about half an inch above the surface of the lead; and by degrees, as the fibres strengthen, and the plume shoots from the head, keep the water higher and higher, till at length the whole bulb is covered. The water is to be kept at this standard till the season for drying them returns. —At the time of planting the bulbs, they must be carefully cleaned from any foulness at the bottom by scraping them with the point of a knife till the sound part of the bulb appears; clear them likewise from any loose skins, and even take off their brown skin till they appear white; otherwise this brown skin will tinge the water, and the growth will not succeed so well.

The notches in the side of each lead are intended to give easy passage to the water, that, if there should be any foulness or sediment in it, on shaking it a little it may all run through, and fresh water be put in its place. But this shifting the water need not be done more than once or twice in a winter, as there may be occasion from the foulness; and when this is done, the sides of the vessel should be cleaned with a painter's brush, and rinsed out again, and the bulbs themselves washed, by pouring water on them at a little distance.

At any time when the outer skins of the bulbs dry, they are to be peeled off, that they may not occasion foulness in the water; and if any dust or foul matter be at any time observed swimming on the surface, the method is to fill up the pot or vessel to the rim, and let it run over: this will carry off that light foulness, and the water may afterwards be poured away to the proper standard.

Bulbs of equal bigness should be planted together in the

the same pot, that they may all have the same benefit of the water. Narcissuses and hyacinths do well together; as also tulips and jonquils, and crocuses and snowdrops.

**FLUDD, Robert**, a philosopher and physician of some celebrity in his time, was the son of Sir Thomas Fludd, treasurer of war to Queen Elizabeth; and was born at Milgate in Kent, in the year 1574. He received his education at St John's college, Oxford, and afterwards spent six years in travelling through Europe. He acquired a strong attachment to the Rosycrucian philosophy, which chiefly consisted of mysticism and jargon, and such as were admitted among them had certain secrets analogous to those of free masonry. On his return home, he took the degree of M. D. settled in the city of London, and was chosen a fellow of the college of physicians. His piety was of an enthusiastic nature, and the seeming depth of his knowledge procured him much admiration, and gave him a temporary fame. It is said that he employed a kind of unintelligible cant when speaking to his patients, which sometimes contributed to their recovery, as it operated on their faith. He is chiefly known as a sectary in philosophy, and not as a physician. He blended the incomprehensible reveries of the Cabalists and Paracelsians, forming a new physical system replete with mystery and absurdity. He believed in two universal principles, the northern or condensing, and the southern or rarefying power. Innumerable geniuses he conceived to preside over these, and committed the charge of diseases to legions of spirits collected from the four winds of heaven. In his estimation, a harmony subsisted between the macrocosm and the microcosm, or the world of nature and of man. All his fancies and whims it is impossible to enumerate, yet they attracted the notice of the philosophers of that age, being supported by mysterious gravity and the shadow of erudition. Even Kepler himself thought his extravagant jargon worthy of refutation, and Gassendi for this purpose wrote his *Examen Philosophiæ Fluddianæ*. One of Fludd's performances, entitled *Nexus utriusque Cosmi*, is illustrated by some prints of a very singular and extraordinary nature.

**FLUENT, or Flowing Quantity**, in the doctrine of fluxions, is the variable quantity which is considered as increasing and decreasing: or the fluent of a given fluxion, is that quantity whose fluxion being taken, according to the rules of that doctrine, shall be the same with the given fluxion. See Fluxions. See also Fluents, Supplement.

**FLUID**, an appellation given to all bodies whose particles easily yield to the least partial pressure, or force impressed. For the *Laws and Properties of Fluids*, see Hydrodynamics in this work; and Fluids, Elevation of, in the Supplement.

There are various kinds of animalcules to be discerned in different fluids by the microscope. Of many remarkable kinds of these, a description is given under the article Animalcule. All of these little creatures are easily destroyed by separating them from their natural element. Naturalists have even fallen upon shorter methods. A needle point, dipped in spirit of vitriol, and then immersed into a drop of pepper water, readily kills all the animalcules: which, though before frisking about with great liveliness and activity, no sooner come within the influence of the acid particles, than they spread themselves, and tumble down to all appearance dead. The like may be done by a solution of salt; only with this difference, that, by the latter application, they seem to grow vertiginous, turning round and round till they fall down. Tincture of salt of tartar, used in the same manner, kills them still more readily; yet not so, but there will be apparent marks of their first being sick and convulsed. Inks destroy them as fast as spirit of vitriol, and human blood produces the same effect. Urine, sack, and sugar all destroy them, though not so fast; besides, that there is some diversity in their figures and appearances, as they receive their deaths from this poison or that. The point of a pin dipped in spittle, presently killed all the kinds of animalcules in puddle water, as Mr Harris supposes it will other animalcules of this kind.

Fluid.

All who are acquainted with microscopic observations, know very well, that in water, in which the best glasses can discover no particle of animated matter, after a few grains of pepper, or a fragment of a plant of almost any kind, has been some time in it, animals full of life and motion are produced; and those in such numbers, as to equal the fluid itself in quantity.—When we see a numerous brood of young fishes in a pond, we make no doubt of their having owed their origin to the spawn, that is, to the eggs of the parents of the same species. What are we then to think of these? If we will consider the progress of nature in the insect tribes in general, and especially in such of them as are most analogous to these, we shall find it less difficult to give an account of their origin than might have been imagined.

A small quantity of water taken from any ditch in the summer months, is found to be full of little worms, seeming in nothing so much as in size to differ from the microscopic animalcules. Nay, water, without these, exposed in open vessels to the heat of the weather, will be always found to abound with multitudes of them, visible to the naked eye, and full of life and motion. These we know, by their future changes, are the fly worms of the different species of gnats, and multitudes of other fly species; and we can easily determine, that they have owed their origin only to the eggs of the parent fly there deposited. Nay, a closer observation will at any time give ocular proof of this; as the flies may be seen laying their eggs there, and the eggs may be followed through all their changes to the fly again. Why then are we to doubt but that the air abounds with other flies and animalcules as minute as the worms in those fluids; and that these last are only the fly worms of the former, which, after a proper time spent in that state, will suffer changes like those of the larger kinds, and become flies like those to whose eggs they owed their origin? *Vid. Reaumur, Hist. Insect.* vol. iv. p. 431.

The differently medicated liquors made by infusions of different plants, afford a proper matter for the worms of different species of these small flies: and there is no reason to doubt, but that among these some are viviparous, others oviparous; and to this may be, in a great measure, owing the different time taken up for the production of these insects in different fluids. Those which are a proper matter for the worms of the viviparous fly, may be soonest found full of them; as, probably the liquor is no sooner in a state to afford them,

them proper nourishment, than their parents place them there: whereas those produced from the eggs of the little oviparous flies, must, after the liquor is in a proper state, and they are deposited in it in the form of eggs, have a proper time to be hatched, before they can appear alive.

It is easy to prove, that the animals we find in these vegetable infusions were brought thither from elsewhere. It is not less easy to prove, that they could not be in the matter infused any more than in the water in which it is infused.

Notwithstanding the fabulous accounts of salamanders, it is now well known, that no animal, large or small, can bear the force of fire for any considerable time; and, by parity of reason, we are not to believe, that any insect, or embryo insect, in any state, can bear the heat of boiling water for many minutes. To proceed to inquiries on this foundation: If several tubes be filled with water, with a small quantity of vegetable matter, such as pepper, oak bark, truffles, &c. in which, after a time, insects will be discovered by the microscope; and other like tubes be filled with simple water boiled, with water and pepper boiled together, and with water with the two other ingredients all separately boiled in it; when all these liquors come to a proper time for the observation of the microscope, all, as well those which have been boiled as those which have not, will be found equally to abound with insects, and those of the same kind, in infusions of the same kind, whether boiled or not boiled. Those in the infusions which had sustained a heat capable of destroying animal life, must therefore not have subsisted either in the water or in the matters put into it, but must have been brought thither after the boiling; and it seems by no way so probable, as by means of some little winged inhabitants of the air depositing their eggs or worms in these fluids.

On this it is natural to ask, how it comes to pass, that while we see myriads of the progeny of these winged insects in water, we never see themselves? The answer is equally easy, viz. because we can always place a drop of this water immediately before the focus of the microscope, and keep it there while we are at leisure to examine its contents; but that is not the case with regard to the air inhabited by the parent flies of these worms, which is an immense extent in proportion to the water proper for nourishing these worms; and consequently, while the latter are clustered together in heaps, the former may be dispersed and scattered. Nor do we want instances of this, even in insects of a larger kind. In many of our gardens, we frequently find vessels of water filled with worms of the gnat kind, as plentiful, in proportion to their size, as those of other fluids are with animalcules. Every cubic inch of water in these vessels contains many hundreds of animals: yet we see many cubic inches of air in the garden not affording one of the parent flies.

But neither are we positively to declare that the parent flies of these animalcules are in all states wholly invisible to us; if not singly to be seen, there are some strong reasons to imagine that they may in great clusters. Every one has seen in a clear day, when looking stedfastly at the sky, that the air is in many places disturbed by motions and convolutions in certain spots. These cannot be the effects of imagination, or of faults in our eyes, because they appear the same to all; and if we consider what would be the case to an eye formed in such a manner as to see nothing smaller than an ox, on viewing the air on a marsh fully peopled with gnats, we must be sensible that the clouds of these insects, though to us distinctly enough visible, would appear to such an eye merely as the moving parcels of air in the former instance do to us: and surely it is thence no rash conclusion to infer, that the case may be the same, and that myriads of flying insects, too small to be singly the objects of our view, yet are to us what the cloud of gnats would be in the former case.

*Nervous* FLUID. See ANATOMY *Index*.

*Elastic* FLUIDS. See CHEMISTRY *Index*.

FLUIDITY, is by Sir Isaac Newton defined to be, that property of bodies by which they yield to any force impressed, and which have their parts very easily moved among one another.

To this definition some have added, that the parts of a fluid are in a continual motion. This opinion is supported by the solution of salts, and the formation of tinctures. If a small bit of saffron is thrown into a phial full of water, a yellow tincture will soon be communicated to the water to a considerable height; though the phial is allowed to remain at rest; which indicates a motion in those parts of the fluids which touch the saffron, by which its colouring matter is carried up.

With regard to water, this can scarce be denied; the constant exhalations from its surface show, that there must be a perpetual motion in its parts from the ascent of the steam through it. In mercury, where insensible evaporation does not take place, it might be doubted; and accordingly the Newtonian philosophers in general have been of opinion, that there are some substances essentially fluid, from the spherical figure of their constituent particles. The congelation of mercury, however, by an extreme degree of cold, demonstrates that fluidity is not essentially inherent in mercury more than in other bodies.

That fluids have vacuities in their substance is evident, because they may be made to dissolve certain bodies without sensibly increasing their bulk. For example, water will dissolve a certain quantity of salt; after which it will receive a little sugar, and after that a little alum, without increasing its first dimensions. Here we can scarce suppose any thing else than that the saline particles were interposed between those of the fluid; and as, by the mixture of salt and water, a considerable degree of cold is produced, we may thence easily see why the fluid receives these substances without any increase of bulk. All substances are expanded by heat, and reduced into less dimensions by cold; therefore, if any substance is added to a fluid, which tends to make it cold, the expansion by the bulk of the substance added will not be so much perceived as if this effect had not happened; and if the quantity added be small, the fluid will contract as much, perhaps more, from the cold produced by the mixture, than it will be expanded from the bulk of the salt. This also may let us know with what these interstices between the particles of the fluid were filled up; namely, the element of fire or heat. The saline particles, upon their solution in the fluid, have occupied these spaces; and now the liquor being deprived of a quantity of this element equal in bulk to the salt added, feels sensibly colder.

As, therefore, there is scarce any body to be found, but what may become solid by a sufficient degree of cold, and none but what a certain degree of heat will render fluid; the opinion naturally arises, that fire is the cause of fluidity in all bodies, and that this element is the only essentially fluid substance in nature. Hence we may conclude, that those substances which we call *fluids* are not essentially so, but only assume that appearance in consequence of an intimate union with the element of fire; just as gums assume a fluid appearance on being dissolved in spirit of wine, or salts in water.

Upon these principles Dr Black mentions fluidity as an effect of heat. The different degrees of heat which are required to bring different bodies into a state of fluidity, he supposes to depend on some particulars in the mixture and composition of the bodies themselves: which becomes extremely probable, from considering that we change the natural state of bodies in this respect, by certain mixtures; thus, if two metals are compounded, the mixture is usually more fusible than either of them separately. See CHEMISTRY *Index*.

It is certain, however, that water becomes warmer by being converted into ice; which may seem contradictory to this opinion. To this, however, the doctor replies, that fluidity does not consist in the degree of sensible heat contained in bodies, which will affect the hand or a thermometer; but in a certain quantity which remains in a latent state. This opinion he supports from the great length of time required to melt ice; and to ascertain the degree of heat requisite to keep water in a fluid state, he put five ounces of water into a Florence flask, and converted it into ice by means of a freezing mixture put round the flask. Into another flask of the same kind he put an equal quantity of water cooled down nearly to the freezing point, by mixing it with snow, and then pouring it off. In this he placed a very delicate thermometer; and found that it acquired heat from the air of the room in which it was placed: seven degrees of heat were gained the first half hour. The ice being exposed to the same degree of heat, namely, the air of a large room without fire, it cannot be doubted that it received heat from the air as fast as the water which was not frozen; but, to prevent all possibility of deception, he put his hand under the flask containing the ice, and found a stream of cold air very sensibly descending from it, even at a considerable distance from the flask; which undeniably proved, that the ice was all that time absorbing heat from the air. Nevertheless, it was not till 11 hours that the ice was half melted, though in that time it had absorbed so much heat as ought to have raised the thermometer to 140°; and even after it was melted, the temperature of the water was found scarce above the freezing point: so that as the heat which entered could not be found in the melted ice, he concluded that it remained concealed in the water, as an essential ingredient of its composition.

FLUKE, or FLOUNDER. See PLEURONECTES, ICHTHYOLOGY *Index*.

*Fluke Worm*. See FASCIOLA, HELMINTHOLOGY *Index*.

*Fluke of an Anchor*, that part of it which fastens in the ground. See ANCHOR.

FLUMMERY, a wholesome sort of jelly made of oatmeal.

The manner of preparing it is as follows. Put three large handfuls of finely ground oatmeal to steep, for 24 hours, in two quarts of fair water: then pour off the clear water, and put two quarts of fresh water to it; strain it through a fine hair sieve, putting in two spoonfuls of orange flower water, and a spoonful of sugar: boil it till it is as thick as a hasty pudding, stirring it continually while it is boiling, that it may be very smooth.

FLUOR, in *Physics*, a fluid; or, more properly, the state of a body that was before hard or solid, but is now reduced by fusion or fire into a state of fluidity.

*Fluor Acid*. See *Flouric Acid*, CHEMISTRY *Index*.

*Fluor Albus*, a flux incident to women, commonly known by the name of *whites*. See MEDICINE *Index*.

*Fluor Spar* or *Blue John*, called also fluxing spars, vitrescent or glass spars, are minerals composed of calcareous earth united with fluoric acid. See MINERALOGY *Index*.

FLUSHING, a handsome, strong, and considerable town of the United Provinces, in Zealand, and in the island of Walcheren, with a very good harbour, and a great foreign trade. It was put into the hands of Queen Elizabeth, for a pledge of their fidelity, and as a security for the money she advanced. It was taken by the British in the memorable and ill conducted expedition of 1809, and kept some months. E. Long. 3. 32. N. Lat. 51. 26.

FLUTE, an instrument of music, the simplest of all those of the wind kind. It is played on by blowing it with the mouth; and the tones or notes are changed by stopping and opening the holes disposed for that purpose along its side.

This is a very ancient instrument. It was at first called the flute *à bec*, from *bec* an old Gaulish word signifying the beak of a bird or fowl, but more especially of a cock; the term *flute à bec* must therefore signify the *beaked flute;* which appears very proper, on comparing it with the traverse or German flute. The word *flute* is derived from *fluta*, the Latin for a lamprey or small eel taken in the Sicilian seas, having seven holes immediately below the gills on each side, the precise number of those in the front of the flute.

By Mersennus this instrument is called the *fistula dulcis seu Anglica;* the lowest note, according to him, for the treble flute, is *C fa ut*, and the compass of the instrument 15 notes. There is however, a flute known by the name of the *concert flute*, the lowest note of which is F. Indeed, ever since the introduction of the flute into concerts, the lowest note of the instrument, of what size soever it is, has been called F; when in truth its pitch is determinable only by its correspondence in respect of acuteness or gravity with one or other of the chords in the *scala maxima* or great system.

Besides the true concert flute, others of a less size were soon introduced into concerts of violins; in which case the method was to write the flute part in a key correspondent

correspondent to its pitch. This practice was introduced in 1710 by one Woodcock, a celebrated performer on this instrument, and William Babell organist of the church of All-Hallows, Bread Street, London. They failed, however, in procuring for the flute a reception into concerts of various instruments; for which reason one Thomas Stanesby, a very curious maker of flutes and other instruments of the like kind, about the year 1732, adverting to the scale of Mersennus, in which the lowest note was C, invented what he called the *new system;* in which, by making the flute of such a size as to be a fifth above concert pitch, the lowest note became *C sol fa ut*. By this contrivance the necessity of transposing the flute part was taken away; for a flute of this size, adjusted to the system above mentioned, became an octave to the violin. To further this invention of Stanesby's, one Lewis Merci, an excellent performer on the flute, published about the year 1735, six solos for this instrument, three of which are said to be accommodated to Mr Stanesby's new system; but the German flute was now become a favourite instrument, and Stanesby's ingenuity failed of its effect.—One great objection indeed lies against this instrument, which, however, equally affects all perforated pipes; namely, that they are never perfectly in tune, or cannot be made to play all their notes with equal exactness. The utmost that the makers of them can do is to tune them to some one key; as the hautboy to C, the German flute to D, and the English flute to F; and to effect this truly, is a matter of no small difficulty. The English flutes made by the younger Stanesby came the nearest of any to perfection; but those of Bressan, though excellent in their tone, are all too flat in the upper octave. For these reasons some are induced to think, that the utmost degree of proficiency on any of those instruments is not worth the labour of attaining it.

*German* FLUTE, is an instrument entirely different from the common flute. It is not, like that, put into the mouth to be played; but the end is stopt with a tompion or plug, and the lower lip is applied to a hole about two inches and a half or three inches distant from the end. This instrument is usually about a foot and a half long; rather bigger at the upper end than the lower; and perforated with holes, besides that for the mouth, the lowest of which is stopped and opened by the little finger's pressing on a brass or sometimes a silver key, like those in hautboys, bassoons, &c. Its sound is exceeding sweet and agreeable; and serves as a treble in a concert.

FLUTE, or FLUYT, is a kind of long vessel, with flat ribs or floor timbers, round behind, and swelled in the middle; serving chiefly for the carrying of provisions in fleets or squadrons of ships; though it is often used in merchandise. The word *flute*, taken for a sort of boat or vessel, is derived, according to Borel, from the ancient *flotte*, a little boat. In the verbal process of the miracles of St Catherine of Sweden, in the 12th century, we read *Unus equum suum una cum mercibus magni ponderis introduxit super instrumentum de lignis fabricatum, vulgariter dictum fluta.* Upon which the Bollandists observe, that in some copies it is read *flotta*, an instrument called by the Latins *ratis;* and that the word *flutta* or *flotta* arose from *flotten* or *vlotten*, "to float."

FLUTES, or FLUTINGS, in *Architecture*, are perpendicular channels or cavities cut along the shaft of a column or pilaster. They are supposed to have been first introduced in imitation of the plaits of women's robes; and are therefore called by the Latins *striges* and *rugæ*. The French call them *cannelures*, as being excavations; and we, *flutes* or *flutings*, as bearing some resemblance to the musical instrument so called. They are chiefly affected in the Ionic order, in which they had their first rise; though they are also used in all the richer orders, as the Corinthian and Composite; but rarely in the Doric, and scarce ever in the Tuscan.

FLUX, in *Medicine*, an extraordinary issue or evacuation of some humour. Fluxes are various, and variously denominated, according to their seats or the humours thus voided; as a flux of the belly, uterine flux, hepatic flux, salival flux, &c. The flux of the belly is of four kinds, which have each their respective denominations, viz. the *lientery*, or *fluxus lientericus;* the *cœliac*, or *fluxus chylosus;* the *diarrhœa;* and the *dysentery*, or *bloody flux*. See MEDICINE *Index*.

FLUX, in *Hydrography*, a regular periodical motion of the sea, happening twice in 24 hours; wherein the water is raised and driven violently against the shores. The flux or flow is one of the motions of the tide; the other, whereby the water sinks and retires, is called the reflux or ebb. There is also a kind of rest or cessation of about half an hour between the flux and reflux; during which time the water is at its greatest height, called *high water*. The flux is made by the motion of the water of the sea from the equator towards the poles; which, in its progress, striking against the coasts in its way, and meeting with opposition from them, swells, and where it can find passage, as in flats, rivers, &c. rises up and runs into the land. This motion follows, in some measure, the course of the moon; as it loses or comes later every day by about three quarters of an hour, or more precisely by 48 minutes; and by so much is the motion of the moon slower than that of the sun. It is always highest and greatest in full moons, particularly those of the equinoxes. In some parts, as at Mount St Michael, it rises 80 or 90 feet, though in the open sea it never rises above a foot or two; and in some places, as about the Morea, there is no flux at all. Its runs up some rivers above 120 miles. Up the river Thames it only goes 80, viz. near to Kingston in Surry. Above London bridge the water flows four hours and ebbs eight; and below the bridge, flows five hours and ebbs seven.

FLUX, in *Metallurgy*, is sometimes used synonymously with *fusion*. For instance, an ore, or other matter, is said to be a liquid flux, when it is completely fused.

But the word *flux* is generally used to signify certain saline matters, which facilitate the fusion of ores and other matters, which are difficultly fusible in essays and reductions of ores; such are alkalies, nitre, borax, tartar, and common salt. But the word *flux* is more particularly applied to mixtures of different proportions of only nitre and tartar; and these fluxes are called by particular names, according to the proportions of these ingredients, as in the following articles.

*White* FLUX, is made with equal parts of nitre and of tartar detonated together, by which they are alkalized.

Flux.

lized. The residuum of this detonation is an alkali composed of the alkalies of the nitre and of the tartar, both which are absolutely of the same nature. As the proportion of nitre in this mixture is more than is sufficient to consume entirely all the inflammable matter of the tartar, the alkali remaining after the detonation is perfectly white, and is therefore called *white flux;* and as this alkali is made very quickly, it is also called *extemporaneous alkali*. When a small quantity only of white flux is made, as a few ounces for instance, some nitre always remains undecomposed, and a little of the inflammable principle of the tartar, which gives a red or even a black colour to some part of the flux; but this does not happen when a large quantity of white flux is made; because then the heat is much greater. This small quantity of undecomposed nitre and tartar which remains in white flux is not hurtful in most of the metallic fusions in which this flux is employed: but if the flux be required perfectly pure, it might easily be disengaged from those extraneous matters by a long and strong calcination, without fusion.

*Crude Flux*. By crude flux is meant the mixture of nitre and tartar in any proportions, without detonation. Thus the mixture of equal parts of the two salts used in the preparation of the white flux, or the mixture of one part of nitre and two parts of tartar for the preparation of the black flux, are each of them a crude flux before detonation. It has also been called *white flux*, from its colour; but this might occasion it to be confounded with the white flux above described. The name, therefore, of crude flux is more convenient.

Crude flux is detonated and alkalized during the reductions and fusions in which it is employed; and is then changed into white or black flux, according to the proportions of which it is composed. This detonation produces good effects in these fusions and reductions, if the swelling and extravasation of the detonating matters be guarded against. Accordingly, crude flux may be employed successfully in many operations; as, for instance, in the ordinary operation for procuring the regulus of antimony.

*Black Flux*. Black flux is produced from the mixture of two parts of tartar and one part of nitre detonated together. As the quantity of nitre which enters into the composition of this flux is not sufficient to consume all the inflammable matter of the tartar, the alkali which remains after the detonation contains much black matter, of the nature of coal, and is therefore called *black flux*.

# FLUXIONS.

## INTRODUCTION.

Introduction.

THE branch of mathematical analysis which is called in this country the *Method of Fluxions*, but on the continent the *Differential* and *Integral Calculi*, was invented near the end of the 17th century; and *Sir Isaac Newton*, and *Mr Leibnitz*, two of the greatest philosophers of that age, have both claimed the discovery.

It will appear very possible that two such men should both fall upon this method of calculation nearly about the same time, if it be considered, that from the beginning of the 17th century its principles were gradually coming into view, in consequence of the united labours and discoveries of a number of mathematicians, such as *Napier*, *Cavallerius*, *Roberval*, *Fermat*, *Barrow*, *Wallis*, and others. And considering the number of men of the first abilities engaged at that time in the study of mathematics, we may reasonably suppose, that the fluxional or differential calculus, would very soon have been found according to the ordinary progress of human knowledge, even although a *Newton*, or a *Leibnitz*, had not by the force of superior genius anticipated perhaps by a few years that event. The first intimation that was given of the discovery of the calculus was in the year 1669, when through the intervention of *Dr Barrow*, a correspondence was begun between *Sir Isaac Newton* (then *Mr Newton*), and *Mr Collins*, one of the secretaries to the Royal Society. *Dr Barrow* communicated to the latter a paper by *Newton*, which had for its title, *De analysi per æquationes numero terminorum infinitas*. In this paper, besides shewing how to resolve equations by approximation, *Newton* teaches how to square curves, not only when the expression for the ordinate in terms of the abscissa is a rational quantity, but also when it involves radical quantities, by first resolving these into an infinite series of rational terms by means of the binomial theorem, a thing which had never before been done. *Newton* in this paper gives some rather obscure indications of the nature of his calculus, which however serve to shew, beyond all doubt, that he was then in possession of it; and indeed there is good reason to believe that he knew it as early as the year 1665, or even sooner.

These analytical discoveries of *Newton* were immediately circulated among mathematicians both in this country and abroad, by *Dr Barrow*, and by *Collins* and *Oldenburg*, the two secretaries to the Royal Society.

About the end of the year 1672, *Newton* communicated to *Collins*, by letter, a method of drawing tangents to curve lines, illustrated by an example, from which it again plainly appears, that he now possessed his method of fluxions.

In the course of the following year, *Leibnitz* came to London, and communicated to several members of the Royal Society, some researches relating to the theory of differences. It was however shewn to him, that this subject had been previously treated by *Mouton* an astronomer of Lyons; upon this *Leibnitz* directed his attention to the doctrine of series, which was now considerably advanced, in consequence of the discoveries of the English mathematicians.

The first direct communication that passed between *Newton* and *Leibnitz*, was by a letter, which the former addressed to *Oldenburg*, about the middle of the year 1676. In the beginning of this letter, which was intended to be shewn to *Leibnitz*, *Newton* speaks of him with much respect. The letter itself chiefly refers to the

the theory of infinite series. In a second letter, written also with a view to its being communicated to *Leibnitz*, *Newton*, after bestowing deserved commendation on him, proceeds to explain the steps by which he was led to the discovery of the binomial theorem. He afterwards, among other things, delivers several theorems which have the method of fluxions for their basis; but he does not give their demonstrations, and only observes, that they depend on the solution of a general problem, the enunciation of which he conceals under an anagram of transposed letters, but the meaning of it is this: *An equation being given containing any number of flowing quantities, to find their fluxions; and the contrary.* This letter affords another proof that *Newton* was now in full possession of his calculus.

In the end of June 1677, *Leibnitz* sent to *Oldenburg*, for the purpose of being communicated to *Newton*, a letter containing the first essays of his *Differential Calculus*. The death of *Oldenburg*, which happened soon after, put an end to the correspondence, and in the year 1684, *Leibnitz* published his method in the *Leipsic Acts* for the month of October 1684. The title of the memoir which contained it was, *Nova methodus pro* maximis et minimis, *itemque tangentibus, quæ nec fractas, nec irrationales quantitates moratur, et singulare pro illis calculi genus.* Thus, in whatever way *Leibnitz* came by his calculus, whether he discovered it solely by the force of his own genius, or founded it on the method of fluxions, previously invented by Newton, both of which hypotheses are possible, his method was certainly published before *Newton's*, which, except what transpired in consequence of the circulation of his letters and manuscripts, became only known to the world in general for the first time, by the publication of the *Principia* in the end of the year 1686.

It seems at first to have been allowed, that *Leibnitz* had invented his calculus, without having any previous knowledge of what had been done by *Newton*; for in the first edition of the *Principia*, *Newton* says, "In the course of a correspondence which ten years ago I carried on with the very learned geometrician *Mr Leibnitz*, having intimated to him that I possessed a method of determining *maxima* and *minima*, of drawing tangents, and resolving such problems, not only when the equations were rational, but also when they were irrational; and having concealed this method, by transposing the letters of the following sentence—*An equation being given, containing any number of flowing quantities, to find their fluxions; and the contrary*; this celebrated man answered that he had found a similar method, which he communicated to me, and which differs from mine, only in the enunciation, and in the notation." To this, in the edition of 1714 is added, "and in the manner of conceiving the quantities to be generated *."

There is reason to suppose that *Leibnitz* might have continued to enjoy undisturbed the honour of being considered as one of the inventors of the fluxional or differential calculus, if he had not manifested a disposition to attribute the invention too exclusively to himself. This called forth some remarks respecting the priority of *Newton's* claim to the discovery. In particular *M. Facio* asserted, in a treatise *on the Line of swiftest descent*, published in 1699, "that he was obliged to own *Newton* as the *first inventor* of the differential calculus, and the first by many years; and that he left the world to judge whether *Leibnitz*, the *second inventor*, had taken any thing from him."

On the other hand, when *Newton's* treatise on the quadrature of curves, and on the enumeration of lines of the third order was published, which was in 1704, the Leipsic journalists insinuated, in a very liberal account which they gave of the work, that *Leibnitz* was the first inventor, and that *Newton* had taken his method from *Leibnitz's*, substituting fluxions for differences.

In consequence of this attack on *Newton*, *Dr John Keill* asserted, in the Philosophical Transactions for 1708, that *Newton* was beyond a doubt the first inventor of the arithmetic of fluxions, and that the same arithmetic having its name and notation changed, was afterwards published by *Mr Leibnitz* in the Leipsic Acts. In answer to this, *Leibnitz* replied, in a letter to *Hans Sloane*, secretary to the Royal Society, that no one knew better than *Newton* himself, that the charge against him implied in *Keill's* assertion was false; and he required *Keill* to retract what he had said. To this request, however, *Keill* would by no means accede; but on the contrary, he wrote a long letter to the secretary of the Royal Society, in which he endeavoured to prove, not only that *Newton* had preceded *Leibnitz* in the invention, but that he had given to the latter such indications of the nature of his calculus, as made it easy for him to fall upon the same. This letter was sent to *Leibnitz*, who replied, that *Keill*, although learned, was too young a man to be fit to judge of what had passed between him and *Newton*, and he requested the Royal Society to put a stop to *Keill's* clamours.

The Royal Society being thus appealed to as a judge, appointed a committee to examine all the old letters, papers, and documents, which had passed among the several mathematicians, relating to the question. The judgment of the committee was to the following effect: "That *Mr Leibnitz* was in London in 1673, and went thence to Paris, where he kept a correspondence with *Mr Collins* by means of *Mr Oldenburg*, till about September 1676, and then returned by London and Amsterdam to Hanover; and that *Mr Collins* was very free in communicating to able mathematicians what he had received from *Newton*. That it did not appear, that *Mr Leibnitz* knew any thing of the differential calculus before his letter of the 21st of June 1677, which was a year after a copy of *Newton's* letter of the 10th of December 1672 had been sent to Paris, to be communicated to him, and above four years after *Mr Collins* began to communicate that letter to his correspondents; in which letter the method of fluxions was sufficiently described to any intelligent person. That *Newton* was in possession of his calculus before the year 1669, and that those who had reputed *Leibnitz* the first inventor, knew little or nothing of his correspondence with *Mr Collins*, and *Mr Oldenburg*, long before, nor of *Newton's* having that method above 15 years before *Mr Leibnitz* began to publish it in the Leipsic Acts. That for these reasons, they reckoned *Newton* the first inventor, and were of opinion, that *Mr Keill* in asserting the same had been in no ways injurious to *Mr Leibnitz*."

It is deserving of remark, that the committee delivered no opinion upon the advantage which *Leibnitz* was accused of having taken of the hints furnished to him

* *Principia* lib. ii. lem. 2 schol.

in the course of his correspondence with *Newton;* they left the decision of this point to the world in general; and to enable every one to judge for himself, the Royal Society ordered the opinion of the committee to be printed, together with all the documents upon which it was founded. These appeared in 1712 under the title of, *Commercium Epistolicum de Analysis promota.* This work was carefully circulated over Europe, to vindicate the title of the English nation to the discovery.

The *Commercium Epistolicum* having appeared, *Leibnitz* expressed great dissatisfaction, and threatened to reply in such a manner as to confound his adversaries. There seems no reason however to suppose, that any thing he could have said, would have affected *Newton's* claim to the honour of being the first inventor; for on this point there cannot be any doubt. With respect, however, to the other question, whether *Leibnitz* took his calculus from *Newton,* or found it himself, it is impossible to decide with such certainty. *Mr Montucla,* in his History of Mathematics *, says, "There are only three places of the *Commercium Epistolicum,* which treat of the principles of fluxions in so clear a way, as to prove that *Newton* had found it before *Leibnitz,* but too obscurely, it seems, to take from the latter the merit of the discovery. One of these is in a letter from *Newton* to *Oldenburg,* who had signified to him, that *Slusius* and *Gregory* had each found a very simple method of drawing tangents. *Newton* replied, that he conjectured what the nature of that method was; and he gave an example of it, which shews it to be in effect the same thing as those geometricians had found. He adds, that it is only a particular case, or rather a corollary to a method much more general, which, without a laborious calculation, applies to the finding of tangents to all sorts of curves, geometrical or mechanical, and that without being obliged to free the equation from radicals. He repeats the same thing without explaining himself farther, in another letter, and he conceals the principle of the method under transposed letters. The only place where *Newton* has allowed any thing of his method to transpire, is in his *Analysis per æquationes numero terminas infinitas.* He here discloses, in a very concise and obscure manner, his principle of fluxions, but there is no certainty of *Leibnitz's* having seen this essay. His opponents have never asserted that it was communicated to him by letter, and they have gone no farther than to suspect, that he had obtained a knowledge of it in the interview which he had with *Collins,* upon his second journey to London. Indeed, this suspicion is not entirely destitute of probability, for *Leibnitz* admitted, that in this interview, he saw a part of the *Epistolary Correspondence* of *Collins.* However I think it would be rash to pronounce upon this circumstance. If *Leibnitz* had confined himself to a few essays of his new calculus, there might have been some foundation for that suspicion; but the numerous pieces he inserted in the Leipsic Acts, prove the calculus to have received such improvements from him, that probably he owed the invention of it to his genius, and to the efforts he made to discover a method, which put *Newton* in possession of so many beautiful truths. This is so much the more likely, as, from the method of tangents discovered by *Dr Barrow,* the transition to the differential calculus was easy, nor was the step too great for such a genius as that with which *Leibnitz* appears to have been endowed." Such is the opinion of *Montucla,* who being a foreigner, cannot be supposed to have been too partial towards *Newton,* an Englishman. The British mathematicians have hitherto, with few exceptions, entertained an opinion still more decidedly in favour of the claims of their celebrated countryman.

It has been said that *Newton* took no share in the controversy; this however seems not to have been exactly the case, for besides suppressing in the third edition of his *Principia* (printed in 1726) the passage we have already quoted, which seems to admit that *Leibnitz* invented his calculus for himself, he is known to have written the notes which accompany the edition of the *Commercium Epistolicum,* printed in 1722. *Leibnitz* had also begun to prepare a *Commercium Epistolicum,* but he died before it was completed.

Besides the disputes that have happened respecting the inventor of the method of fluxions, the accuracy of the method itself has been the subject of controversy, both in Britain and on the continent. The differential calculus was attacked abroad by *Nieuwentiit,* a writer of little or no reputation as a mathematician, and by *Rolle,* who was an expert algebraist, and an indefatigable calculator, but rash, and too confident of the justness of his own opinions, and jealous of the inventions of others. To the first of these writers *Leibnitz* himself replied, and afterwards *Bernoulli* and *Herman;* the attack from *Rolle* was successfully repelled by *Varignon,* who was as zealous and intelligent, as his adversary was warm and impetuous.

The very concise manner in which the great inventor of the method of fluxions thought proper to explain its principles, gave occasion to the celebrated *Dr Berkley* bishop of Cloyne to call in question, not only the logical accuracy of the reasoning employed to establish the theory of fluxions, but also the faith of mathematicians in general, in regard to the truths of religion. The bishop commenced the controversy first in a small work entitled *The Minute Philosopher;* but his principal attack made its appearance in 1734, under the title of "*The Analyst,* or *A Discourse addressed to an Infidel Mathematician,*" (understood to be Dr Halley,) "*wherein it is examined whether the object, principles, and inferences of the modern Analysis are more distinctly conceived than religious mysteries and points of faith.*" One of the best answers which was made to this work came from the pen of *Benjamin Robins,* and is entitled, "*A discourse concerning the nature and certainty of Sir Isaac Newton's methods of fluxions, and of prime and ultimate ratios.*" Other mathematicians likewise attempted to defend *Newton,* and the method of fluxions, against the very cogent and well-directed arguments of the bishop: but the most satisfactory way of removing all objections to the method, was to abandon those obscure and inaccurate modes of expression, of which *Berkley* had, not without some reason, complained, and to substitute in their place, others more intelligible, and more consonant to the common methods of mathematical reasoning. This was accordingly done by the celebrated *Maclaurin,* who, in the year 1742, published his *Treatise of Fluxions,* a work which, although in some respects rather diffuse, placed the principles of the method beyond controversy, by establishing them on the firm basis of geometrical demonstration.

It would extend this introduction to too great a

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ii. p.

Direct Method.

length were we to enter into a detailed account of the various improvements which the calculus has received from its first invention to the present time. We shall just briefly observe, that among those who contributed the first and the most effectually to its improvement, we may reckon *Newton* and *Leibnitz* themselves, the two illustrious rivals for the honour of its discovery; these were followed by the two brothers *James* and *John Bernoulli*, by the *Marquis de L'Hopital*, and many other foreign mathematicians; and in this country we may reckon *Craig*, *Cheyne*, *Cotes*, *Taylor*, and *De Moivre*, as among the earliest of its improvers. It is to *Cotes* in particular that we are indebted for the discovery of the method of finding the fluents of certain rational fractions, a discovery which was extended by *De Moivre*, so as to form one of the most beautiful and complete branches of the theory of fluxions.

Besides innumerable memoirs on particular branches of the fluxional calculus, which are to be found in academical collections, many distinct treatises have been written on the subject. Some of the most valuable of these are as follow. *The Method of Fluxions and Infinite Series*, by *Sir Isaac Newton*. This work was written in Latin, but was not published till the year 1736, when it was translated into English, and given to the world, along with a comment, by *Mr Colson*. *Harmonia Mensurarum*, by *Cotes*, a most valuable and original work, published in 1716. *A Treatise on Fluxions, in two books*, by *Maclaurin*, published in 1742. Many parts of the writings of the celebrated *Euler* have a reference to the theory of fluxions, or the differential and integral calculi. He has, however, three works in particular that relate to that subject; the first is his *Introductio in Analysin Infinitorum*, the second his *Institutiones Calculi Differentialis*, and the third his *Institutiones Calculi Integralis*.

There is a work on this subject which deserves to be particularly mentioned, both on account of its excellence, and the singular circumstance of its being composed by a lady. Its title is, *Analytical Institutions, in four books, originally written in Italian, by Donna Maria Gaetana Agnesi*. This lady was Professor of Mathematics and Philosophy in the University of Bologna; her work was originally published in 1748, and has been styled by her countryman *Frisi*, *Opus nitidissimum, ingeniosissimum, et certo maximum quod adhuc ex fœminæ alicujus calamo prodierit*. A part of this work has been published in the French language by Bossut. An English translation was prepared for the press many years ago by the late *Professor Colson*; it remained, however, unpublished, and might still have continued so, but for the liberality of *Baron Maseres*, who, after satisfying some pecuniary claims upon the manuscript, caused it, in 1801, to be published (we believe at his own expence), in two volumes quarto. *The Doctrine and Application of Fluxions*, by *Thomas Simpson*, is a work deservedly in high estimation. *The Doctrine of Fluxions*, by *Emerson*, is also very generally read by the British mathematicians. We are sorry, however, to observe, that there is no work in the English language that exhibits a complete view of the theory of fluxions, with all the improvements that have been made upon it to the present time. We cannot at present acquire any tolerable acquaintance with the subject, without consulting the writings of the foreign mathematicians. There are several excellent works in the French language; we may mention in particular a *Traité de Calcul Differentiel et de Calcul Integral*, by *Cousin*, in 2 vols. 4to.; another by *Bossut*, in 2 vols. 8vo.; and another by *La Croix*, in 3 vols. 4to. This last deserves particular notice, as the author intended it to comprehend the substance of the various valuable treatises by *Euler*, as well as of the most important academical memoirs that relate to this subject. The author has also published an abridgment of his work, in one volume octavo. *Principiorum Calculi Differentialis et Integralis*, by *L'Huilier*, published in 1795, contains a very clear exposition of the principles of the calculus. The writings of our countrymen *Landen* and *Waring*, and of these foreign mathematicians *La Grange*, *Le Gendre*, *La Place*, and many others, abound with improvements in the calculus. Having given this sketch of the history of this very important branch of mathematical science, we proceed to explain its principles.

# PART I. THE DIRECT METHOD OF FLUXIONS.

## SECT. I. *Principles and Definitions.*

1. IN the application of algebra to the theory of curve lines, we find that some of the quantities which are the subject of consideration, may be conceived as having always the same magnitude, as the parameter of a parabola, and the axes of an ellipse or hyperbola; while others again are indefinite in respect of magnitude, and may have any number of particular values, such are the co-ordinates at any point in a curve line. This difference in the nature of the quantities which are compared together, has equally place in various other theories, both in pure and mixed mathematics, and it naturally suggests the divisions of all quantities whatever into two kinds, namely, such as are constant, and such as are variable.

2. A *constant* quantity is that which retains always the same magnitude, however other quantities with which it is connected may be supposed to change; and a *variable* quantity is that which is indefinite in respect of magnitude, or which may be supposed to change its value. Thus, in the arithmetic of sines, the radius is a constant quantity, while the cosine, sine, tangent, &c. of an arch, also the arch itself, are variable quantities; and in the conic sections the axes and the parameters of the axes are constant quantities, and any abscissa and its corresponding ordinate are variable quantities.

Constant quantities are usually denoted by the first letters of the alphabet $a$, $b$, $c$, &c. and variable quantities by the last letters $z$, $y$, $x$, &c.

3. Any expression of calculation, containing a variable quantity, along with other constant quantities, is called a *Function* of that variable quantity. Thus, supposing $x$ to be variable, and the other quantities constant, any

any one of these expressions $a x^n$, $\frac{a+b x^m}{c x^n+d x^p}$, $a^x$, *log.* $x$, *cos.* $x$. *sin.* $x$, &c. is a function of $x$; and in any such equation as $y=a x+b x+b x^2+c x^3$, the quantity $y$ is called a function of $x$. Even although the variable quantities $x$ and $y$, should not be separated as in the last example, but should be related to each other as in the following,

$$a x^2 y+b x y^2+y^3=0,$$

as, setting aside the consideration of the constant quantities, the value of $y$ depends on that of $x$, and on the contrary the value of $x$ depends upon that of $y$, the quantity $y$ is said to be a function of $x$, and on the other hand $x$ is said to be a function of $y$.

4. If a variable quantity be supposed to change its value, then a corresponding change will take place in the value of any function of that quantity. Let us examine the nature of this change in the magnitude of a function.

First, let us suppose that, $x$ denoting any variable quantity, the function to be considered is any integer power of that quantity, as $x^2$, or $x^3$, or $x^4$, &c.; then, $x$ being supposed to be increased by an indefinite quantity $h$, and thus to become $x+h$, the function will change its value; if it be $x^2$ it will become $(x+h)^2$, or

$$x^2+2 x h+h^2;$$

and if it be $x^3$ it will become $(x+h)^3$ or

$$x^3+3 x^2 h+3 x h^2+h^3;$$

and if it be $x^4$ it will become $(x+h)^4$, or

$$x^4+4 x^3 h+6 x^2 h^2+4 x h^3+h^4;$$

and so on, for other integer powers.

If we compare the new value of the function in each of these cases with its former value, it will immediately appear, that the new value may be resolved into two parts, one of which is the original value of the function, and, therefore, the other is the increment which the function has received, in consequence of the change in the value of the variable quantity $x$. Thus, the function being $x^2$, we have found its new value to be $x^2+2xh+h^2$, of which expression, the first term $x^2$ is the original value of the function; therefore the other part of the expression viz. $2 x h+h^2$ is its increment. In like manner the expression $x^3=3 x^2 h+3 x h^2+h^3$, which is the new value of the function $x^3$, may be resolved into $x^3$, the original value of the function, and $3 x^2 h+3 x h^2+h^3$ its increment; and $x^4+4 x^3 h+6 x^2 h^2+4 x h^3+h^4$, the new value of the function $x^4$, may be resolved into $x^4$, the function itself, and $4 x^3 h+6 x^2 h^2+4 x h^3+h^4$ its increment.

5. Having seen that, by conceiving the variable quantity $x$ to receive the indefinite increment $h$, the functions $x^2$, $x^3$, $x^4$ receive the increments

$$2 x h+h^2,$$
$$3 x^2 h+3 x h^2+h^3,$$
$$4 x^3 h+6 x^2 h^2+4 x h^3+h^4,$$

respectively, we next observe that each increment is expressed by a series, the first term of which is the first power of the indefinite quantity $h$ multiplied by some function of the variable quantity $x$ as a co-efficient. The second term of the series consists of the second power of $h$, multiplied also by a function of $x$ as a coefficient; and, in like manner, the third and following terms are composed of the third and higher powers of $h$ (the exponents forming the arithmetical series 1, 2, 3, 4, &c.) each multiplied by a function of $x$ as a coefficient; and it appears, that the particular form of the function which constitutes the coefficient of any assigned term of the series depends entirely upon the particular form of the original function. Thus, when the original function is $x^2$, the function which is the coefficient of the first term is $2 x$; when the original function is $x^3$, the co-efficient of the first term is $3 x^2$; when the original function is $x^4$, the coefficient of the first term is $4x^3$, and so on. It also appears that the functions of $x$, which are the co-efficients of the powers of $h$, are composed only of the variable quantity $x$ and given quantities, so that they are entirely independent of the indefinite increment $h$.

6. These observations may be extended to a function that is any power whatever of a variable quantity, by the application of the binomial theorem. Let $x$ be supposed to become $x+h$, then $x^n$ will become $(x+h)^n$; but by the binomial theorem, (see ALGEBRA, Sect. xvii.) $(x+h)^n$ when expanded into a series, is

$$x^n+\frac{n}{1} x^{n-1} h+\frac{n(n-1)}{1 \cdot 2} x^{n-2} h^2$$
$$+\frac{n(n-1)(n-2)}{1 \cdot 2 \cdot 3} x^{n-3} h^3+\text{ \&c.}$$

where it appears, that the first term of the series is the original value of the function, and the following terms are the first, second, and following powers of the increment $h$, each multiplied by a new function of $x$, that is independent of the increment. Let us denote the functions $n x^{n-1}$, $\frac{n(n-1)}{1 \cdot 2} x^{n-2}$, and $\frac{n(n-1)(n-2)}{1 \cdot 2 \cdot 3} x^{n-3}$, &c. by $p$, $q$, $r$, &c. respectively; and it is to be observed that, in the present case, as well as in the case of any other function of $x$ we may hereafter consider, by the letters $p$, $q$, $r$, &c. or the same letters with accents over them, or lastly the capital letters P, Q, R, &c. we do not mean to denote functions of $x$ of any particular form, but functions of $x$ in general, that consist only of $x$ and given quantities. This being kept in view, it appears that the variable quantity $x$ being supposed to change its value, and to become $x+h$, the function $x^n$ changes its value, so as to become

$$x^n+p h+q h^2+r h^3+s h^4+, \text{ \&c.}$$

a series, the terms of which have the properties already explained in the two preceding sections.

7. Every rational and integer function of a variable quantity $x$ is necessarily of this form,

$$A x^\alpha+B x^\beta+C x^\gamma+\text{ \&c.}$$

where A, B, C, &c. and $\alpha$, $\beta$, $\gamma$, are supposed to denote constant quantities.

Let us examine what is the form which the function assumes when the variable quantity $x$ changes its value to to $x+h$; and to avoid complicated expressions, let us suppose the function to consist of these two terms $Ax^{\alpha}+Bx^{\beta}$. We have already found in last section that $x$ being supposed to become $x+h$, $x^{\alpha}$ will become

$$x^{\alpha}+ph+qh^2+rh^3+\&c.$$

where $p$, $q$, $r$, &c. denote functions of $x$ independent of $h$, as explained in the last section, and consequently $Ax^{\alpha}$ will become

$$Ax^{\alpha}+Aph+Aqh^2+Arh^3+\&c.$$

In like manner $Bx^{\beta}$ will become

$$Bx^{\beta}+Bp'h+Bq'h^2+Br'h^3+\&c.$$

$p'$, $q'$, $r'$, &c. denoting also functions of $x$ independent of $h$; therefore taking the sum of the two series, it appears that, supposing $x$ to change its value, and to become $x+h$, the function $Ax^{\alpha}+Bx^{\beta}$ becomes

$$Ax^{\alpha}+Bx^{\beta}+(Ap+Bp')h+(Aq+Bq')h^2 \\ +(Ar+Br')h^3+\&c.$$

now $p$ and $p'$ being functions of $x$, $Ap+Bp'$ will also be a function of $x$, and may be denoted more simply by P, and for the same reason $Aq+Bq'$, $Ar+Br'$, &c. which are functions of $x$, may be denoted by Q, R, &c. thus the expression for the new value of $Ax^{\alpha}+Bx^{\beta}$ is

$$Ax^{\alpha}+Bx^{\beta}+Ph+Qh^2+Rh^3+\&c.$$

a series, the form and properties of which are in all respects analogous to those of the series that expresses the new value of the function $x^n$; and although we have supposed the function to consist of but two terms, still the form of the series and its properties will be the same; that is, it will consist of two parts, one of which is independent of $h$, and is the original value of the function, and the other is a series, the terms of which are the successive powers of the increment $h$, each multiplied by a function of the variable quantity $x$ as a coefficient. This conclusion may be expressed in symbols concisely thus. Let $u$ denote any rational and integer function of a variable quantity $x$, let $x$ be conceived to change its magnitude, and to become $x+h$, and let $u'$ denote the new value which the function acquires in consequence of the change in the value of $x$, then

$$u'=u+ph+qh^2+rh^3+, \&c.$$

where $p$, $q$, $r$, &c. denote functions of $x$ as already stated.

8. Suppose next the function of $x$ to be of this form:—

$$(Ax^{\alpha}+Bx^{\beta}+Cx^{\gamma}+\&c.)^n,$$

that is, suppose it to be the $n$th power of a polynomial, consisting of any number of terms whatever. Let the expression between the parenthesis be denoted by $v$, then we are to consider the function $v^n$. Now when $x$ becomes $x+h$, we have already found that $v$ becomes

$$v+ph+qh^2+rh^3+\&c.$$

therefore $v^n$ will become

$$(v+ph+qh^2+rh^3+\&c.)^n,$$

or, putting $ph+qh^2+rh^3+\&c.=M$,

$v^n$ will become $(v+M)^n$,

and this expression when expanded into a series by the binomial theorem is

$$x^n+av^{n-1}M+bv^{n-2}M^2+vc^{n-3}M^3+\&c.$$

where $a$, $b$, $c$, &c. express numbers.

Now from the form of the series denoted by M, it is manifest that its square, cube, or any power of it whatever, will be a series proceeding by the powers of $h$, and having for the coefficients of its terms certain combinations of the quantities $p$, $q$, $r$, &c. which being functions of $x$, any combinations of them will also be functions of $x$. Therefore, each of the terms of the above series, expressing the developement of $(v+M)^n$, excepting the first term $v^n$, will itself be a series proceeding by the powers of $h$, and having its terms multiplied by functions of $x$, and consequently their sum will be a series of the same nature. Let us as before denote the functions of $x$, which are the coefficients of the successive powers of $h$ by P, Q, R, &c. and we shall have upon the whole

$$(v+ph+qh^2+rh^3+\&c.)^n$$

expressed by a series of this form

$$v^n+Ph+Qh^2+Rh^3+\&c.$$

therefore, putting the single letter $u$ for the function $v^n$, or for

$$(Ax^{\alpha}+Bx^{\beta}+Cx^{\gamma}+\&c.)^n$$

and $u'$ for the new value which $u$ acquires by $x$ changing its value to $x+h$,

$$u'=u+Ph+Qh^2+Rh^3+\&c.$$

a series of the same nature as before.

9. Let us now consider a fractional function of $x$, and let us suppose it to be

$$\frac{A'x^{\alpha'}+B'x^{\beta'}+C'x^{\gamma'}+\&c.}{Ax^{\alpha}+Bx^{\beta}+Cx^{\gamma}+\&c.}$$

Where A', A, B', B, &c. also $\alpha'$, $\alpha$, $\beta'$, $\beta$, &c. denote constant quantities. Let $v$ denote the numerator of the fraction, and $w$ its denominator, then the function is

$$\frac{v}{w}, \text{ or } vw^{-1},$$

now when $x$ becomes $x+h$, $v$ becomes

$$v+ph+qh^2+rh^3+\&c.$$

and $w^{-1}$ becomes

$$w^{-1}+p'h+q'h^2+r'h^3+\&c.$$

and consequently $vw^{-1}$ becomes

$$(v+ph+qh^2+\&c.)\ (w^{-1}\times p'h+q'h^2+\&c.)$$

and

and the product of these two factors, by actual multiplication is

$$\left.\begin{array}{r} vw^{-1}+vp' \\ +w^{-1}p \end{array}\right\} \left.\begin{array}{l} +vq' \\ +pp' \\ +w^{-1}q \end{array}\right\} h^2+\&c.$$

Now, here as before, it appears that the coefficients of the powers of $h$ are functions of $x$, therefore, denoting these functions by P, Q, R, &c. and observing that $v\,w^{-1}$ is $\frac{v}{w}$, we have the new value of $\frac{v}{w}$ expressed by the series

$$\frac{v}{w}+\mathrm{P}h+\mathrm{Q}\,h^2+\mathrm{R}h^3+\&c.$$

or, substituting the single letter $u$ for $\frac{v}{w}$, that is, for

$$\frac{\mathrm{A}'\,x^{\alpha'}+\mathrm{B}'\,x^{\beta'}+\mathrm{C}'\,x^{\gamma'}+\&c.}{\mathrm{A}\,x^{\alpha}+\mathrm{B}\,x^{\beta}+\mathrm{C}\,x^{\gamma}+\&c.}$$

and putting $u'$ for the value that $u$ acquires when $x$ becomes $x+h$,

$$u'=u+\mathrm{P}\,h+\mathrm{Q}\,h^2+\mathrm{R}\,h^3+\&c.$$

a series in all respects analogous to those already found for the other functions of $x$.

10. In the functions which we have hitherto considered, the exponents of the powers of $x$ were constant quantities. Let us now consider a function in which the exponent is the variable quantity $x$ itself.

Suppose then the function to be $a^x$, where $a$ denotes a given number; then, by supposing $x$ to become $x+h$, the function will become

$$a^{x+h}=a^x\,a^h.$$

Now it has been shown in the article ALGEBRA, § 295, that if A be put to denote the quotient arising from the division of a logarithm of $a$ by the logarithm of 2·7182818··· the exponential quantity $a^h$ is expressed by the series

$$1+\frac{\mathrm{A}}{1}h+\frac{\mathrm{A}^2}{1\cdot2}h^2+\frac{\mathrm{A}^3}{1\cdot2\cdot3}h^3+\&c.$$

therefore, $a^{x+h}$, the new value of the function, is

$$a^x\,(1+\frac{\mathrm{A}}{1}h+\frac{\mathrm{A}^2}{1\cdot2}h^2+\frac{\mathrm{A}^3}{1\cdot2\cdot3}h^3+\&c.$$

this series, by multiplying all its terms by $a^x$, and putting $p$, $q$, $r$, &c. for that part of each term which is independent of $h$, becomes

$$a^x+p\,h+q\,h^2+r\,h^3+\&c.$$

so that denoting the function $a^x$ by $u$, and its new value by $u'$,

$$u'=u+p\,h+q\,h^2+r\,h^3+\&c.$$

a series of the same form as the others.

11. From a due consideration of what has been shewn relating to the changes that take place in the magnitude of a variable function, corresponding to the change that takes place in the magnitude of the variable quantity from which the function is formed, we may conclude the truth of the following general proposition to be sufficiently established.

Direct Method.

*Let* x *denote a variable quantity, and* u *any function whatever of that quantity, let* x *be supposed to receive any increment* h, *and thus to become* x+h, *and let* u' *be the new value which the function acquires by the change in the value of* x; *then, the new value of* u *may in every case be expressed thus:*

$$u'=u+p\,h+q\,h^2+r\,h^3+\&c.$$

*where* p, q, r, &c. *denote quantities that are quite independent of* h, *and consequently can only involve the variable quantity* x, *and given quantities.*

12. Having examined what is the general form that any function of a variable quantity acquires by a change in the value of that quantity, and found it to be a series, the first term of which is always the function itself, it is evident that the remaining terms will express the increment that the function receives, in consequence of the change in the magnitude of the variable quantity from which the function is formed. Let us now compare the simultaneous increments of a variable quantity and its function with each other, and that we may at first avoid general reasoning, and fix the mind more completely, let us suppose the functions to have a determinate form, as $x^2$, $x^3$, $x^4$, &c.

Putting $u$ and $u'$ as before to denote the two succeeding values of the function, first let it be supposed that $u=x^2$, then $x$ being supposed to receive the indefinite increment $h$, and thus to become $x+h$, and $u$ to change its value to $u'=(x+h^2)$, we have

$$u'=x^2+2\,x\,h+h^2,$$
$$\text{or, } u'=u+2\,x\,h+h^2,$$

and consequently

$$u'-u=2\,x\,h+h^2.$$

Thus it appears, that the simultaneous increments of $x$ and $x^2$ (or $u$) are $h$ and $2\,x\,h+h^2$, respectively. Let us now compare these increments, not in respect of their absolute magnitudes, but in respect of their ratio to each other, thus we shall have the increment of $u$ to the increment of $x$, as $2\,x\,h+h^2$ to $h$, that is, (dividing the two last terms of the proportion by $h$) as $2\,x+h$ to 1. Or, instead of employing an analogy, let us, for the sake of brevity, and in conformity to the algebraic notation, rather express each of these ratios by the quotient arising from the division of the antecedents of the ratio by its consequents, and put the results equal to each other. Then, observing that the symbol $u'-u$, which expresses the difference between the succeeding values of the function, may be employed to denote its increment, we have

$$\frac{u'-u}{h}=\frac{2\,x\,h+h^2}{h}=2x+h.$$

Hence it appears that the expression for the ratio of the increment of the function $u$ to the increment of the variable quantity $x$ is made up of two parts, one of these, viz. $2\,a\,x$, is quite independent of $h$, the increment of $x$, and the other is in the present case that increment itself. In consequence of this peculiarity in the form

form of the expression for the ratio, it is evident that if the increment $h$ be conceived to be continually diminished, the part of the expression which consists of $h$ will continually diminish, so that the whole expression, viz. $2x+h$, may become more nearly equal to its first term $2x$ than by any assignable difference; therefore, $2x$ may be considered as the *limit* of the ratio $\frac{u'-u}{h}$, that is, a quantity to which the ratio may approach nearer than by any assignable difference, but to which it cannot be considered as becoming absolutely equal.

Let us next suppose that $u=x^3$, then $x$ being supposed to become $x+h$, we have $u'=(x+h)^3, =x^3+3x^2h+3xh^2+h^3$, or

$$u'=u+3x^2h+3xh^2+h^3,$$

and consequently

$$u'-u=3x^2h+3xh^2+h^3,$$

$$\text{and } \frac{u'-u}{h}=3x^2+3xh+h^2.$$

Here it is evident, as in the former case, that the expression for the ratio $\frac{u'-u}{h}$ is composed of two parts, one of these, viz. the first term $3x^2$, is a function of $x$ that is independent of the increment $h$, but the other, viz. $3xh+h^2$, or $h(3x+h)$, is the product of two factors, one of which is the increment itself. From the particular form of this latter part of the expression for the ratio, it is plain, that $h$ being supposed to be continually diminished, that part will also diminish, and may become less than any assignable quantity. Therefore in this case, as well as in the former, the ratio $\frac{u'-u}{h}$ has a *limit*, and that limit is the first term of the general expression for the ratio, namely the quantity $3x^2$.

Suppose, next, that $u=x^4$, and consequently

$$u'=(x+h)^4=x^4+4x^3h+6x^2h^2+4xh^3+h^4,$$

or,

$$u'=u+4x^3h+6x^2h^2+4xh^3+h^4,$$

$$\text{and } \frac{u'-u}{h}=4x^3+h\,(6x^2+4xh+h^2).$$

Here, as in the two former cases, we have only to inspect the general expression for the ratio $\frac{u'-u}{h}$ to discover, that by supposing $h$ to be continually diminished, the latter part of the expression, viz. $h(6x^2+4xh+h^2)$, and which comprises all the terms except the first, will become smaller than any assignable quantity; and consequently, that the first term $4x^3$ is the limit of the ratio.

13. It is easy to see that the property which we have found to belong to the ratio of the simultaneous increments of a variable quantity, and its function in these three particular cases, is an immediate consequence of the form of the expression for the increment of the function, so that it is not peculiar to the functions $x^2$, $x^3$, and $x^4$, but belongs equally to all functions whatever.

For we have found, § 11, that $u$ being supposed to denote any function of a variable quantity, as for example, $ax^n$, or $ax^m+bx^n+$ &c. or

$$\frac{ax^m+bx^n+\&c.}{a'x^{m'}+b'x^{n'}+\&c.}$$

and $u'$ being put for the new value which the function acquires when $x$ becomes $x+h$,

$$u'=u+ph+qh^2+rh^3+\&c.$$

where $p$, $q$, $r$, &c. denote functions of $x$ that are independent of $h$, therefore,

$$u'-u=ph+qh^2+rh^3+\&c.$$

and

$$\frac{u'-u}{h}=p+qh+rh^3+\&c.$$

or,

$$\frac{u'-u}{h}=p+h\,(q+rh+\&c.)$$

Thus it appears, that whatever be the form of the function, the ratio $\frac{u'-u}{h}$ is always expressed by a quantity which may be resolved into two parts; one of these, viz. $p$, is independent of the increment $h$, and the other, viz. $h(q+rh+\&c.)$, is the product of $h$ by a series, the first term of which is a function of $x$, and the remaining terms also functions of $x$ multiplied by the first, second, third, and higher powers of $h$. Now from the particular form of this last part of the general expression for the ratio, it is manifest, that $h$ being conceived to be continually diminished, the quantity $h\,(q+rh+$ &c. will also be continually diminished, and may become less than any assignable quantity; therefore, the limit of the ratio $\frac{u'-u}{h}$ is simply $p$, that is, the function of $x$, which is the coefficient of the first or simple power of $h$ in the general expression for the increment.

14. From what has been just shewn, we may infer the truth of the following general proposition relative to the simultaneous changes that take place in a variable quantity and its function.

*Let* x *denote a variable quantity and* u *any function of that quantity, let* x *be conceived to change its value and become* x+h, *where* h *denotes an arbitrary increment, and let* u' *denote the new value that the function acquires, in consequence of the change in the magnitude of* x. *Then, observing that* h *and* u'−u *are the simultaneous increments of the variable quantity and its function, if* h *be conceived to be continually diminished, the ratio* $\frac{u'-u}{h}$ *will continually approach to a certain Limit, which will be different for different functions, but always the same for the same function, and in every case quite independent of the magnitude of the increments.*

The ratio which is the *limit* of the ratio of the increments, when these increments are conceived to be continually diminished, may be called the *limiting ratio* of the increments.

15. The analytical fact contained in the preceding proposition, affords the foundation for a mathematical theory of great extent, and which may be divided into

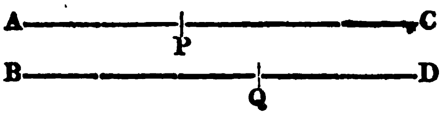
into two distinct branches; one having for its object the resolution of the following problem. *Having given the relation of any number of variable quantities to each other, to determine the limiting ratios of their increments;* and the other the converse of that problem, namely, *Having given the limiting ratios, to determine the relations of the quantities themselves.*

The theory to which we have alluded constitutes the METHOD of FLUXIONS, and in explaining the foundation of the method, we have endeavoured to show, that it rests upon a principle purely analytical, namely, the theory of limiting ratios; and this being the case, the subject may be treated as a branch of pure mathematics, without having occasion to introduce any ideas foreign to geometry.

16. Sir Isaac Newton, however, in first delivering the principles of the method, thought proper to employ considerations drawn from the theory of motion. But he appears to have done this chiefly for the purpose of illustration, for he immediately has recourse to the theory of limiting ratios; and it has been the opinion of several mathematicians of great eminence (A) that the consideration of motion was introduced into the method of fluxions at first without necessity, and that succeeding writers on the subject ought to have established the theory upon principles purely mathematical, independent of the ideas of time and velocity, both of which seem foreign to investigations relating to abstract quantity.

17. That we may conform to the usual method of treating this subject, we proceed to show how the theory of motion is commonly applied to the illustration of the nature of variable quantities, and of the relations that result from their being conceived to change their value.

As quantities of every kind, if we abstract from their position, figure, and such affections, and consider their magnitude only, may be represented by lines, we may consider a variable quantity $x$, and $u$ any function of that quantity, to be represented by two lines AP, BQ, which have A, B, one extremity of each given, and which vary by the points P, Q, their other extremities, moving in the directions AC, BD, while the equation expressing the relation between $x$ and $u$, or their representative lines AP, BQ, remains always the same.



18. The lines AP, BQ being thus conceived to vary, the relation that is supposed always to subsist between them, in respect of their magnitudes, will necessarily give rise to another relation, namely, that which will constantly subsist between the velocities of the moving points P and Q, by which the lines are generated.

With a reference to this particular mode of conceiving variable quantities to exist, the quantities themselves have been called *flowing quantities* or *fluents*, and the measures of the velocities with which the variable quantities increase have been called their *fluxions*.

Direct Method.

19. To simplify the hypothesis, we may suppose that the point which generates the line AP, or $x$, moves uniformly; thus the measure of its velocity, or the fluxion of $x$, will be a given quantity, with which the measure of the velocity of the point Q, or the fluxion of $u$, may be continually compared. To determine then the fluxions, or rather the ratio of the fluxions of $x$ a variable quantity, and $u$, any function of that quantity, is in effect to resolve the following problem.

*Having given an equation expressing the relation at every instant between the spaces passed over by two points, one of which moves with an uniform velocity: It is required to find an expression for the ratio that the measures of the velocities have at every instant to each other.*

20. Now it is a fundamental principle in the theory of motion, resulting indeed from the very nature of a variable velocity, that when two velocities are compared together, whether they be both variable, or one of them uniform, and the other variable, *the measures of their velocities are any quantities having to each other the ratio that is the limit of the ratio of the spaces described in the same time, when those spaces are conceived to be continually diminished.* And hence it follows that the ratio of the fluxions of two variable quantities is no other than the limiting ratio of their simultaneous increments.

That the theory of motion may be applied to the generation of variable algebraic quantities, we have supposed them to be represented by lines; this, however, is not necessary, if the variable quantities are themselves geometrical magnitudes; for like as a line is conceived to be generated by the motion of a point, so a surface may be considered as generated by the motion of a line, a solid by the motion of a surface, and an angle by the rotation of one of the lines which contain it; and the fluxions of those quantities at any instant, or position, will be the measures of the velocities, or degrees of swiftness, according to which they increase at that instant or position.

But in every case the ratio of the rates of increase, or fluxions of two homogeneous magnitudes, will be the limiting ratio of their simultaneous increments.

21. Having thus found that by conceiving variable quantities as generated by motion, and taking their velocities, or rates of increase, as an object for the mind to contemplate and reason on, we are in the end led to the consideration of the limiting ratios of their increments, a subject which is purely mathematical, and independent of the ideas of time or velocity, we shall exchange the definition of a fluxion given in § 18, which involves those ideas, for another that rests entirely upon the existence of limiting ratios.

By the fluxions then of two variable quantities having any assigned relation to each other, we are in the following treatise always to be understood to mean *any indefinite*

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(A) Such as *Lagrange*, *Cousin*, *La Croix*, &c. abroad, and *Landen* in this country.

*indefinite quantities which have to each other the limiting ratio of their simultaneous increments.*

In conformity to this definition of fluxions, it is evident that we are to consider them, not as absolute, but as relative quantities, which derive their origin from the comparison of variable quantities with each other in respect of their simultaneous variations of magnitude.

22. Sir Isaac Newton employed different symbols at different times to denote the fluxions of variable quantities. It is now however common in Britain to denote them by the same letters employed to express the quantities themselves, and each having a dot over it. Thus $\dot{x}$ denotes the fluxion of the variable quantity expressed by $x$, and in the like manner $\dot{u}$, $\dot{v}$, $\dot{z}$, denote the fluxions of the variable quantities $u$, $v$, $z$, respectively.

23. Suppose now that $u$ is any function of a variable quantity $x$, and that the limiting ratio of the simultaneous increments of $u$ and $x$ is the ratio of $p$ to 1, where $p$ denotes some other function of $x$; then, from the definition just given of fluxions, we have

$$\frac{\dot{u}}{\dot{x}}=p, \text{ and } \dot{u}=p\dot{x}.$$

Hence it follows as a consequence of the preceding definition, that the fluxion of $u$, any function of a variable quantity $x$, is *the product arising from the multiplication of that function of $x$ which is the expression for the limiting ratio of the increments by the fluxion of the variable quantity $x$ itself.*

## SECT. II. *Investigation of the Rules of the Direct Method of Fluxions.*

24. THE method of fluxions naturally resolves itself into two parts, as we have already observed, § 15. We proceed to explain the first of these, which is called the *Direct Method*, and which treats of finding the ratio of the fluxions of variable quantities, having given the relations of those quantities to each other.

25. We shall begin with investigating the ratio of the fluxions of two variable quantities in that particular case, when one of them is any power of the other.

Let us suppose then, that $u$ is such a function of a variable quantity $x$, that $u=x^n$, where $n$ denotes any number whatever, it is required to determine the ratio of the fluxions of $u$ and $x$.

If we recur to the definition which has been given of the fluxions of variable quantities in § 21, it will appear that we have in effect resolved the problem just proposed in three particular cases, when treating of the limiting ratios of the increments of variable quantities. For it has been shown in § 12. that when $u=x^2$, and $x$ is supposed to change its value, so as to become $x+h$, where $h$ denotes an indefinite increment, and in consequence of this change in the magnitude of $x$, $u$ also changes its value, and becomes $u'$, then, observing that $u'-u$ and $h$ are the simultaneous increments of $u$ and $x$, the limiting ratio of $\frac{u'-u}{h}$ is $2x$. Let this expression for the limiting ratio be put equal to the ratio of the fluxions of $u$ and $x$, that is to $\frac{\dot{u}}{\dot{x}}$, thus we have $\frac{\dot{u}}{\dot{x}}=2x$, and $\dot{u}=2x\dot{x}$. Hence it appears, that whatever be the magnitude of the quantity that expresses the fluxion of $x$, the fluxion of $u$ or $x^2$ will be expressed by the fluxion of $x$ multiplied by $2x$.

Again, when $u=x^3$, and $u'$, $u'-u$ and $h$ denote the same as before, it has been shown, § 12, that the limiting ratio of $\frac{u'-u}{h}$ is $3x^2$, therefore, § 21, $\frac{\dot{u}}{\dot{x}}=3x^2$, and $\dot{u}=3x^2\dot{x}$; that is, the fluxion of $x^3$ is expressed by the fluxion of $x$ multiplied by $3x^2$.

And when $u=x^4$, it has been shown, § 12, that the limiting ratio of $\frac{u'-u}{h}$ is $4x^3$. Therefore, § 21, $\frac{\dot{u}}{\dot{x}}=4x^3$ and $\dot{u}=4x^3\dot{x}$.

To resolve the problem generally, or when $u=x^n$; let us suppose $x$ to become $x+h$, and $u$ to become $u'$, then $u'=(x+h)^n$. But this last quantity, when expanded into a series by the binomial theorem (ALGEBRA, SECT. XVII.) is

$$x^n+p\,h+q\,h^2+r\,h^3+ \text{ \&c.}$$
$$\text{or } u+p\,h+h^2\,(q+r\,h+ \text{ \&c.})$$

where $p$, $q$, $r$, &c. denote functions of $x$, independent of $h$. Therefore,

$$u'-u=p\,h+h^2\,(q+r\,h+ \text{ \&c.}),$$

$$\text{and } \frac{u'-u}{h}=p+h\,(q+r\,h+ \text{ \&c.}).$$

Therefore, supposing $h$ to be continually diminished, the limit of $\frac{u'-u}{h}$ is $p$; but, whatever be the nature of the exponent $n$, $p$ is always $nx^{n-1}$, (ALGEBRA, § 267.), therefore, the limit of $\frac{u'-u}{h}$ is $n\,x^{n-1}$, and consequently $\frac{\dot{u}}{\dot{x}}=nx^{n-1}$, and $\dot{u}=nx^{n-1}\dot{x}$.

26. As we shall have frequently occasion to employ the result of this investigation, it will be proper to express it in the form of a practical rule, thus.

*To find the fluxion of any power of a variable quantity. Multiply the fluxion of the variable quantity itself by the exponent of the power, and by a power of the quantity whose exponent is less by unity than the given exponent, and the product will be the fluxion required.*

27.

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(B) We are here to be understood to mean the ratio of the *numerical* values of the increments, which may always be compared with each other, whether the variable quantities be of the same kind, as both lines, or both surfaces, &c. or of different kinds, as the one a line, and the other a surface.

Direct Method.

27. In determining the limit of the ratio of the simultaneous increments of $x$ and $x^n$, we have referred to the binomial theorem; but the only application we have had occasion to make of that theorem was to determine the numeral coefficient of the second term of the developement of $(x+h)^n$, when $n$ is supposed to be any number whatever, which is an inquiry of a more simple nature than the general investigation of the theorem. We shall now show how that coefficient may be deduced from the first principles of algebra. Thus the investigation of the fluxion of $x^n$ will be rendered independent of the general demonstration of the binomial theorem; and we shall hereafter show that the theorem itself is easily investigated by the direct method of fluxions.

28. Since $x+h$ is equal to $x\left(1+\frac{h}{x}\right)$ it follows that $(x+h)^n=x^n\left(1+\frac{h}{x}\right)^n$, thus the developement of $(x+h)^n$ is reduced to that of $\left(1+\frac{h}{x}\right)^n$, or putting $\frac{h}{x}=v$, to $(1+v)^n$. Now if we give particular values to $n$, and suppose it to be 1, 2, 3, &c. or —1, —2, &c. or lastly $\frac{1}{2}$, $\frac{1}{3}$, &c. we can find the series that express the powers of $1+v$, whose exponents are those numbers, by the operations of multiplication, division, and evolution, and in every particular case we shall find, that the powers of $1+v$ are expressed by a series of this form,

$$1+Av+Bv^2+Cv^3+Dv^4+\&c.$$

Where A, B, C, D, &c. denote numeral coefficients which depend for their value only on $n$ the exponent of the power, and not on the quantity $v$; and as the form of the series will be found to be the same whatever particular values we may give to the exponent, we may conclude that it is the same, whether the exponent be positive or negative, whole or fractional.

29. First let us suppose that the exponent is a whole positive number, then, because

$$(1+v)^n=1+Av+Bv^2+\&c.$$

if we multiply both sides of this equation by $1+v$, and collect together the like powers of $v$, it will appear that

$$(1+v)^{n+1}=1\left.\begin{matrix}+A\\+1\end{matrix}\right\}v\left.\begin{matrix}+B\\+A\end{matrix}\right\}v^2+\&c.$$

Hence it appears that the coefficient of the second term of any power of $1+v$ exceeds that of the next less power by unity. Now in the case of the first power of $1+v$, the coefficient of the second term is obviously 1, therefore, in the second power it is 2, in the third power 3, and universally, in the $n$th power it is $n$; so that $n$ being a whole positive number,

$$(1+v)^n=1+nv+\&c.$$

30. Let us next suppose the exponent to be a fraction denoted by $\frac{m}{n}$, so that

$$(1+v)^{\frac{m}{n}}=1+Av^2+Bv^2+\&c.$$

Let both sides of this equation be raised to the power $n$, having first substituted $Mv$ for $Av+Bv^2+\&c.$ then

$$(1+v)^m=(1+Mv)^n.$$

Now as we have just found that $m$ and $n$ being integers,

$$(1+v)^m=1+mv+\&c.$$
$$\text{and }(1+Mv)^n=1+nMv+\&c.$$

Here we stop at the second term, that being the only one whose coefficient is required. Substitute now for $Mv$ its value $Av+\&c.$ then, stopping again at the second term, we get

$$(1+Mv)^n=1+nAv+\&c.$$

therefore,

$$1+mv+\&c.=1+nAv+\&c.$$

and making the coefficients of $v$ in each series equal to each other,

$$nA=m,\text{ and }A=\frac{m}{n}.$$

31. In the last place, let us suppose that the exponent is a negative quantity either whole or fractional, so that

$$(1+v)^{-\frac{m}{n}}=1+A'v+B'v^2+\&c.$$
$$\text{or }\frac{1}{(1+v)^{\frac{m}{n}}}=1+A'v+B'v^2+\&c.$$

then, multiplying both sides by $(1+v)^{\frac{m}{n}}$ we get

$$1=(1+v)^{\frac{m}{n}}(1+A'v+B'v^2+\&c.)$$

or, substituting $1+Av+Bv^2+\&c.$ for $(1+v)^{\frac{m}{n}}$ and actually multiplying the two series,

$$1=1\left.\begin{matrix}+A\\+A'\end{matrix}\right\}v\left.\begin{matrix}+B\\+AA'\\+B'\end{matrix}\right\}v^2+\&c.$$

Now that this equation may subsist, whatever be the value of $v$, it is necessary that

$$A+A'=0,$$
$$B+AA'+B'=0,$$
&c.

and by these equations we may determine A′, B′, C′, &c. It is, however, only required at present to find the first of these, viz. A′, now we have $A'=-A$; but A being the coefficient of the second term of the series expressing $(1+v)^{\frac{m}{n}}$, the exponent of which is positive, we have already found it to be $\frac{m}{n}$, therefore, $A'=-\frac{m}{n}$.

32. As we have found that the coefficients of the second term of the developements of $(1+v)^n$, $(1+v)^{\frac{m}{n}}$ and $(1+v)^{-\frac{m}{n}}$ are $m$, $\frac{m}{n}$, and $-\frac{m}{n}$, respectively, it appears that whatever be the number denoted by $n$, the two first terms of the series expressing $(1+v)^n$ are, $1+nv$, and therefore, substituting for $v$ its value $\frac{h}{x}$, and multiplying by $x^n$, the two first terms of the series expressing $(x+h)^n$ are $x^n+nx^{n-1}h$, agreeing with what we

have assumed in § 25. as given by the binomial theorem (c).

33. The mode of reasoning employed to determine the ratio of the fluxions of $u$ and $x$, when the former is a function of the latter of the form $x^n$, will apply equally when the function has any other assigned form. But instead of investigating in this manner the fluxion of every particular function, it is better to consider a complex function as the sum, or difference, or product or quotient, &c. of other simple functions, and to investigate rules for each of these cases, supposing that the fluxions of the simple functions are previously known.

34. Let us first suppose that $u$, a function of a variable quantity $x$, is equal to the sum of $v$ and $w$, two other functions of $x$. It is required to find the fluxion of $u$, having given the fluxions of $v$ and $w$.

Let $x$ be conceived to change its value, and to become $x+h$, then, as $v$ and $w$ will also change their values, § 11, the one to

$$v'=v+ph+qh^2+rh^3+\text{\&c.}$$

and the other to

$$w'=w+p'h+q'h^2+r'h^3+\text{\&c.}$$

if $u'$ as usual denote the corresponding new value of $u$, we have

$$u=v+w$$
$$u'=\begin{cases} v+ph+qh^2+\text{\&c.} \\ +w+p'h+q'h^2+\text{\&c.} \end{cases}$$
$$u'-u=(p+p')h+(q+q')h^2+\text{\&c.}$$
$$\frac{u'-u}{h}=p+p'+(q+q')h+\text{\&c.}$$

If we now conceive $h$ to be continually diminished, we shall have the limit of $\frac{u'-u}{h}$ expressed by $p+p'$. But $p$ is the limit of $\frac{v'-v}{h}$, § 14, and in like manner $p'$ is the limit of $\frac{w'-w}{h}$, therefore,

$$\text{limit of } \frac{u'-u}{h}=\text{limit of } \frac{v'-v}{h}+\text{limit of } \frac{w'-w}{h}.$$

Substitute now the ratio of the fluxions instead of the limited ratios, and we have

$$\frac{\dot{u}}{\dot{x}}=\frac{\dot{v}}{\dot{x}}+\frac{\dot{w}}{\dot{x}};$$

$$\text{therefore,} \quad \dot{u}=\dot{v}+\dot{w}.$$

35. If we suppose $s$ to be a function of $x$, and $u$, $v$, $w$, &c. other functions of $x$, such that

$$s=au+bv+cw+\text{\&c.}$$

where $a$, $b$, $c$, denote any given numbers, positive or negative, then, by reasoning as above, it is evident that

$$\dot{s}=a\dot{u}+b\dot{v}+c\dot{w}+\text{\&c.}$$

*Therefore, to find the fluxion of the sum of any number of functions, each multiplied by a constant quantity. Multiply the fluxion of each function by its constant coefficient, and the sum of the products is the fluxion required.*

36. If $c$ denote a constant quantity, and $u$, $v$, be functions of $x$, such, that $u=c+v$; then $x$ being supposed to become $x+h$, and consequently $v$ to become $v'$, or $v+ph+qh^2+$ &c. and $c+v$ to become $c+v+ph+qh^2+$ &c. we have

$$u=c+v,$$
$$\text{and } u'=c+v+ph+qh^2+\text{\&c.}$$
$$\text{and hence } u'-u=ph+qh^2+\text{\&c.}$$
$$\text{or } u'-u=v'-v,$$
$$\text{therefore, } \frac{u'-u}{h}=\frac{v'-v}{h},$$

and these ratios being always equal, their limits must also be equal; therefore, substituting for the limiting ratios these of the fluxions, we have $\frac{\dot{u}}{\dot{x}}=\frac{\dot{v}}{\dot{x}}$ and $\dot{u}=\dot{v}$; that is to say, the fluxion of $c+v$ is $\dot{v}$, from which it appears, *That the fluxion of any variable function is the very same as the fluxion of the same function, increased or diminished by any constant quantity.* This is a remark of great importance in the theory of fluxions, as will appear hereafter.

37. Let us now suppose that $u$, $v$, $w$, are functions of $x$, such, that $u=vw$, it is required to find the fluxion of $u$, supposing the fluxions of $v$ and $w$ to be given.

By supposing that $x$, $u$, $v$, and $w$, change their values as usual, we have

$$u=vw$$
$$u'=(v+ph+qh^2+\text{\&c.})\,(w+p'h+q'h^2+\text{\&c.})$$

and this last expression by multiplication becomes

$$u'=\left.\begin{matrix} vw+vp'h+vq'h^2 \\ +wph+wqh^2 \end{matrix}\right\}+\text{\&c.}$$

therefore

$$u'-u=(vp'+wp)h+(vq'+pp'+wq)h^2+\text{\&c.}$$

dividing now by $h$, and taking the limit of $\frac{u'-u}{h}$, we have that limit expressed by $vp'+wp$; but $p'$ is the limit of $\frac{w'-w}{h}$ § 14, and in like manner $p$ is the limit of $\frac{v'-v}{h}$; therefore

the

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(c) In this investigation we have supposed $n$ to be a rational number. If, however, it were irrational, still the result would be the same; for, corresponding to every such number, two rational numbers, one greater, and the other less than it, may be found, which shall differ from each other by less than any assignable quantity. Therefore, the general properties of these numbers must belong also to the irrational number which is their limit.

$$\text{the limit of } \frac{u'-u}{h} = \begin{cases} v \times \text{ limit of } \frac{w'-w}{h} \\ +w \times \text{ limit of } \frac{v'-v}{h}; \end{cases}$$

Hence, by substituting for the limiting ratios the ratios of the fluxions, we have

$$\frac{\dot u}{\dot x} = \frac{v\dot w}{\dot x} + \frac{w\dot v}{\dot x} \text{ and } \dot u = v\dot w + w\dot v.$$

*Therefore, to find the fluxion of the product of any two functions, multiply the fluxion of each function by the other function, and the sum of these products is the fluxion required.*

38. We have just now seen that when

$$u = v\,w$$

$$\text{then } \dot u = w\dot v + v\dot w.$$

Let each side of the latter equation be divided by the corresponding side of the former, thus we get

$$\frac{\dot u}{u} = \frac{\dot v}{v} + \frac{v\dot w}{w};$$

suppose now that the function $w$ is the product of two other functions $s$, $t$, so that

$$u = v\,s\,t,$$

then, because $w = s\,t$, from what has been shewn it follows that $\frac{\dot w}{w} = \frac{\dot s}{s} + \frac{\dot t}{t}$; therefore, substituting this value of $\frac{\dot w}{w}$ in the equation $\frac{\dot u}{u} = \frac{\dot v}{v} + \frac{\dot w}{w}$, it becomes

$$\frac{\dot u}{u} = \frac{\dot v}{v} + \frac{\dot s}{s} + \frac{\dot t}{t}.$$

In general, if we suppose that

$$u = v\,s\,t\,r \text{ \&c.}$$

by reasoning as above it will be found that

$$\frac{\dot u}{u} = \frac{\dot v}{v} + \frac{\dot s}{s} + \frac{\dot t}{t} + \frac{\dot r}{r} + \text{\&c.}$$

whatever be the number of factors.

Suppose the number of factors to be three, so that

$$u = v\,s\,t$$

$$\text{and } \frac{\dot u}{u} = \frac{\dot v}{v} + \frac{\dot s}{s} + \frac{\dot t}{t};$$

then substituting $v\,s\,t$ for $u$ in this last equation, and taking away the denominators, we find

$$\dot u = s\,t\,\dot v + v\,t\,\dot s + v\,s\,\dot t.$$

And as a similar result will be found, whatever be the number of factors, we may conclude that *The fluxion of the product of any number of functions is equal to the sum of the products of the fluxion of each function by all the other functions.*

39. Let us in the last place suppose that $u = \frac{v}{w}$, and that it is required to find the fluxion of $u$, having given the fluxions of $v$ and $w$.

From the given equation we have $v = w\,u$, and therefore (§ 37.) $\dot v = w\dot u + u\dot w$, let $\frac{v}{u}$ be substituted for $u$ in this equation, and it becomes $\dot v = w\dot u + \frac{v\dot w}{w}$, from which we easily obtain

$$\dot u = \frac{w\dot v - v\dot w}{w^2}.$$

Hence we have the following rule for finding the fluxion of a fraction.

*Multiply the fluxion of the numerator by the denominator, and from the product subtract the fluxion of the denominator multiplied by the numerator, and divide the remainder by the square of the denominator; the result is the fluxion required.*

40. It will now be proper to shew the application of these general rules for determining the fluxions of variable functions to some particular examples.

Example 1. Suppose $u = a + b\sqrt{x} - \frac{c}{x}$. Required the fluxion of $u$.

Here $a$ being a constant quantity, the fluxion of $a + b\sqrt{x} - \frac{c}{x}$ is the same as the fluxion of $b\sqrt{x} - \frac{c}{x}$, § 36, or $b x^{\frac{1}{2}} - c x^{-1}$. Now, by § 26, the fluxion of $x^{\frac{1}{2}}$ is $\frac{1}{2} x^{\frac{1}{2}-1}\dot x$, which expression is equivalent to $\frac{1}{2} x^{-\frac{1}{2}}\dot x$, or to $\frac{\dot x}{2\sqrt{x}}$, and in like manner the fluxion of $x^{-1}$ is $-x^{-1-1}\dot x$, or $-x^{-2}\dot x$, or $\frac{-\dot x}{x^2}$, therefore, multiplying the fluxion of $x^{\frac{1}{2}}$ by $b$, and the fluxion of $x^{-1}$ by $c$, and taking the sum of the products, agreeably to the rule in § 35. we have

$$\dot u = \frac{b\dot x}{2\sqrt{x}} + \frac{c\dot x}{x^2}$$

$$\text{or } \dot u = \left(\frac{b}{2\sqrt{x}} + \frac{c}{x^2}\right)\dot x.$$

Ex. 2. Suppose $u = a + \frac{b}{\sqrt[3]{x^2}} - \frac{c}{x^2\sqrt{x}} + \frac{d}{x^2}$.

By writing the function thus

$$u = a + b x^{-\frac{2}{3}} - c x^{-\frac{4}{3}} + d x^{-2}$$

the application of the same rules employed in the last example gives us

$$\dot u = -\tfrac{2}{3} b x^{-\frac{5}{3}}\dot x + \tfrac{4}{3} c x^{-\frac{7}{3}}\dot x - 2 d x^{-3}\dot x$$

or, exchanging the fractional indices for the radical sign, and otherwise reducing,

$$\dot u = \frac{-2b\dot x}{2x^3\sqrt{x^2}} + \frac{4c\dot x}{3x^{2}\sqrt[3]{x}} - \frac{2d\dot x}{x^3}$$

Ex. 3.

Ex. 3. Suppose $u=(a+bx^m)^n$.

In order to find the fluxion of this function by the rules already laid down, it will be necessary to consider it first as a function of a variable quantity that is itself a function of $x$. Let us then put $a+bx^m$ equal to $v$, and thus the proposed equation becomes $u=v^n$; then, $u$ being considered as a function of $v$, we have by § 26. $\dot{u}=nv^{n-1}\dot{v}$. Again, $v$ being considered as a function of $x$, from the equation $v=a+bx^m$, we find by § 36. and § 26. $\dot{v}=mbx^{m-1}\dot{x}$. Let this value of $\dot{v}$ be substituted in the expression for $\dot{u}$, and it becomes

$$\dot{u}=mnbv^{n-1}x^{m-1}\dot{x},$$

which, by substituting for $v$ its value $a+bx^m$, is also

$$\dot{u}=mnbx^{m-1}(a+bx^m)^{n-1}\dot{x}.$$

Ex. 4. Suppose $u=\sqrt{(a^2-x^2)}$.

Here we are to proceed as in the last example, and first put $a^2-x^2=v$, then $u=\sqrt{v}=v^{\frac{1}{2}}$; and therefore (§ 26) $\dot{u}=\frac{1}{2}v^{\frac{1}{2}-1}\dot{v}=\frac{\dot{v}}{2v^{\frac{1}{2}}}=\frac{\dot{v}}{2\sqrt{v}}$. Again, since $v=a^2-x^2$, by § 26. we find $\dot{v}=-2x\dot{x}$. Substitute this value of $\dot{v}$ in the expression for $\dot{u}$, and we have

$$\dot{u}=-\frac{2x\dot{x}}{2\sqrt{v}};$$

which, by restoring $\sqrt{(a^2-x^2)}$ for $v$, and leaving out the number common to the numerator and denominator, becomes

$$\dot{u}=\frac{-x\dot{x}}{\sqrt{(a^2-x^2)}}.$$

Ex. 5. Suppose $u=\sqrt{(a+bx+cx^2)}$.

By proceeding in the same manner as in last example, we find

$$\dot{u}=\frac{(b+2cx)\dot{x}}{\sqrt{(a+bx+cx^2)}}.$$

Ex. Suppose $u=x(a^2+x^2)\sqrt{(a^2-x^2)}$.

Here the proposed function is the product of these three functions, viz. $x$, $a^2+x^2$, and $\sqrt{(a^2-x^2)}$. Therefore, its fluxion will be found by proceeding according to the rule in § 38.

Now the fluxion of $x$ is $\dot{x}$, and the fluxion of $a^2+x^2$ is $2x\dot{x}$, and the fluxion of $\sqrt{(a^2-x^2)}$ has been found in last example to be $\frac{-x\dot{x}}{\sqrt{(a^2-x^2)}}$. Therefore, multiplying the fluxion of each function by the product of the other two functions, and taking the sum of all these products, we find

$$\dot{u}=\left\{\begin{array}{l}(a^2+x^2)\sqrt{a^2-x^2}\,\dot{x}\\+2x^2\sqrt{a^2-x^2}\,\dot{x}\\-\dfrac{x^2(a^2+x^2)\dot{x}}{\sqrt{(a^2-x^2)}}\end{array}\right.$$

and this equation, by reducing all the terms on the latter side of it to a common denominator, is more simply expressed thus,

$$\dot{u}=\frac{(a^4+a^2x^2-4x^4)\dot{x}}{\sqrt{(a^2-x^2)}}.$$

Ex. 7. Suppose $u=\frac{a+x}{a^2+x^2}$.

Here we employ the rule given in § 39. for finding the fluxion of a fractional function; thus we find

$$\dot{u}=\frac{(a^2+x^2)\dot{x}-2x(a+x)\dot{x}}{(a^2+x^2)^2},$$

which when reduced, is

$$\dot{u}=\frac{(a^2-2ax-x^2)\dot{x}}{(a^2+x^2)}.$$

Ex. 8. Suppose

$$u=\sqrt{\left\{(a-\frac{b}{\sqrt{x}}+\sqrt[3]{(c^2-x^2)^2})^3\right\}}$$

To simplify this expression, we put

$$\frac{b}{\sqrt{x}}=y,\ \sqrt[3]{(c^2-x^2)^3}=z.$$

Thus we have

$$u=\sqrt{(a-y+z)^3}=(a-y+z)^{\frac{3}{2}}.$$

Now as the fluxion of $a-y+z$, is $-\dot{y}+\dot{z}$ (§ 35), we find from § 26. that by considering $a-y+z$ as a single variable quantity,

$$\begin{aligned}\dot{u}&=\tfrac{3}{2}(a-y+z)^{\frac{3}{2}-1}(-\dot{y}+\dot{z})\\&=\tfrac{3}{2}(a-y+z)^{\frac{1}{2}}(-\dot{y}+\dot{z})\\&=\tfrac{3}{2}\sqrt{a-y+z}\,(-\dot{y}+\dot{z})\end{aligned}$$

but, since $y=\frac{b}{\sqrt{x}}=bx^{-\frac{1}{2}}$, we have, § 26,

$$\dot{y}=-\tfrac{1}{2}bx^{-\frac{1}{2}-1}\dot{x}=-\frac{b\dot{x}}{2x\sqrt{x}};$$

and since $z=\sqrt[3]{(c^2-x^2)^2}=(c^2-x^2)^{\frac{2}{3}}$, by considering $c^2-x^2$ as a single variable quantity, and observing that its fluxion is $-2x\dot{x}$, we find by § 26, that

$$\dot{z}=\tfrac{2}{3}(c^2-x^2)^{\frac{2}{3}-1}\times-2x\dot{x}=\frac{-4x\dot{x}}{3\sqrt[3]{(c^2-x^2)}}.$$

Instead of $y$, $z$, $\dot{y}$, $\dot{z}$, substitute now their values in the expression for the fluxion of $u$, thus it becomes

$$\dot{u}=\tfrac{3}{2}\sqrt{(a-\frac{b}{\sqrt{x}}+\sqrt[3]{(c^2-x^2)^2})}\times\left(\frac{b\dot{x}}{2x\sqrt{x}}-\frac{4x\dot{x}}{3\sqrt[3]{(c^2-x^2)}}\right).$$

Ex. 9. Suppose $u=av^my^n$, where $v$ and $y$ denote any functions of a variable quantity.

Then, § 37,

$$\dot{u}=\left\{\begin{array}{l}ay^n\times\text{fluxion of }v^m\\+av^m\times\text{fluxion of }y^n\end{array}\right\}$$

But

But fluxion of $v^m = m v^{m-1}\dot{v}$, § 26,
and fluxion of $y^n = n y^{n-1}\dot{y}$;
therefore,

$$\dot{u} = a m y^n v^{m-1}\dot{v} + a n v^m y^{n-1}\dot{y},$$
$$= a v^{m-1} y^{n-1}(m y \dot{v} + n v \dot{y}).$$

Ex. 10. Suppose $u = \dfrac{v+z}{y^3}$, where $v$, $z$ and $y$ denote any function of a variable quantity. Then, because fluxion $(v+z) = \dot{v}+\dot{z}$, § 34, and fluxion $y^3 = 3y^2\dot{y}$, § 26, we have, § 39,

$$\dot{u} = \frac{y^3(\dot{v}+\dot{z}) - 3(v+z)y^2\dot{y}}{y^6},$$
$$= \frac{y(\dot{v}+\dot{z}) - 3(v+z)\dot{y}}{y^4}.$$

41. As when $u$ denotes that particular function of $x$ which is $x^n$, we have (§ 25.)

$$\frac{\dot{u}}{\dot{x}} = n x^{n-1};$$

so, in general, whatever be the form of the function denoted by $u$, we have always

$$\frac{\dot{u}}{\dot{x}} = p,$$

where $p$ denotes a new function of $x$, resulting from the analytical process employed to find the fluxion of the function $u$, and depending for its form upon the particular form of that function: just as in involution, or any of the other operations of algebra, a result is obtained depending upon the particular nature of the operation, and the quantities operated upon.

Let us put $p$ to denote the particular function $nx^{n-1}$, or the expression for $\dfrac{\dot{u}}{\dot{x}}$ the ratio of the fluxion of $u$ to the fluxion of $x$ when $u = x^n$, then, supposing that $n-1$ is not equal to 0, (for in that case $nx^{n-1}$ would be simply $n$, a given number,) we may reason concerning the ratio of the fluxions of the variable quantities $p$ and $x$, in all respects as concerning the ratio of the fluxions of $u$ and $x$; and accordingly, from the equation

$$p = n x^{n-1},$$

we get, by taking the fluxions,

$$\frac{\dot{p}}{\dot{x}} = n(n-1)x^{n-2},$$

or, considering $p$ as denoting generally the function of $x$ that results from the operation of finding the fluxion of the original function $u$, whatever be the form of that function, we have

$$\frac{\dot{p}}{\dot{x}} = q,$$

where $q$ denotes a new function of $x$, derived from $p$, the former function, by the same kind of operation as that by which $p$ was deduced from $u$.

Suppose now $q$ to denote the particular function $n(n-1)x^{n-2}$, then,

$$\frac{\dot{q}}{\dot{x}} = n(n-1)(n-2)x^{n-3},$$

$$\text{or } \frac{\dot{q}}{\dot{x}} = r,$$

where $r$ denotes a function of $x$ derived from $q$, as $q$ was derived from $p$, or $p$ from the original function $u$. And it is evident that we may proceed in this manner as far as we please, unless it happen that in finding the series of functions $p$, $q$, $r$, &c. we at last arrive at a result that is a constant quantity, and then the series of operations will terminate. Thus if the function was $ax^4$, we should have

$$u = ax^4$$
$$\frac{\dot{u}}{\dot{x}} = 4ax^3 = p,$$
$$\frac{\dot{p}}{\dot{x}} = 4.3ax^2 = q,$$
$$\frac{\dot{q}}{\dot{x}} = 4.3.2ax = r,$$
$$\frac{\dot{r}}{\dot{x}} = 4.3.2.1.a = 2.4a.$$

Here the expression for $\dfrac{\dot{r}}{\dot{x}}$ is a constant quantity, which has no fluxion.

Hence it appears, that relatively to any function of a variable quantity, there exists a series of limiting ratios, deducible from that function, and from each other, by a repetition of the operation of finding the fluxion of a variable function.

42. In treating of the fluxion of a function, we have hitherto regarded the fluxion of the variable quantity $x$, from which the function is formed, merely as one of the terms of a ratio, without considering whether it was a constant or a variable quantity.

Now as we may assume any hypothesis respecting the nature of the fluxion of $x$, that is not inconsistent with what has been already delivered, we shall suppose it to be constant. This assumption, if we consider the fluxions of variable quantities as the measures of their respective velocities, or rates of increase, is in effect the same thing as to suppose that the variable quantity $x$ increases uniformly. Then, as in the expressions

$$\frac{\dot{u}}{\dot{x}} = p,\ \frac{\dot{p}}{\dot{x}} = q,\ \frac{\dot{q}}{\dot{x}} = r, \text{ \&c.}$$

or these others, which follow from them,

$$\dot{u} = p\dot{x},\ \dot{p} = q\dot{x},\ \dot{q} = r\dot{x}, \text{ \&c.}$$

the symbol $\dot{x}$ is to be understood as denoting a constant quantity, it follows that if $p$ be variable, then $p\dot{x}$, or $\dot{u}$ will be variable; and if $q$ be variable, then $q\dot{x}$, or $\dot{p}$, will

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$\dot p$ will be variable; and if $r$ be variable, then $r\dot x$, or $\dot q$ will be variable, and so on.

43. Let us now recur to the relation in which the succeeding functions $p$, $q$, $r$, &c. stand to the original function $u$.

By performing that particular analytical operation upon the function $u$, which consists in finding its fluxion, we obtain $p\dot x$ as the expression for its fluxion, that is, we get $\dot u = p\dot x$; and by repeating the operation on the function $p$, we get $\dot p = q\dot x$; and therefore $\dot p\dot x = q\dot x^2$; but, $\dot x$ being regarded as a constant quantity, $\dot p\dot x$ is deduced from $p\dot x$, considered as a function of $x$, just in the same manner as $p\dot x$ is derived from the original function $u$; therefore the expression $q\dot x^2$ is deduced from the function $u$ by performing the operation of taking the fluxion twice; that is, first upon the function $u$ itself, and then upon $\dot u$ or $p\dot x$, the expression for its fluxion; and in this second operation $\dot x$ (or the fluxion of the quantity from which the function is formed) is considered as a constant quantity.

The expression $q\dot x^2$, obtained in this manner from the function $n$, is called the *second fluxion* of the function; and to express its relation to the function $u$, it is denoted by $\ddot u$, that is, by the letter denoting the function itself with two dots over it. Thus, like as $\dot u = p\dot x$, we have

$$\ddot u = q\dot x^2 \text{ and } \frac{\ddot u}{\dot x^2} = q.$$

Again, since $\dot q = r\dot x$, it follows that $\dot q\dot x^2 = r\dot x^3$; but, as $\dot x$ is constant, $\dot q\dot x^2$ is derived from $q\dot x^2$, by the operation of finding its fluxion, considering it as a function of $x$, just in the same manner as $q\dot x^2$, or $\ddot u$ is derived from $p\dot x$, or $\dot u$, and in the same manner as $\dot u$ is derived from the original function $u$; therefore, like as $p\dot x$ or $\dot u$ is the first fluxion of the function, and $q\dot x^2$ or $\ddot u$ is its second fluxion, so $r\dot x^3$ is called its *third fluxion*, and is denoted by $\dddot u$, that is, by the letter expressing the function itself, having three dots placed over it, so that

$$\dddot u = r\dot x^3 \text{ and } \frac{\dddot u}{\dot x^3} = r.$$

The fourth fluxion of a variable function $u$ is denoted by $\ddddot u$, that is, by the letter $u$ with four dots over it, and is derived from the third fluxion, in the same manner as the third is derived from the second, or the second from the first, or the first fluxion from the variable function itself; observing, that in repeating the operation of taking the fluxions, the symbol $\dot x$ (or the fluxion of the variable quantity from which the function is formed) is considered as a constant quantity. And the same mode of notation and deduction is to be understood as applying to a fluxion of any order whatever of a variable function.

44. To illustrate what has been said respecting the second and higher orders of fluxions of a function, let us suppose $u$ to denote the particular function $ax^n$; then, proceeding agreeably to what has been laid down in last section, we obtain, by the rule for finding the fluxion of any power of a variable quantity (§ 26.)

$$\dot u = nax^{n-1}\dot x$$

$$\ddot u = n(n-1)ax^{n-2}\dot x^2,$$

$$\dddot u = n(n-1)(n-2)ax^{n-3}\dot x^3,$$

$$\ddddot u = n(n-1)(n-2)(n-3)\,ax^{n-4}\dot x^4, \text{ \&c.}$$

Here we have exhibited the first, second, third, and fourth fluxions of the function $ax^n$; the law of continuation is obvious, and it appears that when $n$ is any positive integer, the function $ax^n$ will have as many orders of fluxions, as there are units in $n$, and no more; for if $n$ were supposed $=3$, then, as the fourth fluxion, and all the subsequent ones, are multiplied by $n-3$, or in that case by $3-3=0$, they consequently would vanish, and a similar observation may be made when $n$ is any other whole positive number.

45. That we might be able to apply the rules of § 26, § 34, &c. to the determination of the fluxion of a complex function of a variable quantity, we have found it convenient in some cases to consider such a function as composed of other more simple functions of the same quantity, and we have expressed its fluxion by means of the fluxions of those other functions. In finding the fluxion of any higher order than the first of such a complex function by those rules, we must keep in mind, that it is only the fluxion of $x$, the variable quantity from which the functions are all formed, that is to be considered as constant, and that the fluxions of the functions themselves are in general variable quantities; so that each of them may have a second, third, &c. fluxion, as well as the function which is composed of them.

Let us suppose, for example, that

$$u = \sqrt{(a^2+x^2)};$$

then, considering $a^2+x^2$ as a function of $x$, and putting $v$ to denote it, we have $u = \sqrt{v} = v^{\frac{1}{2}}$, and $\dot u = \frac{1}{2}v^{-\frac{1}{2}}\dot v = \frac{\frac{1}{2}\dot v}{\sqrt{v}}$; but since $v = a^2+x^2$, it follows that $\dot v = 2x\dot x$; therefore, substituting for $v$ and $\dot v$ their respective values, we have

$$\dot u = \frac{x\dot x}{\sqrt{(a^2+x^2)}}.$$

Now, to find the second fluxion of $u$, we may either take the fluxion of this last expression, viz. $\frac{x\dot x}{\sqrt{(a^2+x^2)}}$, and consider the symbol $\dot x$, which is found in it, as denoting a constant quantity; or we may recur to the equation $\dot u = \frac{\frac{1}{2}\dot v}{\sqrt{v}}$, and take the fluxion of this other expression for $\dot u$; and in this case, we must consider that both $v$ and $\dot v$ denote variable functions of $x$, and therefore that the fluxion of $\frac{\frac{1}{2}\dot v}{\sqrt{v}}$ may be found by the rule

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for finding the fluxion of a fraction; observing that $\ddot{v}$ is to be substituted as the fluxion of $\dot{v}$. Accordingly, proceeding by this last method, and considering that the fluxion of $\sqrt{v}$, the denominator of the fraction, is $\frac{\frac{1}{2}\dot{v}}{\sqrt{v}}$, we find

$$\dot{u}\begin{cases}=\dfrac{\frac{1}{2}\sqrt{v}\ddot{v}-\dfrac{\frac{1}{2}\dot{v}}{\sqrt{v}}\dot{v}}{v},\\[2ex] =\dfrac{2v\ddot{v}-\dot{v}^2}{4v\sqrt{v}}.\end{cases}$$

Now from the equation $v=a^2+x^2$ we have $\dot{v}=2x\dot{x}$, and (observing that $\dot{x}$ is constant) $v=2\dot{x}^2$. Let these values of $v$, $\dot{v}$, and $\ddot{v}$, be now substituted in the expression for $\dot{u}$, and it becomes

$$\ddot{u}\begin{cases}=\dfrac{4(a^2+x^2)\dot{x}^2-4x^2\dot{x}^2}{4(a^2+x^2)\sqrt{(a^2+x^2)}}\\[2ex] =\dfrac{a^2+x^2}{(a^2+x^2)^{\frac{3}{2}}}\end{cases}$$

The very same expression for $\ddot{u}$ would have been found if we had employed the other method.

By proceeding as in this last example, the rules already delivered for finding the first fluxion of any function of a variable quantity will apply to the finding of the fluxion of any higher order.

Thus if we had $u=vt$, where $v$ and $t$ denote each a function of another variable quantity $x$, and it were required to find the different orders of fluxions of $u$, considered also as a function of $x$; then, by the rule of § 37, we have

$$\dot{u}=t\dot{v}+v\dot{t},$$
and $\ddot{u}=$ fluxion of $t\dot{v}+$ fluxion of $v\dot{t}$;

but $v$ and $t$ being variable functions of $x$, we may consider $\dot{v}$ and $\dot{t}$ as denoting also variable functions of $x$, the fluxions of which are to be denoted by $\ddot{v}$ and $\ddot{t}$ respectively; now by the rule in § 37, we have

fluxion of $t\dot{v}=\dot{v}\dot{t}+t\ddot{v}$,

and fluxion of $v\dot{t}=\dot{t}\dot{v}+v\ddot{t}$,

therefore, $\ddot{u}=2\dot{v}\dot{t}+v\ddot{t}$.

By considering $v$, $\dot{v}$, $\ddot{v}$, also $\dot{t}$, $\ddot{t}$, as denoting each a distinct function of $x$, we may find the third fluxion of $u$ from the second, in the same manner as the second has been found from the first, and so on for the other orders of fluxions of $u$. If it be now required to express the successive orders of fluxions of $u$ in terms of $x$ and its fluxion, we must find the values of $\dot{v}$, $\ddot{v}$, &c. also of $\dot{t}$, $\ddot{t}$ &c. in terms of $x$ and its fluxion, and these values, also the particular functions of $x$ denoted by $v$ and $t$, being substituted in the expressions found for $\dot{u}$, $\ddot{u}$, &c. will give to these expressions the form required.

If for example we suppose that

$$v=a+bx^m,\qquad t=c+dx^n,$$
$$\text{then } \dot{v}=mbx^{m-1}\dot{x}\qquad \dot{t}=ndx^{n-1}\dot{x},$$

and considering $\dot{x}$ as constant,

$$\ddot{v}=m(m-1)bx^{m-2}\dot{x}^2,\qquad \ddot{t}=n(n-1)dx^{n-2}\dot{x}^2$$
&c.

these values of $v$, $t$, $\dot{v}$, $\dot{t}$, &c. being substituted in the expressions of $\dot{u}$, $\ddot{u}$, &c. will give the successive fluxions of $u$ in terms of $x$ and $\dot{x}$ only.

46. If the fluxion of a variable quantity be considered as the measure of its rate of increase, if that rate be uniform, then its measure will be a constant quantity; but if it be variable, then its measure will be a variable quantity, which will also have a certain rate of increase or decrease; and the measure of this rate will be its fluxion, or will be the fluxion of the fluxion of the original variable quantity; that is, it will be the second fluxion of the original variable quantity. And if this second fluxion is not a constant quantity, then the measure of its rate of variation will be its fluxion, or will be the third fluxion of the original variable quantity, and so on. Thus a quantity will have a successive order of fluxions till some one fluxion become constant, and then it will have no more.

47. We have hitherto supposed the equation expressing the relation between a variable quantity, and a function of that quantity, to be of such a form, that the function was found alone, and of the first degree on one side of the equation, and some power, or combination of powers, of the variable quantity on the other; as in these examples,

$$u=ax^n,\qquad u=\frac{a+bx^m}{c+dx^n}.$$

In such cases as these, $u$ is said to be an *explicit* function of $x$. We are now to consider how the ratio of the fluxions is to be found when the relation between the variable quantity and its function is expressed by an equation, the terms of which involve different powers, both of the function, and the variable quantity; as in the following example,

$$y^2-axy+bx^2-c=0,$$

where we are to consider $y$ as a function of $x$; but from the particular manner in which its relation to $x$ is expressed, it is said to be an *implicit* function of that quantity.

Now in this example, by the resolution of a quadratic equation, we find

$$y=\frac{ax\pm\sqrt{\left\{(a^2-4b)x^2+4c\right\}}}{2},$$

and as $y$ is here an *explicit* function of $x$, its fluxion or the ratio of its fluxion to that of $x$, might be determined by the rules already laid down. But it is to be observed that it is only in the particular case of the proposed equation being of the second degree that we can effect the solution generally in this manner. If it were

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were of a higher order, this particular mode of solution would be often impracticable, for want of a general method of resolving equations.

48. We may however in all cases resolve the problem, without a previous resolution of the equation, by reasoning as follows.

Whatever be the degree of the equation, by giving particular values to $x$, we can, by the theory of equations, obtain corresponding particular values of $y$; therefore, we may be assured that in every case $y$ is expressible by means of $x$ in some way or other, if not in finite terms, at least in the form of a series, the terms of which shall involve powers of $x$. Hence we may infer, as in the case of *explicit* functions, that when $x$ changes its value, and becomes $x+h$, $y$ will also change its value, and become

$$y+p\,h+q\,h^2+\text{ \&c.}$$

where $p$, $q$, &c. denote functions of $x$, that are independent of the arbitrary quantity $h$. Let us denote $p\,h+q\,h^2+$ &c. the increment of $y$, by the single letter $k$; then $y+k$ is the new value of $y$, corresponding to $x+h$, the new value of $x$. Let these new values be substituted instead of $x$ and $y$ in the proposed equation

$$y^2-a\,x\,y+b\,x^2-c=0,$$

and as the result must still be $=0$, we have

$$(y+k)^2-a(x+h)\ (y+k)+b(x+h)^2-c=0\,;$$

which equation, by actually involving its terms, substituting for $k$ its value $p\,h+q\,h^2+$ &c. and arranging the result in the form of a series proceeding by the powers of $h$, becomes

$$\left.\begin{array}{r} y^2-a\,x\,y+b\,x^2-c \\ +(2\,p\,y-a(\,p\,x+y)+2\,b\,x)h \\ +\mathrm{Q}\,h^2+\mathrm{R}\,h^3+\text{ \&c.} \end{array}\right\}=0.$$

Here Q, R, &c. denote quantities independent of $h$, and involving $x$, $y$, $p$, $q$, &c. that is to say, $x$, and functions of $x$, and therefore Q, R, &c. are also functions of $x$. Now as this equation must subsist whatever $h$ may be, which is a quantity quite arbitrary and independent of the coefficients by which its powers are multiplied, it follows (as has been observed when treating of the method of indeterminate coefficients, ALGEBRA, § 261.) that the coefficients of the different powers of $h$ must be each equal to 0.

Therefore,

$$\begin{array}{c} y^2-a\,x\,y+b\,x^2-c=0 \\ 2\,p\,y-a(\,p\,x+y)+2\,b\,x=0, \\ \text{\&c.} \end{array}$$

From the first of these equations we can infer nothing, as it is no other than the proposed equation itself; but from the second we find

$$p=\frac{a\,y-2\,b\,x}{2\,y-a\,x}.$$

Now $h$, and $k=p\,h+q\,h^2+$ &c. being the simultaneous increments of $x$ and $y$, we have $\frac{k}{h}=p+qh+$&c. therefore, supposing $h$ to be continually diminished, and putting $\frac{\dot{y}}{\dot{x}}$ equal to the limit of $\frac{k}{h}$, we have $\frac{\dot{y}}{\dot{x}}=p$, therefore

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$$\frac{\dot{y}}{\dot{x}}=\frac{a\,y-2\,b\,x}{2\,y-a\,x}\,;$$

thus we have obtained an expression for the ratio of the fluxions of $y$ and $x$, from which we find

$$2\,y\,\dot{y}-a(x\,\dot{y}+y\,\dot{x})+2\,b\,x\,\dot{x}=0,$$

and this is precisely the expression we should have obtained, had we taken the fluxion of each term of

$$y^2-a\,x\,y+b\,x^2-c=0,$$

the proposed equation, and put the result equal to 0.

49. But to see that this will always be the case, whatever be the degree of the equation, we have only to observe, that, by the very same process employed to deduce from the original equation

$$y^2-a\,x\,y+b\,x^2-c=0,$$

these two others

$$\begin{array}{c} 2\,y\,p-a\,(x\,p+y)+2\,b\,x=0, \\ 2\,y\,\dot{y}-a(x\,\dot{y}+y\,\dot{x})+2\,b\,x\,\dot{x}=0\,; \end{array}$$

if we suppose the equation to be generally expressed thus,

$$y^l+a\,y^m x^n\cdots+x^r+c=0,$$

where the exponents $l$, $m$, $n$, and $r$ denote constant quantities, we shall obtain

$$\left.\begin{array}{l} l\,y^{l-1}p+a\,(m\,y^{m-1}x^n p+n\,y^m x^{n-1}) \\ \quad\cdots+r\,x^{r-1} \end{array}\right\}=0,$$

and hence, by substituting for $p$ its value $\frac{\dot{y}}{\dot{x}}$, and bringing $\dot{x}$ from the denominator,

$$\left.\begin{array}{l} l\,y^{l-1}\,\dot{y}+a(m\,y^{m-1}\,x^n\,\dot{y}+n\,y^m\,x^{n-1}\,\dot{x}) \\ \quad\cdots+r\,x^{r-1}\,\dot{x} \end{array}\right\}=0.$$

From which it appears that, when the relation between $x$, a variable quantity, and $y$, a function of that quantity, is expressed by an equation, the terms of which are brought all to one side, so as to produce an expression $=0$; *the relation of the fluxions will be found, by taking the fluxion of each term of the equation (considering* y *as a function of* x*), and putting the sum of these fluxions equal to* 0.

50. Having from the equation

$$y^2-a\,x\,y+b\,x^2-c=0,$$

found that

$$\dot{y}=\frac{(a\,y-2\,b\,x)\,\dot{x}}{2\,y-a\,x},$$

if it be required to find the second fluxion of $y$, we have only to take the fluxion of the latter side of this equation,

equation, considering $\dot{x}$ as constant, and $y$ as a function of $x$; thus we have

$$\ddot{y}=\frac{\left\{\begin{array}{l}(2y-ax)(a\dot{y}-2b\dot{x})\dot{x}\\-(ay-2bx)(2\dot{y}-a\dot{x})\dot{x}\end{array}\right\}}{(2y-ax)^2}$$

an equation which abbreviates to

$$\ddot{y}=\frac{(4b-a^2)(x\dot{y}-y\dot{x})\dot{x}}{(2y-ax)^2},$$

and from which we may exterminate $\dot{y}$ by means of the equation

$$\dot{y}=\frac{(ay-2bx)\dot{x}}{2y-ax}.$$

By the same mode of proceeding we may determine the third or any higher fluxion of the function $y$.

51. As far as we have yet gone in explaining the principles of fluxions, we have had continually occasion to employ the rule for finding the fluxion of the particular function $x^n$, where $x$ denotes a variable quantity, and $n$ any constant number; and we may therefore in respect of other functions, consider $x^n$ as a simple function. Besides the function $x^n$, writers on Analysis have considered each of the following as also constituting a simple analytic function of a variable quantity; viz.

$a^x$, where $a$ is constant, and $x$ is variable.

Log. $x$, that is the logarithm of $x$, a variable number.

Sin. $x$, that is the sine of $x$, a variable arch of a circle, radius being unity.

Cos. $x$, that is the cosine of $x$, a variable arch of a circle, radius being as before unity.

52. We have already found the fluxion of $x^n$, and we proceed to find the fluxions of the other simple functions of $x$; and, as in the investigation of these we shall have occasion to employ the binomial theorem, it will be proper to show how that theorem may be deduced from the principles already explained. We are then to find the series that expresses $(a+x)^n$, when $n$ is any number whatever. Or, since $(a+x)^n$ is equal to $a^n(1+v)^n$, where $v$ denotes the fraction $\frac{x}{a}$, we may leave the quantity $a^n$ out of consideration, as has been formerly observed, § 28, and seek the series that expresses $(1+v)^n$. As we have already pointed out (§ 28.) the process of induction by which we may find the general form of the series, we shall not here repeat it, but assume

$$(1+v)^n=1+Av+Bv^2+Cv^3+Dv^4+\&c.$$

where A, B, C, D, &c. denote numbers that are independent of $v$.

Now, as the fluxion of a variable function must be the same, whether that function be expressed by one term, or developed into a series of terms; by performing the operation of taking the fluxion on each side of the above equation, the results must be equal, that is, § 26.

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$$n(1+v)^{n-1}\dot{v}=A\dot{v}+2Bv\dot{v}+3Cv^2\dot{v}+4Dv^3\dot{v}+\&c.$$

or leaving out the quantity $\dot{v}$, common to each term,

$$n(1+v)^{n-1}=A+2Bv+3Cv^2+4Dv^3+\&c.$$

Let both sides of this equation be multiplied by $1+v$, and divided by $n$, thus we shall have

$$(1+v)^n=\frac{1}{n}\left\{\begin{array}{l}A+2Bv+3Cv^2+4Dv^3+\&c.\\\quad+Av+2Bv^2+3Cv^3+\&c.\end{array}\right\}$$

Thus, by performing on the quantities the analytical process of taking their fluxions, we have obtained a new expression for $(1+v)^n$. Let the quantities that are independent of $v$ in each expression be put equal to each other, and also the coefficients of like powers of $v$; thus we obtain

$$1=\frac{A}{n},\text{ and hence }A=n$$

$$A=\frac{A+2B}{n},\ B=\frac{n-1}{2}A$$

$$B=\frac{2B+3C}{n},\ C=\frac{n-2}{3}B$$

$$C=\frac{3C+4D}{n},\ D=\frac{n-3}{4}C$$

&c. &c.

Or, substituting successively the expression for each coefficient in that which follows it,

$$A=n,$$

$$B=\frac{n(n-1)}{2},$$

$$C=\frac{n(n-1)(n-2)}{2\cdot3},$$

$$D=\frac{n(n-1)(n-2)(n-3)}{2\cdot3\cdot4},$$

&c.

Hence it appears that

$$(1+v)^n=1+nv+\frac{n(n-1)}{2}v^2+\frac{n(n-1)(n-2)}{2\cdot3}v^3$$
$$+\frac{n(n-1)(n-2)(n-3)}{2\cdot3\cdot4}v^4+\&c.,$$

and therefore, substituting $=\frac{x}{a}$ for $v$, and multiplying by $a^n$,

$$(a+x)^n=a^n+na^{n-1}x+\frac{n(n-1)}{2}a^{n-2}x^2$$
$$+\frac{n(n-1)(n-2)}{2\cdot3}a^{n-3}x^3+\&c.$$

where the law of continuation is evident.

53. We now proceed to investigate the fluxion of the function $u=a^x$, $a$ being supposed constant, and $x$ the variable quantity, to which the function is referred.

Let $x$ be supposed, as formerly, to change its value, and to become $x+h$, and put $u'$ for the new value that the function acquires by this change in the magnitude of $x$, then we have

$$u'=a^{x+h}=a^x\times a^h,$$

and, taking the difference between the two succeeding values,

$$u'-u=a^x\times a^h-a^x=a^x\,(a^h-1).$$

We must now develope the expression $a^h-1$ into a series, the terms of which are arranged according to the successive powers of the increment $h$. To effect this, let us put $b=a-1$, so that $a=1+b$, and $a^h=(1+b)^h$; but by the binomial theorem, this last expression may be expanded into the following series:

$$1+hb+\frac{h(h-1)}{2}b^2+\frac{h(h-1)\,(h-2)}{2\cdot 3}b^3+\text{\&c.}$$

Therefore,

$$a^b=1+hb+\frac{h(h-1)}{2}b^2+\frac{h(h-1)\,(h-2)}{2\cdot 3}b^3+\text{\&c.}$$

As the terms of this series are not arranged according to the powers of $h$, but according to the powers of $b$, it is necessary that we transform it into another having the required form; now this may be effected by actually multiplying together all the factors that constitute each term, and arranging the series anew in such a manner, that each of its terms may be a power of $h$, multiplied by a coefficient composed only of the powers of $b$, and given numbers;

Accordingly we have

$$\begin{aligned}
&hb\quad .\quad .\quad .\quad =bh,\\
&\frac{h(h-1)}{2}b^2\qquad =-\frac{b^2}{2}h+\frac{b^2}{2}h^2,\\
&\frac{h(h-1)\,(h-2)}{2\cdot 3}b^3=\frac{b^3}{3}h-\frac{b^3}{2}h^2+\frac{b^3}{6}h^3,\\
&\text{\&c.}
\end{aligned}$$

Therefore, by taking the sum of all the quantities on each side of these equations, we get the series,

$$1+hb+\frac{h(h-1)}{2}b^2+\frac{h(h-1)\,(h-2)}{2\cdot 3}b^3+\text{\&c.}$$

otherwise expressed thus,

$$1+Ah+Bh^2+Ch^3+\text{\&c.}$$

where A is equal to the infinite series $b-\frac{b^2}{2}+\frac{b^3}{3}-\frac{b^4}{4}+\text{\&c.}$

that is, to

$$\frac{a-1}{1}-\frac{(a-1)^2}{2}+\frac{(a-1)^3}{3}\ \frac{(a-1)^4}{4}+\text{\&c.}$$

and B, C, &c. are also quantities composed of the powers of $b$, and consequently are independent of $h$; but as these are all to disappear in the course of the investigation, it is not necessary to express them otherwise than by a general symbol. Therefore, we have now got

$$a^h=1+Ah+Bh^2+Ch^3+\text{\&c.}$$

and consequently,

$$u'-u=a^x\,(a^h-1)=a^x\,(Ah+Bh^2+Ch^3+\text{\&c.})$$

and

$$\frac{u'-u}{h}=Aa^x+Ba^xh+Ca^xh^2+\text{\&c.}$$

Hence, when $h$ is conceived to be continually diminished, we have the limit of $\frac{u'-u}{h}$ expressed by $Aa^x$, and therefore, § 21,

$$\frac{\dot{u}}{\dot{x}}=Aa^x,\ \text{and}\ \dot{u}=Aa^x\dot{x}.$$

54. In the preceding investigation, we have had occasion to develope the exponential expression $a^h$ into a series of this form,

$$1+Ah+Bh^2+Ch^3+\text{\&c.}$$

that is, a series the terms of which are the successive powers of the exponent, each multiplied by a coefficient, which is independent of the exponent.

We have however only determined the coefficients of the first two terms of the series, these being the only ones we had occasion to employ.

The result of the investigation however may be applied to determine all the coefficients by the very same kind of process as that which we have employed in § 53, to determine the coefficients of the terms of the series which constitutes the other expansion of $a^h$.

Instead of denoting the exponent by $h$, let us consider it as a variable quantity, and express it by $x$, then, from what has been shewn, it appears that

$$a^x=1+Ax+Bx^2+Cx^3+Dx^4+\text{\&c.}$$

where A, B, C, &c. express constant quantities. Let the operation of taking the fluxions be now performed on both sides of this equation, (observing that the fluxion of $a^x$ is $Aa^x\dot{x}$) and let all the terms be divided by $\dot{x}$, which is common to each, thus we obtain

$$Aa^x=A+2Bx+3Cx^2+4Dx^3+\text{\&c.}$$

and, dividing by A,

$$a^x=1+2\frac{B}{A}x+\frac{3C}{A}x^2+\frac{4D}{A}x^3+\text{\&c.}$$

Let the coefficients of the same powers of $x$ in each of the two series expressing $a^x$ be put equal to each other, then,

$$\begin{aligned}
&\frac{2B}{A}=A,\ \text{hence,}\ B=\frac{A^2}{2},\\
&\frac{3C}{A}=B;\ \ .\ .\ .\ C=\frac{A^3}{2\cdot 3},\\
&\frac{4D}{A}=C,\ .\ .\ .\ .\ D=\frac{A^4}{2\cdot 3\cdot 4},\\
&\text{\&c.}\qquad\qquad\qquad \text{\&c.}
\end{aligned}$$

Therefore,

Therefore, substituting these values of B, C, D, &c. in the original series, we have

$$a^x=1+Ax+\frac{A^2x^2}{2}+\frac{A^3x^3}{2.3}+\frac{A^4x^4}{2.3.4}+\&c.$$

the same result as has been found in the article ALGEBRA, § 293. by proceeding in a different manner.

55. If we suppose $x=1$, then the preceding equation becomes

$$a=1+A+\frac{A^2}{2}+\frac{A^3}{2\cdot3}+\frac{A^4}{2\cdot3\cdot4}+\&c.$$

and if we suppose $x=\frac{1}{A}$, it becomes

$$a^{\frac{1}{A}}=1+1+\frac{1}{2}+\frac{1}{2\cdot3}+\frac{1}{2\cdot3\cdot4}+\&c.$$

thus the quantity $a^{\frac{1}{A}}$ is equal to a constant number, which is the value of $a$ when $A=1$, and which, by taking the sum of the first ten terms of the series, is found to be 2·7182818, or by taking the sum of a greater number of terms, more accurately

2·718281828459045 · · · ·

We shall, in the remainder of this treatise, denote this number always by $e$, then $a^{\frac{1}{A}}=e$, and $a=e^A$, and taking the logarithms, log. $a=A\times$ log. $e$, hence,

$$A=\frac{\text{log. }a}{\text{log. }e}.$$

56. If we now substitute this value of A in the expression for the fluxion of $u=a^x$, found in § 53, it becomes

$$\dot{u}=\frac{\text{log. }a}{\text{log. }e}a^x\dot{x}.$$

*Hence it appears, that the fluxion of the function* $a^x$ *is equal to the fluxion of* x *multiplied by the function itself, and by the quotient arising from the division of the logarithm of* a *by the logarithm of* e, *where* e *denotes,*

$1+\frac{1}{1}+\frac{1}{1\cdot2}+\frac{1}{1\cdot2\cdot3}+\frac{1}{1\cdot2\cdot3\cdot4}+$ &c. *a series whose sum is* 2·7182818 *nearly.*

57. Let us now consider the third simple function of $x$, namely $u=$log. $x$. Let $a$ be the radical number of the particular system, in which $u$ is a logarithm, and $x$ the corresponding number; then from the nature of logarithms (see ALGEBRA, § 277.) we have $a^u=x$. Now, whether we consider $u$ as a function of $x$, or $x$ as a function of $u$, the limiting ratio of their simultaneous increments, and consequently the ratio of their fluxions, will be the very same. But by considering $x$ as a function of $u$, we have immediately, from what has been shewn in § 53, and § 55,

$$\frac{\dot{x}}{\dot{u}}=Aa^u=Ax,$$

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and therefore, $u=\frac{1}{A}\frac{\dot{x}}{x}=\frac{\text{log. }e}{\text{log. }a}\frac{\dot{x}}{x}$, but as $a$ is the radical number of the system, log. $a=1$, therefore

$$\dot{u}=\text{log. }e\,\frac{\dot{x}}{x}.$$

The number which we have denoted by $e$ occurs very often in analytical investigations; it is the radical number of the system of logarithms first invented by *Baron Napier*, and called by some writers *Hyperbolic* logarithms, but by others, with more propriety, *Napierean* logarithms. The expression $\frac{\text{log. }e}{\text{log. }a}$ is called the *modulus* of the system of logarithms whose radical number is $a$. In the Napierean system $\frac{\text{log. }e}{\text{log. }a}=\frac{\text{log. }e}{\text{log. }e}=1$, that is, the *modulus* is unity; but in the common system, or that in which $a=10$, the *modulus* $\frac{\text{log. }e}{\text{log. }a}=0{\cdot}434294482$. The rule for finding the fluxion of the logarithm of a variable quantity may now be expressed thus:

*Multiply the fluxion of the variable quantity by the modulus of the system, and divide the product by the variable quantity itself, the result is the fluxion required.*

58. By the application of the rule for finding the fluxion of the logarithm of a variable quantity, we may readily find the fluxions of exponential functions in general. Thus, for example, if $u=z^y$, $z$ and $y$ being both functions of any variable quantity $x$, then log. $u=y\times$ log. $z$; and taking the fluxions (considering $y\times$ log. $z$ as the product of two functions $y$ and log. $z$, and proceeding by the rules of § 37 and last),

$$\frac{\dot{u}}{u}=\dot{y}\,\text{log. }z+y\frac{\dot{z}}{z};$$

and hence

$$\dot{u}=u\left(\dot{y}\,\text{log. }z+y\frac{\dot{z}}{z}\right);$$

$$=z^y\left(\dot{y}\,\text{log. }z+\frac{y\dot{z}}{z}\right).$$

59. We are next to consider the functions $u=$sin. $x$, and $u=$cos. $x$.

Suppose $x$ to change its value, and to become $x+h$, and $u$ to become $u'$, then, since

$$u=\text{sin. }x,\text{ and }u'=\text{sin. }(x+h),$$

$$u'-u=\text{sin. }(x+h)-\text{sin. }x;$$

but by the arithmetic of sines (see ALGEBRA, § 353), sin. $(x+h)=$sin. $x$ cos. $h+$cos. $x$ sin. $h$, therefore,

$$u'-u=\text{sin. }x\text{ cos. }h+\text{cos. }x\text{ sin. }h-\text{sin. }x$$

$$=\text{cos. }x\text{ sin. }h-\text{sin. }x\,(1-\text{cos. }h).$$

In this case, as when treating formerly of other functions, we might consider the above expression for $u'-u$, as resolvable into a series $ph+qh^2+$ &c. proceeding by the powers of the increment, and thence we might

Direct Method. might find the limit of $\frac{u'-u}{h}$ as before. But we may discover the limit otherwise, by proceeding as follows: Because

$$\text{Sin.}^2 h = 1 - \cos.^2 h = (1 + \cos. h)\,(1 - \cos. h)$$

$$\text{therefore, } 1 - \cos. h = \frac{\sin.^2 h}{1 + \cos. h};$$

Let this value of $1 - \cos. h$ be substituted in the expression for $u'-u$, and it becomes

$$u'-u = \cos. x \sin. h - \frac{\sin. x \sin.^2 h}{1 + \cos. h};$$

And hence, dividing by $h$, and arranging the terms so as to exhibit the ratio $\frac{\sin. h}{h}$, we get

$$\frac{u'-u}{h} = \frac{\sin. h}{h}\left\{\cos. x - \frac{\sin. h \sin. x}{1 + \cos. h}\right\}.$$

Conceive now $h$ to be continually diminished, and we shall have the limit of $\frac{u'-u}{h}$ equal to the limit of $\frac{\sin. h}{h}$ multiplied by the limit of the following expression

$$\cos. x - \frac{\sin. h \sin. x}{1 + \cos. h}.$$

Now, the sine of an arch being less than the arch itself, we have $\frac{\sin. h}{h} < 1$. Again, the arch being less than its tangent, $\frac{\sin. h}{h} > \frac{\sin. h}{\tan. h}$; but $\tan. h = \frac{\sin. h}{\cos. h}$, and therefore $\frac{\sin. h}{\tan. h} = \cos. h$; consequently $\frac{\sin. h}{h} >$ $\cos. h$. Hence it appears, that the expression for the ratio $\frac{\sin. h}{h}$ is less than 1, or radius, but greater than $\cos. h$. But $h$ being conceived to be continually diminished, $\cos. h$ continually approaches to 1, and may come nearer to it than by any assignable difference; therefore, the limit of $\frac{\sin. h}{h}$ is 1. As to the other expression, $\cos. x - \frac{\sin. h \sin. x}{1 + \cos. h}$; when $h$ is supposed to be continually diminished, its second term, to wit, $\frac{\sin. h \sin. x}{1 + \cos. h}$ may become less than any assignable quantity; therefore the limit of the expression is simply $\cos. x$: thus, upon the whole we have found that the limit of $\frac{u'-u}{h}$ is $\cos. x$, and therefore

$$\frac{\dot{u}}{\dot{x}} = \cos. x, \text{ and } \dot{u} = \dot{x} \cos. x.$$

The fluxion of the other function, $u = \cos. x$, is easily deduced from that which we have just found, by proceeding thus:

Put $c$ to denote a quadrant, then $\cos. x = \sin. (c - x)$, and therefore

$$u = \sin. (c - x).$$

Now, it has been just shewn that

$$\text{flux. of } \sin. (c - x) = \cos. (c - x) \times \text{flux. of } (c - x)$$

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but $\cos. (c - x) = \sin. x$, and the fluxion of $c - x$ is $-\dot{x}$, therefore

$$\dot{u} = -\dot{x} \sin. x.$$

*Thus it appears, that the fluxion of the sine of a variable arch is equal to the fluxion of the arch multiplied by its cosine; and that the fluxion of the cosine is equal to the fluxion of the arch (taken with a negative sign) multiplied by the sine.*

60. We can now very readily find the fluxion of any other function of an arch of a circle. Thus, suppose $u = \tan. x$; then, because $\tan. x = \frac{\sin. x}{\cos. x}$, we have $u = \frac{\sin. x}{\cos. x}$. This expression being considered as a fractional function of $x$, we have, by § 39, and what has been just now shewn

$$\dot{u} = \frac{\dot{x} \cos.^2 x + \dot{x} \sin.^2 x}{\cos.^2 x},$$

$$= \frac{\dot{x}(\cos.^2 x + \sin.^2 x)}{\cos.^2 x};$$

or, since $\cos.^2 x + \sin.^2 x = 1$, and $\frac{1}{\cos. x} = \text{secant } x$,

$$\dot{u} = \frac{\dot{x}}{\cos.^2 x} = \dot{x} \sec.^2 x.$$

Hence also we have $\dot{x} = \frac{\dot{u}}{\sec.^2 x} = \frac{\dot{u}}{1 + u^2}$.

In like manner, if we suppose $u = \sec. x$, then, because $\sec. x = \frac{1}{\cos. x}$, we have $u = \frac{1}{\cos. x}$, and

$$\dot{u} = \frac{\dot{x} \sin. x}{\cos.^2 x},$$

or, since $\frac{\sin. x}{\cos. x} = \tan. x$, and $\frac{1}{\cos. x} = \sec. x$,

$$\dot{u} = \dot{x} \tan. x \sec. x.$$

Proceeding in this manner, we find that when $u = \text{cotan. } x$, then

$$\dot{u} = \frac{-\dot{x}}{\tan.^2 x \cos.^2 x} = \frac{-\dot{x}}{\sin.^2 x};$$

And when $u = \text{cosec. } x$, then

$$\dot{u} = \frac{-\dot{x} \cos. x}{\sin.^2 x} = -\dot{x} \text{ cotan. } x \text{ cosec. } x.$$

61. Let us now consider the fluxions of geometrical magnitudes: And first let it be required to find the expression for the fluxion of BDPC the area bounded by CP, a curve line, and by CB, PD, the ordinates at its extremities, and BD, the portion of AE, the line of the abscissas, which lies between those ordinates. Let the numerical measures of AD and PD, the co-ordinates at the point, be denoted by $x$ and $y$, and the numerical measure of the area BDPC by $s$; then

Plate CCXIX. fig. 1.

then $y$ and $s$ may both be considered as functions of the abscissa $x$.

Let $x$, or AD, be supposed to change its value, and to become AD′, and let D′P′, and BD′P′C be the corresponding new values of $y$ and $s$; then DD′, and DD′P′P will be the geometrical expressions for the simultaneous increments of the abscissa and area. But, as one of these quantities is a line, and the other a space, they cannot be compared in respect of their ratio. Therefore, let us consider $a$ as denoting a line whose numerical value is unity, and then the numerical values of the increments of the abscissa and area may be considered as analogous to the geometrical quantities $DD' \times a$, and the area DD′P′P respectively, which quantities being homogeneous may now be compared with each other. We are now to investigate the limit of $\frac{\text{area } DD'P'P}{a \times DD'}$, the general expression for the ratio of the increments of $s$ and $x$. Draw PM and P′N parallel to AE, meeting the ordinates in M and N. The curvilineal area DD′P′P is greater than the rectangle DD′MP, that is, greater than $PD \times DD'$; but less than the rectangle DD′P′N, that is, less than $P'D' \times DD'$, therefore

$$\frac{\text{area } DD'P'P}{a \times DD'} > \frac{PD \times DD'}{a \times DD'} > \frac{PD}{a},$$

$$\text{and } \frac{\text{area } DD'P'P}{a \times DD'} < \frac{P'D \times DD'}{a \times DD'} < \frac{P'D'}{a}.$$

But the increments being supposed to be continually diminished, $\frac{PD}{a}$ is the limit of $\frac{P'D'}{a}$, therefore $\frac{PD}{a}$ is also the limit of $\frac{\text{area } DD'P'P}{a \times DD'}$, and hence (§ 21.) $\frac{\dot{s}}{\dot{x}} = \frac{PD}{a} = \frac{y}{1} = y$, and $\dot{s} = y\dot{x}$.

*That is, the fluxion of a curvilineal area is equal to the product of the ordinate, and the fluxion of the abscissa.*

62. Before we proceed to investigate the expression for the fluxion of an arch of a curve, it is necessary that we should inquire what is the limited ratio of an arch of a curve to its chord.

Fig. 2.

Let APB be any curve line, all the parts of which are concave towards its chord AP. Let AQ, QP be tangents at the extremities of the arch, and let $apq$ be a triangle similar to APQ, but having its base $ap$ of a given magnitude, then

$$AQ + QP : AP :: aq + qp : ap.$$

Suppose now the point P to approach to A, then the angles at A and P, and consequently the angles at $a$ and $p$, which are equal to them, will decrease, and may become less than any assignable angles; therefore, the limit of the ratio of $aq + qp$ to $ap$ is evidently a ratio of equality; hence also the limit of the ratio of $AQ + QP$ to AP is the ratio of equality; and since the arch AP is less than $AQ + QP$, but greater than its chord AP, the limit of the arch AP to its chord AP must also be the ratio of equality.

63. We proceed now to find the fluxion of an arch of a curve. Let APP′ be a curve line of any kind, and AB, BP any two co-ordinates at a point P in the curve. Put $x$ for AB, the abscissa, $y$ for BP, the ordinate, and $z$ for the curve line AP, then $z$ and $y$ may be considered as each a function of $x$. Draw P′B′ another ordinate, and draw PM parallel to AB, meeting P′P′ in M, and draw the chord PP′; then PM, MP′, and the arch PP′, are the simultaneous increments of $x$, $y$, and $z$ respectively. Now we have

Fig. 3.

$$\frac{\text{arch } PP'}{PM} = \frac{\text{arch } PP'}{\text{chord } PP'} \times \frac{\text{chord } PP'}{PM}$$

But chord $PP' = \sqrt{(PM^2 + MP'^2)} = PM\sqrt{\left(1 + \frac{MP'^2}{PM^2}\right)}$;

therefore,

$$\frac{\text{arch } PP'}{PM} = \frac{\text{arch } PP'}{\text{chord } PP} \times \sqrt{\left(1 + \frac{MP'^2}{PM^2}\right)}.$$

Suppose now the increments to be continually diminished, then, as $\frac{\dot{z}}{\dot{x}} =$ limit of $\frac{\text{arch } PP'}{PM}$, and $\frac{\dot{y}^2}{\dot{x}} =$ limit of $\frac{MP'^2}{PM^2}$ (§ 21.), and $1 =$ limit of $\frac{\text{arch } PP'}{\text{chord } PP'}$ (last §) we have

$$\frac{\dot{z}}{\dot{x}} = \sqrt{\left(1 + \frac{\dot{y}^2}{\dot{x}^2}\right)}, \text{ and } \dot{z} = \sqrt{(\dot{x}^2 + \dot{y}^2)}.$$

*Hence it appears that the square of the fluxion of a curve line of any kind is equal to the sum of the squares of the fluxions of the co-ordinates.*

64. The expression for the fluxion of a solid may be found by the same mode of reasoning as that which we have employed, § 61, to find the fluxion of a curvilineal area. Let APQ$p$ be a portion of a solid generated by the revolution of APB, a curve line, about AC, a line taken in the plane of the curve, as an axis. Let PD$p$, P′D′$p'$ be the lines in which BA$b$, a plane passing along the axis AC, meets PQ$p$, P′Q′$p'$, the planes of two circles formed by sections of the solid perpendicular to its axis. Draw PM and P′N parallel to AD. Put AD$=x$, DP$=y$, let $s$ denote the solid APQ$p$, having $y$ for the radius of its circular base, and $x$ for its altitude; put $\pi$ for the number 3·14159··· viz. the circumference of a circle having its diameter $=1$, and let $a$ denote an area, having its numerical measure expressed by unity; then DD′, or $a \times DD'$ being considered as the increment of $x$, the portion of the solid comprehended between the parallel planes PQ$p$, P′Q′$p'$ will be the corresponding increment of $s$, which we are to consider as a function of $x$; hence (§ 21.) $\frac{\dot{s}}{\dot{x}}$ is equal to the limiting ratio of the portion of the solid, comprehended between the planes PQ$p$, and P′Q′$p'$ to the solid $a \times DD'$. But the former of these solids being evidently greater than a cylinder P$m$, having the circle PA$p$ for its base, and DD′ for its altitude, that is greater than $\pi PD^2 \times DD'$, and less than a cylinder N$p'$, having the circle P′Q′$p'$ for its base, and DD′ for its altitude, that is less than $\pi P'D'^2 \times DD'$;

Fig. 4.

it

it follows, that as long as DD′ has an assignable magnitude,

$$\frac{\dot{s}}{\dot{x}} > \pi PD^2 \times DD' \times \frac{1}{a \times DD'},$$
$$> \frac{\pi PD'^2}{a};$$
$$\text{and } \frac{\dot{s}}{\dot{x}} < \pi P'D'^2 \times DD' \times \frac{1}{a \times DD'},$$
$$< \frac{\pi P'D'^2}{a};$$

but the increment DD′ being continually diminished, $\frac{\pi P'D'^2}{a}$, the greater limit of $\frac{\dot{s}}{\dot{x}}$, approaches continually to its lesser limit $\frac{\pi PD^2}{a} = \frac{\pi y^2}{a} =$ (because $a=1$) $\pi y^2$, so as to come nearer to it than by any assignable difference, therefore $\frac{\dot{s}}{\dot{x}} = \pi y^2$, and $\dot{s} = \pi y^2 \dot{x}$. Now, if we observe that $\pi y^2$ is the area of the circle PQ*p*, it will appear, *that the fluxion of a solid generated by the revolution of a curve about its axis is equal to the fluxion of the axis multiplied by the general expression for the area of a circle formed by supposing the solid to be cut by a plane perpendicular to its axis.*

Fig. 5.

65. To find the fluxion of the surface of the solid, let us denote that surface by *s*, and let *x* and *y* denote as before; then the surface contained between the circles PQ*p* and P′Q′*p*′ will be the increment of *s*, corresponding to DD′ the increment of *x*. Draw the chord PP′; then the curve line PP′ being supposed to revolve about the axis AC, and thus to generate the increment of the surface of the solid, the chord PP′ will generate at the same time the convex surface of a frustum of a cone; now the limiting ratio of the curve line PP′ to its chord PP′ being the ratio of equality, the limiting ratio of the surfaces generated by the revolution of these lines will also be the ratio of equality; therefore $\frac{\dot{s}}{\dot{x}}$, which is equal to the limit of

$$\frac{\text{surf. gener. by arch PP}'}{1 \times DD'}$$

will also be equal to the limit of

$$\frac{\text{surf. gener. by chord PP}'}{DD'};$$

but the convex surface of a frustum of a cone is equal to the product of its slant side into half the sum of the circumference of its two bases (see GEOMETRY), and in the present case these circumstances are equal to 2 PD × π, and 2 P′D′ × π, therefore $\frac{\dot{s}}{\dot{x}}$ is equal to the limit of

$$\frac{\pi(PD+P'D')\,PP'}{DD'} = \pi(PD+P'D')\frac{PP'}{DD'};$$

but the point D′ being supposed to approach to D, the limit of PD+P′D′, will manifestly be 2 PD=2*y*; and since $\frac{PP'}{DD'} = \frac{(\sqrt{DD'^2+P'M^2})}{DD'} = \sqrt{(1+\frac{P'M^2}{DD'^2})}$, the limit of this expression (if we consider that P′M and DD′ are the simultaneous increments of *y* and *x*) is evidently equal to $\sqrt{(1+\frac{\dot{y}^2}{\dot{x}^2})}$, therefore

$$\frac{\dot{s}}{\dot{x}} = 2\pi y\sqrt{(1+\frac{\dot{y}^2}{\dot{x}^2})},$$

and consequently

$$\dot{s} = 2\pi y\sqrt{(\dot{x}^2+\dot{y}^2)}.$$

If we now observe that $2\pi y$ is the circumference of the circle PQ*p*, and $\sqrt{(\dot{x}^2+\dot{y}^2)}$ is the fluxion of the curve line AP, § 63, it will appear, *that the fluxion of the surface of a solid generated by the revolution of a curve about its axis is equal to the fluxion of the curve line multiplied by the general expression for the circumference of a circle formed by supposing the curve to be cut by a plane perpendicular to its axis.*

## SECT. III. *The Application of the Direct Method of Fluxions.*

HAVING explained the principles of the direct method of fluxions at as great a length as we think suitable to the work of which this treatise forms a part, we proceed to shew how the calculus may be applied to the resolution of some general problems in Analysis and Geometry.

### *Investigation of a general formula for expanding a Function into a Series.*

66. In treating of the principles of the method of fluxions, we have, from an examination of particular functions, inferred by induction, that *u* being any function of a variable quantity *x*, which was either actually expressed, or capable of being expressed by a combination of the powers of *x*, then, *x* being supposed to change its value, and to become $x+h$, the new value which the function *u* will acquire when $x+h$ is substituted in it instead of *x* will always be capable of being expanded into a series of this form,

$$u+p\,h+q\,h^2+r\,h^3+\&c.$$

where *p*, *q*, &c. denote functions of *x* that are quite independent of *h*.

We have shewn that, from the particular form of this developement, it happens that the ratio of $p\,h+q\,h^2+r\,h^3+\&c.$ the increment of the function, to *h* the increment of the variable quantity *x* itself, admits of a limit, which is always expressed by *p*, the coefficient of its second term; and as we have defined this limit to be the expression for the ratio of the fluxions of *u* and *x*, so that $p=\frac{\dot{u}}{\dot{x}}$, the new value of the function may also be expressed thus,

$$u+\frac{\dot{u}}{\dot{x}}h+q\,h^2+r\,h^3+\&c.$$

And

And this expression may be considered as indicating not only the general form of the series, but also the particular relation subsisting between $u$, the original function, and $p$, the coefficient of the second term of the series, the latter being in every case that function of $x$ which results from the operation of taking the fluxion of the former, and dividing by $\dot{x}$

We are now to investigate the relation that subsists between each of the remaining coefficients and the original function.

67. First let us suppose the function $u$ to have the particular form $x^n$, $n$ being a constant number. Then $x$ changing its value to $x+h$, $u$ changes to $u'=(x+x)^n$, therefore, by the binomial theorem (§ 52.)

$$u'=x^n+nx^{n-1}h+\frac{n(n-1)}{2}x^{n-2}h^2$$
$$+\frac{n(n-1)(n-2)}{2.3}x^{n-3}h^3+\&c.$$

But since $u=x^n$, by taking the successive fluxions of $u$, and considering $\dot{x}$ as constant, we have

$$\frac{\dot{u}}{\dot{x}}=nx^{n-1},$$
$$\frac{\ddot{u}}{\dot{x}^2}=n(n-1)u^{n-2},$$
$$\frac{\dddot{u}}{\dot{x}^3}=n(n-1)(n-2)x^{n-3},$$
$$\frac{\ddddot{u}}{\dot{x}^4}=n(n-1)(n-2)(n-3)x^{n-4},$$
&c.

Let $u$, $\frac{\dot{u}}{\dot{x}}$, $\frac{\ddot{u}}{\dot{x}^2}$ &c. be now substituted for $x^n$, $nx^{n-1}$, $n(n-1)x^{n-2}$, &c. respectively, in the series for $u'$, and we have

$$u'=u+\frac{\dot{u}}{\dot{x}}h+\frac{\ddot{u}}{\dot{x}^2}\frac{h^2}{2}+\frac{\dddot{u}}{\dot{x}^3}\frac{h^3}{2.3}+\frac{\ddddot{u}}{\dot{x}^4}\frac{h^4}{2.3.4}+\&c.$$

68. This manner of expressing the developement of $u'$, or $(x+h)^n$, indicates directly the relation that each of the coefficients of the successive powers of $h$ has to the original function.

The first term of the series is the original function $u$, or $x^n$, itself, or it is what the function $(x+h)^n$ becomes upon the supposition that $h=0$. The second term is $h$, or $\frac{h}{1}$, multiplied by the coefficient $\frac{\dot{u}}{\dot{x}}$, which coefficient is a function of $x$ derived from the original function by the operation of taking its fluxion, and dividing the result by $\dot{x}$. The third term is $\frac{h^2}{1.2}$ multiplied by the coefficient $\frac{\ddot{u}}{\dot{x}^2}$, that is, by a function of $x$ derived from the preceding coefficient $\frac{\dot{u}}{\dot{x}}$ by the same operation as that coefficient was derived from the original function, namely by taking the fluxion of $\frac{\dot{u}}{\dot{x}}$, considering $\dot{x}$ as constant, and dividing by $\dot{x}$. The fourth term is $\frac{h^3}{1.2.3}$ multiplied by $\frac{\dddot{u}}{\dot{x}^3}$, that is, by a function of $x$ deduced from the third coefficient by the very same operation as that by which the third was derived from the second, or the second from the first. And so on with respect to all the other terms of the series, the $n$th term being the product of $\frac{h^{n-1}}{1.2.3...(n-1)}$, and the $(n-1)$th fluxion of the function $u$ divided by $\dot{x}^{n-1}$.

69. Let us now suppose that $u$ denotes any other function of $x$, then, whatever be its nature, it may always be conceived as capable of being expressed by a series, the terms of which are powers of $x$, in this manner;

$$Ax^a+Bx^b+Cx^c+Dx^d+\&c.$$

where A, B, C, &c. $a$, $b$, $c$, &c. denote constant numbers. Thus we have

$$u=Ax^a+Bx^b+Cx^c+\&c.$$

Then, $x$ being supposed to become $x+h$, and (in consequence of the change in the value of $x$) $u$ to become $u'$; we have

$$u'=A(x+h)^a+B(x+h)^b+C(x+h)^c+\&c.$$

Let us now denote $Ax^a$ by P, $Bx^b$ by Q, $Cx^c$ by R, &c. then by last §

$$A(x+h)^a=P+\frac{\dot{P}}{\dot{x}}h+\frac{\ddot{P}}{\dot{x}^2}\frac{h^2}{2}+\frac{\dddot{P}}{\dot{x}^3}\frac{h^3}{2.3}+\&c,$$
$$B(x+h)^b=Q+\frac{\dot{Q}}{\dot{x}}h+\frac{\ddot{Q}}{\dot{x}^2}\frac{h^2}{2}+\frac{\dddot{Q}}{\dot{x}^3}\frac{h^3}{2.3}+\&c.$$
$$C(x+h)^c=R+\frac{\dot{R}}{\dot{x}}h+\frac{\ddot{R}}{\dot{x}^2}\frac{h^2}{2}+\frac{\dddot{R}}{\dot{x}^3}\frac{h^3}{2.3}+\&c.$$
&c.

Therefore, substituting these developements in the series expressing $u'$,

$$u'=\begin{cases} P+Q+R+\&c \\ +\left(\frac{\dot{P}}{\dot{x}}+\frac{\dot{Q}}{\dot{x}}+\frac{\dot{R}}{\dot{x}}+\&c.\right)h \\ +\left(\frac{\ddot{P}}{\dot{x}^2}+\frac{\ddot{Q}}{\dot{x}^2}+\frac{\ddot{R}}{\dot{x}^2}+\&c.\right)\frac{h^2}{2} \\ +\left(\frac{\dddot{P}}{\dot{x}^3}+\frac{\dddot{Q}}{\dot{x}^3}+\frac{\dddot{R}}{\dot{x}^3}+\&c.\right)\frac{h^3}{2.3} \\ +\&c. \end{cases}$$

But

But

$$u=P+Q+R+\text{ \&c.}$$
$$\frac{\dot{u}}{\dot{x}}=\frac{\dot{P}}{\dot{x}}+\frac{\dot{Q}}{\dot{x}}+\frac{\dot{R}}{\dot{x}}+\text{ \&c.}$$
$$\frac{\ddot{u}}{\dot{x}^2}=\frac{\ddot{P}}{\dot{x}^2}+\frac{\ddot{Q}}{\dot{x}^2}+\frac{\ddot{R}}{\dot{x}^2}+\text{ \&c.}$$
&c.

Therefore, substituting $u, \frac{\dot{u}}{\dot{x}}$, &c. for the series to which they are respectively equal,

$$u'=u+\frac{\dot{u}}{\dot{x}}\frac{h}{1}+\frac{\ddot{u}}{\dot{x}^2}\frac{h^2}{1.2}+\frac{\dddot{u}}{\dot{x}^3}\frac{h^3}{1.2.3}+\text{ \&c.}$$

Hence it appears that $u$ being any function of $x$ whatever, if $x+h$ be substituted in that function instead of $x$, the series expressing the developement of this new value of the function will have the general properties which have been shewn, in last §, to belong to it in the case of the function having the particular value $x^n$.

The very general theorem which we have just now investigated is one of the most elegant and important in analysis. It was first published by *Dr Brooke Taylor* in a work entitled *Methodus Incrementorum*, which made its appearance about the year 1716. The theorem itself is generally known by the name of *Taylor's* theorem. It is more general than the celebrated *Binomial* theorem, inasmuch as this last, and innumerable others, are comprehended in it as particular cases.

70. We shall now give some examples to shew the manner of applying Taylor's theorem, as well as its great utility as an instrument of analysis.

*Example* 1. Suppose $=ua^x$, $a$ being constant and $x$ variable. Then $x$ becoming $x+h$, $u$ becomes $u'=a^{x+h}$. Now from the equation $u=a^x$ we derive (§ 56.) $\frac{\dot{u}}{\dot{x}}=A\,a^x$, (here A denotes $\frac{\log. a}{\log. e}$). Again, considering $\dot{x}$ as constant, and repeating the operation of taking the fluxion $\frac{\dot{u}}{\dot{x}}=A\,a^x$, we get $\frac{\ddot{u}}{\dot{x}^2}=A^2\,a^x$, and hence again $\frac{\dddot{u}}{\dot{x}}=A^3\,a^x$, &c. Therefore, substituting for $u', u, \frac{\dot{u}}{\dot{x}}, \frac{\ddot{u}}{\dot{x}^2}$, &c. their values in the general theorem $u'=u+\frac{\dot{u}}{\dot{x}}h+\frac{\ddot{u}}{\dot{x}^2}\frac{h^2}{2}+$ &c. it becomes

$$a^{x+h}=a^x(1\,Ah+\frac{A^2}{2}h^2+\frac{A^3}{2.3}h^3+\text{ \&c.})$$

Suppose now, that $x=0$, then, as in this case $a^x=1$, we have

$$a^h=1+Ah+\frac{A^2}{2}h^2+\frac{A^3}{2.3}h^3+\text{ \&c.}$$

or, exchanging $h$ for $x$,

$$a^x=1+Ax+\frac{A^2x^2}{2}+\frac{A^3x^3}{2.3}+\text{ \&c.}$$

the same result as we formerly obtained in § 54.

*Ex.* 2. Suppose $u=\log. x$. Then, $x$ becoming $x+h$, $u$ becomes $u'=\log. (x+h)$. Now from the equation $u=\log. x$, we find (by § 57.) $\frac{\dot{u}}{\dot{x}}=\frac{M}{x}$. Here M denotes the modulus of the system. Again, supposing $\dot{x}$ constant, we find by § 26, $\frac{\ddot{u}}{\dot{x}^2}=-\frac{M}{x^2}, \frac{\dddot{u}}{\dot{x}^3}=\frac{2M}{x^3}, \overset{::}{u}=-\frac{2.3M}{x^4}$ &c. Therefore, substituting as before the values of $u'$ $u, \frac{\dot{u}}{\dot{x}}$, &c. in the general formula $u'=u+\frac{\dot{u}}{\dot{x}}h+\frac{\ddot{u}}{\dot{x}}\frac{h^2}{2}+$ &c. it becomes

$$\log. (x+h)=\log. x+\frac{M}{x}h-\frac{M}{2x^2}h^2+\frac{M}{3x^3}h^3-\text{ \&c.}$$

If we suppose $x=1$, and change $h$ into $y$, we have, because $\log. x=\log. 1=0$,

$$\log. (1+y)=M(y-\frac{y^2}{2}+\frac{y^3}{3}-\text{ \&c.})$$

For the particular method of applying these two series to the calculation of logarithms, see ALGEBRA, § 285 to § 291. See also LOGARITHMS.

*Ex.* 3. Suppose now $u=\sin. x$. Then $u'=\sin. (x+h)$. From $u=\sin. x$, by the application of the rule in § 59, we deduce $\frac{\dot{u}}{\dot{x}}=\cos. x, \frac{\ddot{u}}{\dot{x}^2}=-\sin. x, \frac{\dddot{u}}{\dot{x}^3}=-\cos. x, \frac{\ddddot{u}}{\dot{x}^4}=\sin. x$, &c. Therefore, substituting for $u', u, \frac{\dot{u}}{\dot{x}}$, &c. their values in the general formula as before, we have

$$\sin. (x+h)=\sin. x+\cos. x\,\frac{h}{1}-\sin. x\,\frac{h^2}{1.2}$$
$$-\cos. x\,\frac{h^3}{1.2.3}+\sin. x\,\frac{h^4}{1.2.3.4}+\text{ \&c.}$$

or sin. $(x+h)$ is equal to

$$\sin. x\,(1-\frac{h^2}{2}+\frac{h^4}{1.2.3.4}-\text{ \&c.})$$
$$+\cos. x\,(h-\frac{h^3}{1.2.3}+\frac{h^5}{1.2.3.4.5}-\text{ \&c.})$$

If we suppose $x=0$, then, as in that case $\sin. x=0$, the preceding formula becomes

sin.

Direct Method.

$$\sin.\ h = h - \frac{h^3}{1\,.\,2\,.\,3} + \frac{h^5}{1\,.\,2\,.\,3\,.\,4\,.\,5} - \&c.$$

or, substituting $x$ instead of $h$,

$$\sin.\ x = x - \frac{x^3}{1\,.\,2\,.\,3} + \frac{x^5}{1\,.\,2\,.\,3\,.\,4\,.\,5} - \&c.$$

*Ex.* 4. Suppose $u = \cos.\ x$, then $u' = \cos.\ (x+h)$, and since $u = \cos.\ x$, by § 59, $\frac{\dot{u}}{\dot{x}} = -\sin.\ x$, $\frac{\ddot{u}}{\dot{x}^2} = -\cos.\ x$, $\frac{\dddot{u}}{\dot{x}^3} = \sin.\ x$, &c. Therefore, substituting as before these values in the general formula $u' = u + \frac{\dot{u}}{\dot{x}}h +$ &c. it becomes

$$\cos.\ (x+h) = \cos.\ x - \sin.\ x\,\frac{h}{1} - \cos.\ x\,\frac{h^2}{1\,.\,2}$$
$$+ \sin.\ x\,\frac{h^3}{1\,.\,2\,.\,3} + \&c.$$

or $\cos.\ (x+h)$ is equal to

$$\cos.\ x\ \left(-\frac{h^2}{1\,.\,2} + \frac{h^4}{1\,.\,2\,.\,3\,.\,4} - \&c.\right)$$
$$\sin.\ x\ \left(h - \frac{h^3}{1\,.\,2\,.\,3} + \frac{h^5}{1\,.\,2\,.\,3\,.\,4\,.\,5} - \&c.\right)$$

which expression, when $x = 0$, and therefore $\cos.\ x = 1$, $\sin.\ x = 0$, becomes simply

$$\cos.\ h = 1 - \frac{h^2}{1\,.\,2} + \frac{h^4}{1\,.\,2\,.\,3\,.\,4} - \&c.$$

or substituting $x$ for $h$,

$$\cos.\ x = 1 - \frac{x^2}{1\,.\,2} + \frac{x^4}{1\,.\,2\,.\,3\,.\,4} - \&c.$$

71. It may be remarked that in each of these examples, from the developement of $u'$ the new value of the function of $u$, we have been able to deduce a developement of $u$ the function itself. But it is easy to see, that by proceeding in the same manner with the general formula as we have done in these particular examples, we shall obtain a general expression for the developement of any function whatever.

The general formula is

$$u' = u + \frac{\dot{u}}{\dot{x}}\frac{h}{1} + \frac{\ddot{u}}{\dot{x}^2}\frac{h^2}{1\,.\,2} + \frac{\dddot{u}}{\dot{x}^3}\frac{h^3}{1\,.\,2\,.\,3} + \&c.$$

Now, $u'$ being the value that $u$ assumes when $x+h$ is substituted in it instead of $x$, if we suppose $x = 0$, then $u'$ becomes the very same function of $h$, that $u$ is of $x$. Let us denote the values which each of the functions $u$, $\frac{\dot{u}}{\dot{x}}$, $\frac{\ddot{u}}{\dot{x}^2}$, &c. acquire, when $x = 0$, by U, U′, U″, &c. respectively.

Then (F) $u'$ (considered as the same function of $h$ that $u$ is of $x$) is equal to

$$U + U'\frac{h}{1} + U''\frac{h^2}{1\,.\,2} + U'''\frac{h^3}{1\,.\,2\,.\,3} + \&c.$$

Let $x$ be now supposed to be substituted both in $u'$, and the series which is its developement instead of $h$, then $u'$ becomes $u$, and we have

$$u = U + U'\frac{x}{1} + U''\frac{x^2}{1\,.\,2} + U'''\frac{x^3}{1\,.\,2\,.\,3} + \&c.$$

and in this formula it is to be considered, as already stated, that U, U′, U″, &c. denote the particular values which the functions $u$, $\frac{\dot{u}}{\dot{x}}$, $\frac{\ddot{u}}{\dot{x}^2}$, $\frac{\dddot{u}}{\dot{x}^3}$, &c. acquire respectively, by supposing that in each of them $x$ is taken $= 0$.

72. As an example of the application of this series let us resume the equation $u = a^x$, then $\frac{\dot{u}}{\dot{x}} = A\ a^x$ (§ 56.), $\frac{\ddot{u}}{\dot{x}^2} = A^2\ a^x$, $\frac{\dddot{u}}{\dot{x}^3} = A^3\ a^x$, &c.

Suppose now that $x = 0$, then $u$, or $a^x$ becomes $a^0 = 1$, $\frac{\dot{u}}{\dot{x}} = Aa^x$ becomes A, $\frac{\ddot{u}}{\dot{x}^2} = A^2\ a^x$ becomes $A^2$, &c. so that $U = 1$, $U' = A$, $U'' = A^2$, &c. substituting therefore these values in the general formula, it becomes

$$a^x = 1 + A\,\frac{x}{1} + A^2\,\frac{x^2}{1\,.\,2} + A^3\,\frac{x^3}{1\,.\,2\,.\,3} + \&c.$$

Let us next suppose that $u$ is an arch of a circle of which the sine is $x$, (radius being unity), then $x = \sin.\ u$. Now the ratio of the fluxion of $u$ to the fluxion of $x$ will be the very same whether we consider $u$ as a function of $x$, or $x$ as a function of $u$; therefore (§ 59.) $\dot{x} = \dot{u}\ \cos.\ u$, and $\frac{\dot{u}}{\dot{x}} = \frac{1}{\cos.\ u}$, but since $\sin.\ u = x$, $\cos.\ u = \sqrt{(1 - x^2)}$, therefore,

$$\frac{\dot{u}}{\dot{x}} = \frac{1}{\sqrt{(1 - x^2)}}.$$

Taking

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(F) For the sake of illustration let us take a particular example. Suppose $u = (a+x)^n$, then $\frac{\dot{u}}{\dot{x}} = n(a+x)^{n-1}$, $\frac{\ddot{u}}{\dot{x}^2} = n(n-1)\ (a+x)^{n-2}$, &c. Suppose now that $x = 0$, then $u$ becomes $a^n$, $\frac{\dot{u}}{\dot{x}}$ becomes $n\,a^{n-1}$, $\frac{\ddot{u}}{\dot{x}^2}$ becomes $n(n-1)\ a^{n-2}$, &c. so that in this particular case we have $U = a^n$, $U' = n\,a^{n-1}$, $U'' = n(n-1)a^{n-2}$, &c.

Direct Method.

Taking now the fluxion of $\frac{1}{\sqrt{(1-x^2)}}$, and the fluxion of the result, &c. we have

$$\frac{\ddot{u}}{\dot{x}^2}=\frac{x}{(1-x^2)^{\frac{3}{2}}},$$

$$\frac{\dddot{u}}{\dot{x}^3}=\frac{1}{(1-x^2)^{\frac{3}{2}}}+\frac{3x^2}{(1-x^2)^{\frac{5}{2}}},$$

$$\frac{\ddddot{u}}{\dot{x}^4}=\frac{3.3x}{(1-x^2)^{\frac{5}{2}}}+\frac{3.5x^3}{(1-x^2)^{\frac{7}{2}}},$$

&c.

Suppose now that $x=0$, then $u$ becomes 0, $\frac{\dot{u}}{\dot{x}}$ becomes 1, $\frac{\ddot{u}}{\dot{x}^2}$ becomes 0, $\frac{\dddot{u}}{\dot{x}^3}$ becomes 1, $\frac{\ddddot{u}}{\dot{x}^4}$ becomes 0, &c. so that $U=0$, $U'=1$, $U''=0$, $U'''=1$, $U''''=0$, &c. Therefore, substituting in the general formula, we find

$$u=x+\frac{x^3}{1.2.3}+\&c.$$

By prosecuting the computations farther, we may find

$$u=x+\frac{1^2x^3}{2.3}+\frac{3^2x^5}{2.3.4.5}+\frac{3^2 5^2x^7}{2.3.4.5.6.7}+\&c.$$

## *Application of the Method of Fluxions to the Drawing of Tangents.*

73. The theory of tangents to curve lines furnishes a good illustration of the truth of the principle which we have considered as the foundation of the method of fluxions, namely, that whatever be the form of a function, the ratio of its increment to the increment of the variable quantity from which the function is formed, is in every case susceptible of a limit.

Fig. 6.

Let AB, the abscissa of a curve, be the geometrical expression of a variable quantity $x$, and let BP the corresponding ordinate, be the expression for $y$, any function of $x$; then the curve line itself is the locus of the equation expressing the relation between $x$ and $y$. Let PT, a tangent to the curve at P, meet AB the abscissa in T; through P draw any straight line meeting the abscissa in D, and the curve in $p$; draw the ordinate $p\,b$, and from P draw P$n$ parallel to the abscissa, meeting the ordinate $bp$ in $n$.

The triangles DBP, P$np$ are similar; therefore

$$pn : nP :: PB : BD.$$

Now $p\,n$, and $n$ P, or B $b$, are the increments of PB and BA, or of $y$ and $x$ respectively, therefore the ratio of the simultaneous increments of PB and BA, or $y$ and $x$, whatever be their magnitudes, is equal to the ratio of PB to BD. Conceive now the point $p$ to approach continually to P, then the angle contained by the straight line $p$PD, and the tangent PT, will decrease, and the point D will approach to T; at the same time $n\,p$, and $n$ P, the increments of $y$ and $x$, will be continually diminished; still, however, they will have to each other the ratio of PB to BD, but this ratio approaches continually to the ratio of PB to BT, and becomes at last more nearly equal to it than any assignable ratio; therefore the ratio of PB to BT is the limit of the ratio of PB to BD, and consequently is also the limit of the ratio of $p\,n$, the increment of $y$, to $n$ P, the increment of $x$. And as this conclusion does not depend upon the particular nature of the curve, or upon any particular relation supposed to subsist between $x$ and $y$, we may conclude, that whatever be the form of the function, the ratio of the simultaneous increments of the function, and the variable quantity from which it is formed, has a limit to which it approaches when the increments are conceived to be continually diminished.

Direct Method.

It is now easy to see how the method of fluxions may be applied to the determination of tangents to curves, for since the ratio of the ordinate PB to the subtangent BT is always the limiting ratio of the increments of the ordinate and abscissa, it is equal to the ratio of their fluxions, that is

$$\dot{y} : \dot{x} :: y : \text{subtan. BT}.$$

Hence in any curve whatever, referred to an axis, the subtangent, (that is, the segment of the abscissa between the ordinate and tangent) is equal to $\frac{\dot{x}}{\dot{y}}y$ where $x$ denotes the abscissa, and $y$ the ordinate at the point of contact; and the subtangent being found, the position of the tangent is thereby determined.

Let us apply the above general formula to some examples.

*Example* 1. Let the proposed curve be a circle. It is required to determine the position of PT, a tangent at any point P in its circumference. Fig. 7.

Put $2a$ for AE the diameter, also $x$ for AB the abscissa, and $y$ for BP the ordinate at the point of contact.

From the nature of the curve, we have

$$AB\times BE=BP^2, \text{ that is}$$
$$x(2a-x)=y^2.$$

Hence taking the relations of the fluxions of $x$ and $y$, we have

$$2a\dot{x}-2x\dot{x}=2y\dot{y},$$

$$\text{therefore } \frac{\dot{x}}{\dot{y}}=\frac{y}{a-x},$$

$$\text{and BT}=\frac{\dot{x}}{\dot{y}}y=\frac{y^2}{a-x};$$

from which it appears that BT the subtangent is a third proportional to $a-x$ and $y$, that is, to CB the distance of the ordinate from the centre, and BP the ordinate, agreeing with what is known from the elements of geometry.

*Ex.* 2. Let the curve be a parabola, required the same as before. Fig. 8.

Put $x$ for AB, the abscissa, and $y$ for BP the ordinate at P the point of contact; also $a$ for the parameter; then, from the nature of the curve

$$PB^2=a\times AB, \text{ that is}$$
$$ax=y^2$$

therefore,

Direct Method.

therefore, taking the fluxions, we get $a\dot{x}=2y\dot{y}$, and

$$\frac{\dot{x}}{\dot{y}}=\frac{2y}{a}, \text{ and}$$

$$\text{BT}=\frac{\dot{x}}{\dot{y}}y=\frac{2y^2}{a}=\frac{2ax}{a}=2x;$$

from which it appears that the sub-tangent BT is double the abscissa BA.

Fig. 9. *Ex.* 3. Let the curve be an ellipse.

Put AB$=x$, BP$=y$, AC the semi-transverse axis $=a$, CH the semi-conjugate axis $=b$.

The nature of the curve is such, that

$$\text{AC}^2 : \text{CH}^2 :: \text{AB} \times \text{BE} : \text{BP}^2$$

$$\text{or } a^2 : b^2 :: (2a—x)\, x : y^2$$

$$\text{Hence } a^2y^2=b^2(2\,a—x)x,$$

and taking the relation of the fluxions,

$$a^2y\dot{y}=b^2(a—x)\dot{x};$$

$$\text{Therefore } \frac{\dot{x}}{\dot{y}}=\frac{a^2y}{b^2(a—x)}, \text{ and}$$

$$\text{But}=\frac{\dot{x}}{\dot{y}}y=\frac{a^2y^2}{b^2(a—x)}.$$

But from the preceding equation expressing the nature of the curve, $\frac{ay^2}{b^2}=(2a—x)x$; therefore

$$\text{BT}=\frac{\dot{x}}{\dot{y}}y=\frac{(2a—x)x}{a—x}.$$

To this expression for BT, let BC$=a—x$ be added, and we have

$$\text{CT}=a—x+\frac{(2a—x)x}{a—x}=\frac{a^2}{a—x};$$

from which it appears that CB : CA :: CA : CT.

Fig. 10. *Ex.* 4. Suppose the curve to be a hyperbola, and let it be required to find, as in the preceding examples.

Put $a$ and $b$, as in the case of the ellipse, to express the semitransverse and semiconjugate axes, then the equation of the curve is

$$a^2y^2=b^2(2a+x)x,$$

and taking the relation of the fluxions,

$$a^2y\dot{y}=b^2(a+x)\dot{x},$$

from which we find

$$\text{BT}=\frac{\dot{x}}{\dot{y}}y=\frac{a^2y^2}{b^2(+x)}$$

or, substituting $(2a+x)x$ for $\frac{a^2y^2}{b^2}$,

$$\text{BT}=\frac{\dot{x}}{\dot{y}}y=\frac{(2a+x)x}{a+x}.$$

Let this expression for BT be subtracted from the expression for CB, that is from $a+x$, and we have

$$\text{CT}=a+x—\frac{2ax+x^2}{a+x}=\frac{a^2}{a+x},$$

therefore CB : CA :: CA : CT.

Direct Method.

*Ex.* 5. Suppose the curve APD to be a cycloid, of Fig. 11. which AE is the axis, and AQE a semicircle described on the axis as a diameter. Suppose AC, the radius, to be unity; put AB$=x$, BP$=y$, and the arch AQ$=v$; then, AB$=1—$ cos. $v$. and BQ $=$sin. $v$. Now, from the nature of the curve, PB $=$arch AQ$+$BQ; hence we have

$$x=1—\text{cos. } v, \qquad y=v+\text{sin. } v,$$

and taking the fluxions, by § 59.

$$\dot{x}=\dot{v}\text{ sin. } v, \qquad \dot{y}=\dot{v}+\dot{v}\text{ cos. } v;$$

therefore,

$$\text{BT}=\frac{\dot{x}}{\dot{y}}=\frac{\dot{v}\,y\text{ sin. } v}{\dot{v}+\dot{v}\text{cos.}v.}=\frac{y\text{ sin. } v}{1+\text{cos.}v}$$

$$=\frac{\text{PB}\times\text{BQ}}{\text{EB}};$$

but from the nature of the circle $\frac{\text{BQ}}{\text{EB}}=\frac{\text{AB}}{\text{BQ}}$, therefore, BT$=\frac{\text{PB}\times\text{AB}}{\text{BQ}}$, and consequently BQ : BA :: BP : BT, from which it appears that if the chord AQ be drawn, the tangent PT is parallel to the chord QA.

74. If PT (fig. 6.) be a tangent to the curve AP at Fig. 6. the point P, and PC be drawn perpendicular to the tangent, meeting AC the axis of the curve in C, then the line PC is called a *normal* to the curve at the point P; and BC, the distance between the ordinate and the extremity of the normal, is called the *sub-normal*.

The triangles TBP, BPC being similar, we have TB : BP :: BP : BC; or, since TB : BP :: $\dot{x}:\dot{y}$, (§73.) $\dot{x}:\dot{y}::y$ : BC, hence in any curve, BC the sub-normal is equal to $\frac{y\dot{y}}{\dot{x}}$; and from this expression, we may find the sub-normal in the same way as we have found the sub-tangent in the examples of last §.

75. As by plane trigonometry

TB : BP :: rad. : tangent of T,

and from § 73, TB : BP :: $\dot{x}:\dot{y}$,

therefore $\dot{x}:\dot{y}::1$ : tan. T,

hence it appears that $\frac{\dot{y}}{\dot{x}}$ expresses the numeral tangent of the angle T, that is, the angle contained by a tangent to the curve, and the axis of the curve. In like manner we have

$\dot{y}:\dot{x}$ :: BP : BD :: CB : BP :: 1 : tan. C,

therefore $\frac{\dot{x}}{\dot{y}}$ expresses the tangent of the angle C, that is, the angle contained by a normal to the curve and its axis.

*Application*

## *Application of Fluxions to Problems relating to* MAXIMA *and* MINIMA.

76. If a variable quantity be supposed to change its magnitude, then any function of that quantity will also change its magnitude. When the variable quantity is supposed to increase continually so as to acquire successively all degrees of magnitude, there are some functions of such a form, that they either increase continually, or decrease continually; but there are others again which increase to a certain limit, after which they decrease; or else they decrease to a certain limit, after which they increase.

If, in consequence of the continual increase of a variable quantity, a function of that quantity first increases to a certain limit, and afterwards decreases, when it arrives at that limit it is then said to be a *maximum*. Or if it decrease to a certain limit, and afterwards increase, when it arrives at that limit, it is then said to be a *minimum*.

77. Let us consider the function $y=b-(x-a)^2$. If we suppose $x=0$, then $y=b-a^2$. Suppose now $x$ to be at first very small, and to increase; then as $(x-a)^2$ will decrease, $y$ will also increase, till $x$ become $=a$, and then $y$ will become $=b$, when it is a *maximum;* for $x$ being supposed to become greater than $a$, $y$ will be less than $b$. By supposing $x$ to increase till $(x-a)^2$ become equal to $b$, then $y$ will decrease to 0; and $x$ being still supposed to increase, $y$ will become negative.

Let us next suppose $y=b+(x-a)^2$. In this case when $x=0$, $y=b+a^2$; as $x$ increases, $(x-a)^2$ decreases, and consequently $y$ decreases, till $x=a$, and then $y=b$, a *minimum;* for $x$ becoming greater than $a$, $y$ becomes greater than $b$.

78. Every function that either increases or decreases continually has neither *maximum* nor *minimum;* for whatever value such a function may acquire, in the one case it may always have a greater, and in the other a less value.

The characteristic property of a *maximum* value of a function, by which it is made the object of analytical inquiry, consists in its being greater than the values immediately preceding, and also greater than the values immediately following it; and that of a *minimum* consists in its being less than the values immediately preceding, and also less than the values immediately following it.

In some cases a function may increase to a certain limit and then decrease, and afterwards increase again indefinitely; or the contrary. Hence it may happen that such a function may have values greater than its *maximum* or less than its *minimum* as they have been here defined. And indeed it is easy to conceive that a function may increase and decrease alternately several times; in such a case it must be considered as having several *maxima* and *minima*.

79. Since $y$ any function of a variable quantity $x$ may be considered as the ordinate of a curve, of which $x$ is the abscissa, it is evident that to determine the greatest or least value of such a function, we have only to seek the greatest or least ordinate of the curve which is the locus of the equation expressing the relation between $x$ and $y$. Let us suppose this curve to be DPE, and that AB is the value of $x$, corresponding to BP the *maximum* or *minimum* value of the ordinate $y$; it is evident, that in the case of a *maximum*, the curve must be concave towards AC, at least to a certain extent, on each side of the point P, as in fig. 12. but that in the case of a *minimum* it must be convex towards AC, as in fig. 13.; and also, that in either case, if a straight line be drawn through P parallel to AC, the curve must be wholly on one side of that line, to a certain extent on each side of the point P, and therefore, that the line PQ must be a tangent to the curve at the point P. Figs. 12. and 13.

Now when PQ a tangent to a curve at P (fig. 8.) meets the axis in T, it has been shewn, § 75, that $\frac{\dot{y}}{\dot{x}}$ is the expression for the tangent of the angle T, radius being unity; but this angle vanishes, when PQ, instead of meeting AC, is parallel to it, as in fig. 12. and fig. 13.; therefore, as in this case the tangent of the angle is $=0$, we have $\frac{\dot{y}}{\dot{x}}=0$.

*Hence it appears, that to determine the* maximum *or* minimum *of* y, *a function of* x, *we must find the fluxion of the function, and divide it by* $\dot{x}$, *and put the result equal to* 0.

80. We proceed to illustrate this rule by some examples.

*Ex.* 1. To divide a given number $a$ into two such parts, that their products may be the greatest possible.

Let $x$ denote the one part, then $a-x$ will be the other part, and $x(a-x)$ the product of the two parts. Therefore, by the question

$$y=x(a-x)=a\,x-x^2,\ \text{a } maximum,$$

hence, taking the fluxion of the function,

$$\dot{y}=a\,\dot{x}-2x\dot{x},\ \text{and } \frac{\dot{y}}{\dot{x}}=a-2\,x,$$

$$\text{therefore, } a-2\,x=0,\ \text{and } x=\tfrac{1}{2}\,a.$$

Thus it appears that the product of the parts will be the greatest possible, when each is half the given number.

*Ex.* 2. To find the fraction which shall exceed its cube by the greatest quantity possible.

Let $x$ denote the fraction, then its cube is $x^3$, so that we have

$$y=x-x^3,\ \text{a } maximum;$$

therefore, taking the fluxion of the function,

$$\dot{y}=\dot{x}-3\,x^2\dot{x},\ \text{and } \frac{\dot{y}}{\dot{x}}=1-3\,x^2=0,$$

hence $3\,x^2=1$, and $x=\sqrt{\frac{1}{3}}$, the fraction required.

*Ex.* 3. To determine the greatest rectangle that can be inscribed in a given triangle.

Put the base AC of the triangle $=b$, and its altitude BD$=a$, and let B $n$, the altitude of the rectangle $p\cdot q\,r\cdot s$, considered as variable, be denoted by $x$, then, Fig. 14

because

because of the parallel lines A C, $pq$, it will be, as B D : A C : : D $n$ : $pq$, that is $a : b :: a-x : pq$, hence $pq=\frac{b(a-x)}{a}$, and the area of the rectangle, or $pq\times$ B $n$, will be $=\frac{b(a-x)x}{a}$, therefore $y=\frac{b(a-x)x}{a}$ must be a *maximum*, and hence $\dot{y}=\frac{ba\dot{x}-2bx\dot{x}}{a}$: thus we have

$$\frac{\dot{y}}{\dot{x}}=\frac{ba-2bx}{a}=0,$$

and $ba-2bx=0$, and $x=\frac{1}{2}a$; hence it appears that the greatest inscribed rectangle is that whose altitude is half the altitude of the triangle.

81. It is proper to observe that the value of a quantity, when a *maximum* or *minimum*, may often be determined more readily by considering that any given multiple, or part of the function, likewise any power or root of it, must then be also a *maximum* or *minimum*. Thus in the preceding example, in which the function to be a *maximum* is $\frac{b(a-x)x}{a}$, we may reject the constant multiplier $\frac{b}{a}$, and then the function to be a maximum is $y=(a-x)x=ax-x^2$, the fluxion of which being taken, we have $\dot{y}=a\dot{x}-2x\dot{x}$ and $\frac{\dot{y}}{\dot{x}}=a-2x=0$, hence $x=\frac{1}{2}a$, the same value as before.

82. *Ex.* 4. Of all the right-angled plane triangles having the same given hypothenuse, to find that whose area is greatest.

Let A B C be the triangle; put A B$=x$, and A C, the given hypothenuse, $=a$, then BC$=\sqrt{(a^2-x^2)}$, and consequently the area of the triangle is $\frac{x}{2}\sqrt{(a^2-x^2)}$, which being a *maximum*, its square $\frac{x^2(a^2-x^2)}{4}$, also four times that square, or $x^2(a^2-x^2)$, will likewise be a *maximum*, therefore, $y=x^2(a^2-x^2)=a^2x^2-x^4$, a *max.* hence $\dot{y}=2a^2x\dot{x}-4x^3\dot{x}$, and

$$\frac{\dot{y}}{\dot{x}}=2a^2x-4x^3=0,$$

hence $2x^2=a^2$, and $x=x\sqrt{\frac{1}{2}}$.

*Ex.* 5. To determine the greatest cylinder that can be inscribed in a given cone.

Put AC the base of the cone $=b$, BH its altitude $=a$, and DF, the diameter of the end of the cylinder DIGF inscribed in the cone, $=x$. From the similar triangles BAC, BDF, we have AC : BH : : DF : BE, that is $b : a :: x$ : BE, hence BE$=\frac{ax}{b}$, and EH$=$BH $-$ BE $=a\frac{ax}{b}=\frac{ab-ax}{b}$. Put $c$ for the number .78539, then the area of the base of the cylinder is (by the Elements of Geometry) $c\times$DF², and its solid content $c\times$DF²$\times$EH$=\frac{cax^2(b-x)}{b}$, hence $\frac{cax^2(b-x)}{b}$ is to be a *maximum*, therefore, leaving out the constant multiplier $\frac{ca}{b}$, we have $y=x^2(b-x)=bx^2-x^3$, a *maximum*; taking now the fluxions, we get

Direct Method.

$$\dot{y}=2bx\dot{x}-3x^2\dot{x}, \text{ and } \frac{\dot{y}}{\dot{x}}=2bx-3x^2=0,$$

hence $3x^2=2bx$, and $x=\frac{2}{3}b$, and consequently HF $=\frac{1}{3}$ BH.

*Ex.* 6. To find the sun's place in the ecliptic, when that part of the equation of time which arises from the obliquity of the ecliptic is a *maximum*.

Let EQ be the equator, EC the ecliptic, S the sun's place, and SA his declination, then this part of the equation of time is the difference of the sun's longitude ES, and right ascension EA, turned into time. Put the arch ES$=x$, the arch EA$=v$, which is to be considered as a function of $x$, and put $a$ for the cosine of the angle E$=23°$ 28′. Then, by Spherical Trigonometry, in the right-angled spherical triangle EAS, we have tan. EA$=$cos. E$\times$tan. ES; therefore, to determine $x$ we have tan. $v=a$ tan. $x$, and $y=x-v$, a *maximum*. Fig. 17.

From the second of these equations we get

$$\dot{y}=\dot{x}-\dot{v}, \text{ and } \frac{\dot{y}}{\dot{x}}=1-\frac{\dot{v}}{\dot{x}}=0,$$

and from the first, by § 60.

$$\dot{v}\text{ sec.}^2v=a\dot{x}\text{ sec.}^2x, \text{ and } \frac{\dot{v}}{\dot{x}}=\frac{a\text{ sec.}^2x}{\text{sec.}^2v},$$

therefore, $1-\frac{a\text{ sec.}^2x}{\text{sec.}^2v}=0$, and sec.²$v=a$ sec.²$x$,

or $1+\text{tan.}^2v=a+a\text{ tan.}^2x$, but from the first equation tan.²$v=a^2$ tan.²$x$, therefore,

$$1+a^2\text{ tan.}^2x=a+a\text{ tan.}^2x,$$
$$\text{or } a(a-1)\text{ tan.}^2x=a-1,$$

hence tan. $x=\frac{1}{\sqrt{a}}=1.04416$, the tangent of 46° 14′, the sun's longitude when this part of the equation is a *maximum*.

83. We have deduced the rule of § 79. for determining when a function is a maximum, or minimum, from the consideration of curve lines. The whole theory of *maxima* and *minima* may however be explained in a manner purely analytical, as follows:

Let us suppose that $y$ is any function whatever of $x$, and that $x$ has acquired the value that produces the *maximum* or *minimum* of the function; then, if we suppose $x-h$ and $x+h$ to be substituted successively in the fuction instead of $x$, the two resulting values ought to be both less than the maximum or both greater than the minimum value.

Direct Method.

Let us denote the value of the function that results from the substitution of $x-h$ by ${}'y$ and that which results from the substitution of $x+h$ by $y'$, then by the theorem given in § 69,

$${}'y=y-\frac{\dot{y}}{\dot{x}}h+\frac{\ddot{y}}{\dot{x}^2}\frac{h^2}{2}-\frac{\dddot{y}}{\dot{x}^3}\frac{h^3}{2.3}+\&c.$$

$$y'=y+\frac{\dot{y}}{\dot{x}}h+\frac{\ddot{y}}{\dot{x}^2}\frac{h^2}{2}+\frac{\dddot{y}}{\dot{x}^3}\frac{h^3}{2.3}+\&c.$$

In each of these values, $\frac{\dot{y}}{\dot{x}}$, the coefficient of $h$, must either be equal to some quantity, positive or negative, or else it must $=0$. Let us suppose, if possible, that it is equal to some quantity, positive or negative; now as $h$ may be conceived to be so small that the term $\frac{\dot{y}}{\dot{x}}h$, or any other term, shall exceed the sum of all the terms that follow it in each series, (D) if we suppose $h$ to have such a value, then, because of the term $\frac{\dot{y}}{\dot{x}}h$ having the sign $-$ in the one series, and $+$ in the other, it follows that the one value of the function is greater, and the other less than $y$, the *maximum* or *minimum* value: But this conclusion is inconsistent with the nature of a *maximum* or *minimum*, therefore $\frac{\dot{y}}{\dot{x}}$ cannot in the case of a maximum or minimum be equal to any positive or negative quantity whatever.

If however we assume $\frac{\dot{y}}{\dot{x}}=0$, so that the two values are,

$${}'y=y+\frac{\ddot{y}}{\dot{x}^2}\frac{h^2}{2}-\frac{\dddot{y}}{\dot{x}^3}\frac{h^3}{2.3}+\&c.$$

$$y'=y+\frac{\ddot{y}}{\dot{x}^2}\frac{h^2}{2}+\frac{\dddot{y}}{\dot{x}^3}\frac{h^3}{2.3}+\&c.$$

then as the second term $\frac{\ddot{y}}{\dot{x}^2}\frac{h^2}{2}$ has the same sign in both, when that term is greater than all the terms that follow it, we shall have both values greater than $y$ when $\frac{\ddot{y}}{\dot{x}^2}$ is positive, and both less when it is negative, the first case corresponding to a *maximum*, and the second to a *minimum*.

Hence, to determine the *maximum* or *minimum* of the function $y$, it appears that we must take the fluxion of $y$, and divide it by $\dot{x}$, and put the result equal to 0, which agrees with what was shewn in § 79.

84. Although in the case of a function admitting of a *maximum* or *minimum* we have always $\frac{\dot{y}}{\dot{x}}=0$, yet we must not conclude that conversely the one or the other of these has place every time that $\frac{\dot{y}}{\dot{x}}=0$. For if it so happens that the value of $x$ that renders $\frac{\dot{y}}{\dot{x}}=0$, causes also $\frac{\ddot{y}}{\dot{x}^2}$ to vanish, without at the same time making $\frac{\dddot{y}}{\dot{x}^3}$ to disappear, then we have

$${}'y=y-\frac{\dddot{y}}{\dot{x}^3}\frac{h^3}{2.3}+\frac{\ddddot{y}}{\dot{x}^4}\frac{h^4}{2.3.4}-\&c.$$

$$y'=y+\frac{\dddot{y}}{\dot{x}^3}\frac{h^3}{2.3}+\frac{\ddddot{y}}{\dot{x}^4}\frac{h^4}{2.3.4}+\&c.$$

and as by giving a proper value to $h$, $\frac{\dddot{y}}{\dot{x}^3}\frac{h^3}{2.3}$ may be rendered greater than the sum of all the following terms in each series, it follows, that $\frac{\dddot{y}}{\dot{x}^3}$ being supposed to be any quantity either positive or negative, because of its sign being different in the two values, the one of them will be greater, and the other less than $y$, the *maximum* or *minimum* value, which result is inconsistent with the nature of a maximum or minimum. If however $\frac{\dddot{y}}{\dot{x}^3}$ be assumed $=0$, then

${}'y=$

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(D) If this should not appear sufficiently obvious, let

$$A\,h+B\,h^2+C\,h^3+D\,h^4+\&c.$$

be such a series, where A, B, C, D, &c. denote quantities either positive or negative, but which are independent of $h$. Then, writing the series thus,

$$h(A+B\,h+C\,h^2+D\,h^3+\&c.)$$

it is obvious that if $h$ be conceived to be continually diminished, and at last to become $=0$, the part

$$B\,h+C\,h^2+D\,h^3+\&c.$$

will also become $=0$, therefore before it vanishes it will be less than A, or any other assignable quantity, therefore $B\,h^2+C\,h^3+D\,h^4+$ &c. may become less than $A\,h$.

Direct Method.

$$y = y + \frac{\overset{::}{y}}{\dot{x}^4}\frac{h^4}{2.3.4} - \&c.$$

$$y' = y + \frac{\overset{::}{y}}{\dot{x}^4}\frac{h^4}{2.3.4} + \&c.$$

here again, the coefficient of the second term having in both values the same sign, the conditions of the maximum or minimum are fulfilled, and the sign of $\frac{\overset{::}{y}}{\dot{x}^4}$ shews when the one or the other is to have place.

It must now be sufficiently evident, without proceeding any further, *that a function can only admit of a* maximum *or a* minimum *when the first of its fluxions that does not vanish, is of an even order (or is its second or fourth fluxion, &c.), and that the sign of that fluxion is negative in the case of a* maximum, *but positive in the case of a* minimum.

85. We shall conclude this theory by applying it to an example. Let $y$ be such a function of $x$ that

$$y^2 - 2mxy + x^2 - a^2 = 0,$$

then by § 49,

$$(y - mx)\dot{y} - (my - x)\dot{x} = 0,$$

and hence $\frac{\dot{y}}{\dot{x}} = \frac{my - x}{y - mx} = 0,$

therefore $my - x = 0$, and $y = \frac{x}{m}$.

To find the value of $x$, let this value of $y$ be substituted in the original equation, it thus becomes

$$\frac{x^3}{m^2} - x^2 - a^2 = 0,$$

hence we find

$$x = \frac{ma}{\sqrt{(1 - m^2)}}, \text{ and } y = \frac{a}{\sqrt{(1 - m^2)}}.$$

We must now examine what is the nature of the expression for $\frac{\ddot{y}}{\dot{x}^2}$. Taking the fluxion of the equation $\frac{\dot{y}}{\dot{x}} = \frac{m - yx}{y - mx}$, and considering that $\dot{x}$ is constant, we have

$$\frac{\ddot{y}}{\dot{x}^2} = \frac{(1 - m^2)(\dot{x}y - \dot{y}x)}{(y - mx)^2},$$

therefore, dividing by $\dot{x}$,

$$\frac{\ddot{y}}{\dot{x}^2} = \frac{1 - m^2}{(y - mx)^2}\left\{\frac{\dot{y}}{\dot{x}}x - y\right\},$$

but as in the present case $\frac{\dot{y}}{\dot{x}} = 0$, and $y = \frac{m}{x}$, this expression becomes simply

$$\frac{\ddot{y}}{\dot{x}^2} = \frac{-m}{x\sqrt{(1 - m^2)}},$$

which equation, by putting instead of $x$ its value $\frac{ma}{\sqrt{(1 - m^2)}}$, becomes

$$\frac{\ddot{y}}{\dot{x}} = -\frac{1}{a\sqrt{(1 - m^2)}},$$

and as this result is negative, we conclude that the value which we have found for $y$ is a *maximum*.

*Of the values of fractions, the numerators and denominators of which vanish at the same time.*

86. There are some fractional functions of such a nature, that by giving a particular value to the variable quantity, both the numerator and denominator of the fraction vanish, and thus the fraction is reduced to this form $\frac{0}{0}$, an expression from which nothing can be concluded. We have an example of this in the fraction $\frac{x - a}{x^2 - a^2}$, which, by supposing $x = a$ becomes $\frac{a - a}{a^2 - a^2} = \frac{0}{0}$; we must not however conclude that the fraction has no determinate value in this particular case, for if we consider that its numerator and denominator have a common divisor, viz. $x - a$, it is evident that by taking this divisor out of both, the fraction $\frac{x - a}{x^2 - a^2} = \frac{x - a}{(x - a)(x + a)}$, becomes $\frac{1}{x + a}$, an expression, which in the case of $x = a$ is equal to $\frac{1}{2a}$.

87. In general, if we make $x = a$ in an expression of this form $\frac{P(x - a)^m}{Q(x - a)^n}$, it becomes $\frac{0}{0}$; however its true value is either nothing, or finite, or infinite, according as $m > n$, or $m = n$, or $m < n$; for by taking out the factors common to the numerator and denominator, the fraction becomes $\frac{P(x - a)^{m - n}}{Q}$ in the first case, $\frac{P}{Q}$ in the second, and $\frac{P}{Q(x - a)^{m - n}}$ in the third; here we suppose that P and Q are such functions as neither become nothing, nor infinite, by the supposition of $x = a$.

88. Therefore, when by giving a particular value to $x$ a function of that quantity assumes the form $\frac{0}{0}$, to discover the true value of the function in this particular case, we must disengage the factors which are common to the numerator and denominator. This may be done in most cases by finding their common measure (ALGEBRA, § 49.) but the direct method of fluxions furnishes us with another method.

In the expression $P(x - a)$, where P denotes any function of $x$ that is independent of $x - a$, if we suppose $x = a$, then the expression vanishes; the fluxion however of the expression, viz. $(x - a)\dot{P} + P\dot{x}$, is a quantity which does not vanish when $x = a$, but is then reduced to its last term, that is to $P\dot{x}$.

Again,

Again, the function $P(x-a)^2$ vanishes by supposing $x=a$, but if we take its fluxion, viz. $(x-a)^2\dot{P}+2(x-a)P\dot{x}$, and again the fluxion of this quantity, we get

$$(x-a)^2\ddot{P}+4(x-a)\dot{P}\dot{x}+1.2P\dot{x}^2,$$

an expression which does not vanish upon the hypothesis of $x=a$, but is reduced to its last term, viz. $1.2P\dot{x}^2$. By proceeding in this manner, it is easy to see that by taking the fluxion of a function of the form $P(x-a)^m$ $m$ times successively ($m$ being a whole number) we shall finally obtain an expression, all the terms of which, except the last, vanish by supposing that $x=a$; and that the last term will be $1.2.3\ldots mP\dot{x}^m$, an expression free from the factor $(x-a)^m$, and involving only the function P.

89. It is not necessary that we should know the number $n$, nor that we should exhibit the factor $(x-a)^n$, in order to determine when the expression $P(x-a)^n$, is freed from that factor. We have only to ascertain after each operation of taking the fluxion, whether the result vanishes or not, when we substitute $a$ instead of $x$; for in the last case the operation is finished, and the result is the quantity $1.2.3\ldots P\dot{x}^n$. Suppose for example the function to be $x^3-ax^2+a^2x+a^3$, which vanishes when $x=a$, its first fluxion also vanishes when $x=a$, but not its second fluxion, which is $(6x-2a)\dot{x}^2$, hence we may conclude that the function has the form $P(x-a)^2$, which is besides obvious, because

$$x^3-ax^2-a^2x+a^3=(x+a)(x-a)^2.$$

90. In applying these observations to the fraction $\frac{P(x-a)^m}{Q(x-a)^n}$, it appears, that by repeating the operation of taking the fluxions of its numerator and denominator, they will be freed at once from the factor $x-a$, if $m=n$. If a result, which does not vanish, be obtained first from the numerator, then we may be assured, that the factor, $(x-a)$ is found in the numerator raised to a less power than in the denominator, and in this case the fraction is infinite when $x=a$. If on the contrary the first result that does not vanish is found from the denominator, then the numerator contains a higher power of $(x-a)$ than the denominator, and in this case, when $x=a$, the fraction vanishes.

The rule for finding the value of a function which becomes $\frac{0}{0}$ by giving a particular value to $x$, may therefore be expressed thus. *Take the successive fluxions of both the numerator and denominator until a result which does not vanish be obtained from either the one or the other, or from both at the same time; in the first case the function is infinite, in the second it is equal to 0, and in the last case its value is finite.*

91. We proceed to illustrate this rule by a few examples.

*Ex.* 1. The value of the function $\frac{x^3-1}{x^2-1}$ is required when $x=1$.

The fluxion of the numerator is $3x^2\dot{x}$, and that of the denominator is $2x\dot{x}$, neither of which quantities vanish when $x=1$, therefore, in this particular case, the value of the fraction is $\frac{3x^2}{2x}=\frac{3}{2}$.

*Ex.* 2. Suppose the fraction to be $\frac{ax^2-2acx+ac^2}{bx^2-2bcx+bc^2}$, which vanishes when $x=c$.

By taking the fluxions of the numerator and denominator we obtain $\frac{2ax\dot{x}-2ac\dot{x}}{2bx\dot{x}-2bc\dot{x}}=\frac{ax-ac}{bx-bc}$, a fraction, the numerator and denominator of which still vanish upon the hypothesis of $x=c$, we therefore take the fluxions a second time, and get $\frac{2a\dot{x}^2}{2b\dot{x}^2}=\frac{a}{b}$ for the value of the proposed fraction in the particular case of $x=c$.

*Ex.* 3. Suppose the fraction to be

$$\frac{x^3-ax^2-a^2x+a^3}{x^2-a^2},$$

which vanishes when $x=a$. In this example, by taking the fluxions of the numerator and denominator once, we get

$$\frac{3x^2\dot{x}-2ax\dot{x}-a^2\dot{x}}{2x\dot{x}}=\frac{3x^2-2ax-a^2}{2x},$$

an expression, of which only the numerator vanishes upon the supposition of $x=a$; hence we may conclude the true value of the fraction in this case to be 0.

The contrary happens in the fraction

$$\frac{ax-x^2}{a^4-2a^3x+2ax^3-x^4};$$

we may therefore conclude that when $x=a$, this last fraction becomes infinite.

92. The rule § 90. can only be applied when the factors common to the numerator and denominator are integer powers of $x-a$, for as by taking the fluxions, the index of $(x-a)^m$ is diminished by an unit at each operation; when $m$ is a fraction we shall at last arrive at a result containing negative powers of $x-a$, which therefore, when $x=a$, will become infinite. The following mode of proceeding will however apply to all cases whatever.

Let $\frac{X}{X'}$ be a fraction of which the numerator and denominator both vanish when $x=a$; by substituting in it $a+h$ instead of $x$, the functions X and X' may be expanded into a series of this form,

$$Ah^{\alpha}+Bh^{\beta}+\&c. \qquad A'h^{\alpha'}+B'h^{\beta'}+\&c.$$

which are *ascending*, that is, having the exponents of the powers positive and increasing; because the series must become 0, upon the hypothesis that $h=0$. We have therefore

$$\frac{Ah^{\alpha}+Bh^{\beta}+\&c.}{A'h^{\alpha'}+B'h^{\beta'}+\&c.}$$

instead of the proposed fraction.

Now

Direct Method.

Now if $\alpha > \alpha'$, by dividing the numerator and denominator of this expression by the factor, $h^{\alpha'}$, which is common to all the terms of each, it becomes

$$\frac{A\,h^{\alpha-\alpha'}+B\,h^{\beta-\alpha'}+\&c.}{A'+B\,h^{\beta'-\alpha'}+\&c.},$$

a quantity which, by supposing $h=0$, is reduced to $\frac{0}{A'}$, that is to 0. If again $\alpha=\alpha'$, the expression for the fraction, after dividing the numerator and denominator by $h^{\alpha}$, is

$$\frac{A+B\,h^{\beta-\alpha'}+\&c.}{A'+B\,h^{\beta'-\alpha'}+\&c.},$$

which, by supposing $h$ to be $=0$, becomes simply $\frac{A}{A'}$, a finite quantity. If, however, $\alpha < \alpha'$, then the expression for the fraction is

$$\frac{A+B\,h^{\beta-\alpha}+\&c.}{A\,h^{\alpha'-\alpha}+B h^{\beta'-\alpha}+\&c.},$$

which, when $h=0$, becomes $\frac{A}{0}$, an expression which may be considered as infinite. Thus it appears that in each case the true value of the fraction depends only on A and A', the first terms of the series.

The following rule is applicable to every function that can appear under the indeterminate form $\frac{0}{0}$.

*Find the first term of each of the ascending series which express the developements of the numerator and denominator when* a+h *is substituted in them instead of* x. *Reduce the new function formed of these first terms to its most simple form, and make* h=0; *the results shall be the different values of the proposed function when* x *is made equal to* a.

Example. Suppose the function to be

$$\frac{\sqrt{x}-\sqrt{a}+\sqrt{(x-a)}}{\sqrt{(x^2-a^2)}},$$

which, when $x=a$, becomes $\frac{0}{0}$. By substituting $a+h$ instead of $x$, and developing the results into series, the numerator becomes $h^{\frac{1}{2}}+\frac{h}{2\sqrt{a}}+$ &c. and the denominator $\sqrt{2a}h^{\frac{1}{2}}+\frac{h^{\frac{3}{2}}}{2\sqrt{2a}}+$ &c. Taking now the first term of each series, we have $\frac{h^{\frac{1}{2}}}{2\sqrt{2a}h^{\frac{1}{2}}}=\frac{1}{2\sqrt{2a}}$, an expression in which $h$ is not found; therefore the value of the function is $\frac{1}{\sqrt{2a}}$, when $x=a$.

### *Of the Radii of Curvature.*

93. Let HC'CF represent a material curve, or mould. Let a thread be fastened to it at H, and made to pass along the curve, so as to coincide with it in its whole extent from H to F. Let the thread be now unlapped or *evolved* from the curve, then its extremity F will describe another curve line FAPP'. The curve HCF is called the Evolute of the curve FAP; and the curve FAP is called the Involute of the curve HCF.

94. From this mode of conceiving the curve to be generated, we may draw the following conclusions.

1st. Suppose PC to be a portion of the thread detached from the evolute, then PC will be a tangent to the evolute at C.

2dly. The line PC will be perpendicular to a tangent to the curve FAP at the point P, or will be a normal to the curve at that point. For the point P may be considered as describing at the same time an element of the curve FAP, and an element of a circle $q$ P $q'$, whose momentary centre is C, and which has PC for its radius.

3dly. That part of the curve between F and P, which is described with radii all of which are shorter than CP, is more incurvated than a circle described on C as a centre, with a radius equal to CP. And in like manner PP', the part of the curve on the other side of P, which is described with radii greater than PC, is less incurvated than that circle.

4thly. The circle $q$ P $q'$ has the same curvature as the curve APP' itself has at P: hence it is called an Equicurve circle, and its radius PC is called the Radius of Curvature at the point C.

95. We are now to investigate how the radius of curvature at any point in FAP any proposed curve may be found.

Let AB and BP be the co-ordinates at P any point in the curve, and PC its radius of curvature; and let PC meet AB in E. Put the abscissa AB$=x$, the ordinate BP$=y$, the arch AP$=z$, the angle AEP (that is, the arch which measures that angle, radius being unity) $=v$, the radius of curvature PC$=r$. Take P' another point in the curve, and let P' C' be the radius of curvature at that point. Let P'C' meet AB in E', and PC in D, and on D as a centre, with a radius$=1$, describe an arch of a circle, meeting the radii PC, P'C' in $m$ and $n$. Then the arch PP' will be the increment of $z$; and since the angle PDP' is the difference of the angles PEA, P'E'A, the arch $m\,n$ will be the corresponding increment of $v$.

Suppose now the point P' to approach continually to P, then the points C' and D will approach to C, and the ratio of the arch PP', the increment of $z$, to the arch $m\,n$ the increment of $v$, will approach to the ratio of CP to C $m$, that is to the ratio of $r$ to 1; therefore the ratio of $r$ to 1 is the limit of the ratio of AP' to $m\,n$, or $r=$ limit of $\frac{\text{PP}'}{m\,n}$, and passing to the ratio of the fluxions, $r=\frac{\dot{z}}{\dot{v}}$, thus we have obtained a formula expressing the radius of curvature, by means of the fluxion of the arch of the curve, and the fluxion of the angle which a normal to the curve makes with the line of the abscissas. We proceed to deduce from this formula other expressions which may involve the fluxions of $x$ and $y$ only.

96. Because PE is a normal to the curve at E, the tangent of the angle PEA or $v$ is equal to $\frac{\dot{x}}{\dot{y}}$ (§ 75.), put $\frac{\dot{x}}{\dot{y}}=t$, then because tan. $v=t$, we have, by taking the fluxions (§ 60.), $\dot{v}$ sec.$^2$ $v=\dot{t}$, but sec.$^2$ $v=1+$tan.$^2$ $v$ $=1+\frac{\dot{x}^2}{\dot{y}^2}=\frac{\dot{x}^2+\dot{y}^2}{\dot{y}}=\frac{\dot{z}^2}{\dot{y}^2}$ (§ 63.), therefore $\frac{\dot{v}\ \dot{z}^2}{\dot{y}}=\dot{t}$ and $\dot{v}=\frac{\dot{t}\ \dot{y}^2}{\dot{z}^2}$.

Substituting now this value of $\dot{v}$ in the formula $r=\frac{\dot{z}}{\dot{v}}$

it becomes $\frac{\dot{z}^3}{\dot{t}\ \dot{y}^2}$.

If we now recollect that $t=\frac{\dot{x}}{\dot{y}}$, and that $\dot{z}^2=\dot{x}^2+\dot{y}^2$, it will appear that this other expression which we have found for $r$ involves in effect the fluxions of $x$ and $y$ only.

97. In computing the values of $t=\frac{\dot{x}}{\dot{y}}$, and $\frac{\dot{z}^3}{\dot{t}\ \dot{y}^2}$ we may consider any two of the three quantities $x$, $y$, $z$, as a function of the remaining quantity; and upon that hypothesis compute their fluxions.

Thus if we suppose that $y$ and $z$ are functions of $x$, then, as in taking the fluxions of $y$, $t$, and $z$, we must consider $\dot{x}$ as a given or constant quantity, from the equation $t=\frac{\dot{x}}{\dot{y}}$ we have $\dot{t}=-\frac{\dot{x}\ \ddot{y}}{\dot{y}^2}$ (§ 39.), and substituting this value of $\dot{t}$ in $\frac{\dot{z}^3}{\dot{t}\ \dot{y}^2}$, the value last found for $r$, it becomes

$$r=\frac{\dot{y}}{-\dot{x}\ \ddot{y}}=\frac{(\dot{x}^2+\dot{y}^2)^{\frac{3}{2}}}{-\dot{x}\ \ddot{y}}.$$

If again, instead of considering $y$ and $z$ as functions of $x$, we consider $x$ and $z$ as functions of $y$, then from the equation $t=\frac{\dot{x}}{\dot{y}}$ (as $\dot{y}$ must now be reckoned constant), we get $\dot{t}=\frac{\ddot{x}}{\dot{y}}$, thus the formula $r=\frac{\dot{z}}{\dot{t}\ \dot{y}^2}$ becomes

$$r=\frac{\dot{z}^3}{\ddot{x}\ \dot{y}}=\frac{(\dot{x}^2+\dot{y}^2)^{\frac{3}{2}}}{\ddot{x}\ \dot{y}}.$$

We shall now apply these formulæ to some examples.

98. *Example* 1.—It is required to find the general expression for the radius of curvature of a parabola.

The equation of the parabola is $y=a^{\frac{1}{2}}\ x^{\frac{1}{2}}$, therefore, $\dot{y}=\frac{1}{2}a^{\frac{1}{2}}\dot{x}x^{-\frac{1}{2}}=\frac{a^{\frac{1}{2}}\dot{x}}{2x^{\frac{1}{2}}}$, and, making $\dot{x}$ constant, $\ddot{y}=-\frac{1}{4}a^{\frac{1}{2}}\dot{x}^2x^{-\frac{3}{2}}=\frac{-a^{\frac{1}{2}}\dot{x}^2}{4x^{\frac{3}{2}}}$, therefore, $\dot{z}=\sqrt{(\dot{x}^2+\dot{y}^2)}$ $=\frac{\dot{x}}{2}\sqrt{\left(\frac{4x+a}{x}\right)}$, and, putting $r$ for the radius of curvature,

$$r=\frac{\dot{z}^3}{-\dot{x}\ \ddot{y}}=\frac{(a+4x)^{\frac{3}{2}}}{2\sqrt{a}}.$$

If in this general expression, we put $x=0$, we find $\frac{a^{\frac{3}{2}}}{2\sqrt{a}}=\frac{1}{2}a$ for the radius of curvature at the vertex of the curve.

*Ex.* 2. Suppose the curve to be an ellipse, required as in the last example.

Putting $a$ and $c$ to denote the two axes, the equation of the ellipse is $a^2y^2=c^2(ax-x^2)$. Hence taking the first and second fluxions, we have $2a^2y\dot{y}=c^2\dot{x}(a-2x)$, and $2a^2\dot{y}^2+2a^2y\ddot{y}=-2c^2\dot{x}^2$; whence $\dot{y}=\frac{c^2\ \dot{x}(a-2x)}{2a^2y}$, and $-\ddot{y}=\frac{a^2\dot{y}^2+c^2\dot{x}^2}{a^2y}$, which expressions, by substituting the values of $y$ and $\dot{y}$, become

$$\dot{y}=\frac{c\dot{x}(a-2x)}{2a\sqrt{(ax-x^2)}}$$

$$-\ddot{y}=\begin{cases}\dfrac{a^2c^2\dot{x}^2(a-2x)^2}{4a^3c(ax-x^2)\sqrt{(ax-x^2)}}\\[2ex] +\dfrac{c\dot{x}^2}{a\sqrt{(ax-x^2)}}\end{cases}$$

$$=\frac{c\dot{x}^2}{a}\times\frac{(a-2x)^2+4(ax-x^2)}{4(ax-x^2)\sqrt{(ax-x^2)}}$$

$$=\frac{ca\dot{x}^2}{4(ax-x^2)^{\frac{3}{2}}};$$

therefore,

$$\dot{z}=\sqrt{(\dot{x}^2+\dot{y}^2)}$$

$$=\sqrt{\left(\frac{c^2\dot{x}^2(a-2x)^2}{4a^2(ax-x^2)}+x^2\right)}$$

$$=\frac{\dot{x}}{2a}\sqrt{\left(\frac{c^2a^2+(a^2-c^2)(4ax-4x^2)}{ax-x^2}\right.},$$

and

$$r=\frac{\dot{z}^3}{-\dot{x}\ \ddot{y}}$$

$$\frac{(a^2c^2+4(a^2-c^2)(ax-x^2))^{\frac{3}{2}}}{2a^4c};$$

which expression, when $x=0$, becomes simply $\frac{c^2}{2a}$, the radius of curvature at the vertices of the transverse axis; but when $=x\frac{1}{2}a$, it becomes $\frac{a^2}{2c}$, the radius of curvature at the vertices of the conjugate axis.

PART

Inverse Method.

# PART II. THE INVERSE METHOD OF FLUXIONS.

99. AS the DIRECT METHOD of fluxions treats of finding the relation between the fluxions of variable quantities, having given the relation subsisting between the quantities themselves; so the INVERSE METHOD treats of finding the relation subsisting between the variable quantities, having given the relation of their fluxions.

Whatever be the relation between variable quantities, we can in every case assign the relation of their fluxions; therefore the direct method of fluxions may in this respect be considered as perfect. But it is not the same with the inverse method, for there are no direct and general rules, by which we can in every case determine, from the relation of the fluxions, that of their flowing quantities or fluents. All we can do is to compare any proposed fluxion with such fluxions as are derived from known fluents by the rules of the direct method, and if we find it to have the same form as one of these, we may conclude that the fluents of both, or at least the variable parts of these fluents, are identical.

100. In the direct method we have shewn, that by proper transformations, the finding of the fluxion of any proposed function is reducible to the finding of the fluxions of a few simple functions, and of the sums, or products, or quotients of such functions. In like manner, in the inverse method we must endeavour to transform complex fluxionary expressions into others more simple, so as to reduce them, if possible, to some fluxion, the fluent of which we already know.

## SECT. I. *Of the Fluents of Fluxions involving one variable quantity.*

101. As when $y$ is such a function of a variable quantity $x$, that $y=Ax^m+C$, where A, $m$ and C denote constant quantities, we find by the direct method (§ 36. and § 26.) that $\dot{y}=m\,A\,x^{m-1}\,\dot{x}$, or (putting $a$ instead of $m$ A, and $n$ instead of $m-1$), $\dot{y}=ax^n\dot{x}$; so, on the contrary, as often as we have the fluxional equation

$$\dot{y}=ax^n\dot{x},$$

we may conclude that the relation of the fluents is expressed by the equation

$$y=\frac{ax^{n+1}}{n+1}+C;$$

for by substituting $m$ A instead of $a$, and $m-1$ instead of $n$ in this equation, it becomes $y=A\,x^m+C$, the same equation as that from which the fluxional equation was derived.

102. The value of the constant quantity C, which is generally called by writers on fluxions, the *correction* of the fluent, is to be determined from the particular inquiry in which the fluxional equation $\dot{y}=ax^n\dot{x}$ occurs. If it be known that $y=0$, when $x$ acquires some known magnitude, which may be denoted by $b$, then the general equation $y=\frac{ab^{n+1}}{n+1}+C$, becomes in that particular case

$$0=\frac{ab^{n+1}}{n+1}+C;$$

Hence, by subtracting each side of this last equation from the corresponding side of the former, we get

$$y=\frac{a(x^{n+1}-b^{1+n})}{n+1}$$

an equation that is independent of the constant and arbitrary quantity C.

103. By giving particular values to $n$ in the fluxional equation $\dot{y}=ax^n\dot{x}$, and in that of the fluents $y=\frac{a(x^{n+1}-b^{n+1})}{n+1}$, we may obtain particular fluxional equations, and corresponding equations of the fluents. There is however one case which requires to be noticed; it is when $n$ is $=-1$; then the equation of the fluxions is $\dot{y}=ax^{-1}\dot{x}=\frac{a\dot{x}}{x}$, and that of the fluents, according to the general formula $y=\frac{a(x^{-1+1}-b^{-1+1})}{-1+1}$ $=\frac{a(x^0-b^0)}{0},=\frac{a(1-1)}{0}=\frac{0}{0}$, but from this expression it is manifest, that nothing can be concluded. The value of the function $\frac{a(x^{n+1}-b^{n+1})}{n+1}$, in the particular case of $n+1=0$ may be found by the rule given in § 90 for determining the value of a function when it assumes the form $\frac{0}{0}$; but it may be otherwise found by proceeding thus. Put $n+1=m$, and let $p=\frac{\log. x}{\log. e}$, and $q=\frac{\log. b}{\log. e}$; then, by the formula of § 54,

$$x^m=1+pm+\frac{p^2m^2}{2}+\&c.$$

$$b^m=1+qm+\frac{q^2m^2}{2}+\&c.$$

and therefore

$$x^m-b^m=(p-q)\,m+(p^2-q^2)\frac{m^2}{2}+\&c.$$

$$\text{and } \frac{x^m-b^m}{m}=(p-q)+(p^2-q^2)\frac{m^2}{2}+\&c.$$

Thus

Thus we have $\frac{x^m-b^m}{m}$; or $\frac{x^{n+1}-b^{n+1}}{n+1}$ expressed generally by a series, all the terms of which, except the first, being multiplied by $m$ or $n+1$, will vanish when $n+1=0$, or when $n=-1$; hence it appears that the general equation $y=\frac{a(x^{n+1}-b^{n+1})}{n+1}$, becomes in the particular case of $n=-1$, $y=a\,(p-q)$, which, substituting for $p$ and $q$ their values, and observing that

$$\frac{\log.x}{\log.e}-\frac{\log.b}{\log.e}=\frac{1}{\log.e}\times\log.\frac{x}{b}, \text{ becomes}$$

$$=y\frac{a}{\log.e}\times\log.\frac{x}{b}$$

where log. $e$ and log. $\frac{x}{b}$ are to be taken according to the same system, which may be any system of logarithms whatever. So that if we take the Napierean system in which log. $e=1$, then

$$y=a\,\text{l}.\frac{x}{b}=a\,\text{l}.x-a\,\text{l}.b=a\,\text{l}.x+\text{C},$$

where C denotes a constant quantity, and where the letter l, in this formula, and in others in which it may occur, is put as an abbreviation of the words *Napierean logarithm*, so that by $a$ l. $x$ is meant $a$ multiplied by the Napierean logarithm of $x$, &c.

This expression which we have found for the value of $y$ in the particular case of $\dot y=ax^{-1}\dot x$, or $\frac{a\dot x}{x}$, coincides with what we might have found by considering that when $y=\text{l}.x$, it has been shewn (§ 57.), that $\dot y=\frac{\dot x}{x}$, so that conversely, when $\dot y=\frac{a\dot x}{x}$, we may conclude that $y=a\,\text{l}.x+\text{C}$, where C denotes a constant quantity, to be determined from the particular question in which the fluxional equation may occur.

104. It must now be evident that if

$$\dot y=ax^m\dot x+bx^n\dot x+cx^p\dot x+\text{ \&c.}$$

where $m$, $n$, $p$, &c. are constant numbers, then

$$y=\frac{ax^{m+1}}{m+1}+\frac{bx^{n+1}}{n+1}+\frac{cx^{p+1}}{p+1}+\text{ \&c. }+\text{C};$$

here C denotes a constant arbitrary quantity that may be considered as the sum of the constant quantities which ought to be added to the terms $\frac{ax^{m+1}}{m+1}$, $\frac{bx^{n+1}}{n+1}$, &c. each being regarded as a distinct fluent.

105. In general, since that when

$$y=a\,t+b\,v+c\,u+\text{ \&c. }+\text{ C},$$

where $t$, $v$, $u$, &c. denote any functions of a variable quantity, and C a constant quantity, we have (§ 35. and § 36.)

$$y=a\dot t+b\dot v+c\dot u+\text{ \&c.}$$

So, on the contrary, if we have any fluxional equation of this last form, we may conclude that

$$y=a\,t+b\,v+c\,u+\text{\&c. }+\text{C}.$$

And since that when $u=v\,t+\text{C}$, where $u$, $v$ and $t$ denote any function of a variable quantity, and C a constant quantity, we have, § 37, $\dot u=v\dot t+t\,\dot v$, so, on the contrary, if

$$\dot u=v\dot t+t\,\dot v,$$

we may conclude that

$$u=v\,t+\text{C},$$

and in like manner if we have

$$\dot u=\frac{t\dot v-v\dot t}{t^2}=\frac{\dot v}{t}-\frac{v\dot t}{t^2},$$

we may infer from § 39. that

$$u=\frac{v}{t}+\text{C}.$$

106. It is often convenient to denote the fluent of a fluxional expression without actually exhibiting that fluent. For this purpose we shall employ the sign $\int$, putting it before the fluxion whose fluent we mean to denote. Thus, by the expression $\int ax^n\dot x$, is to be understood the fluent of $ax^n\dot x$; and as this fluent has been found to be $\frac{ax^{n+1}}{n+1}+\text{C}$, we may express this conclusion in symbols shortly thus,

$$\int ax^n\dot x=\frac{ax^{n+1}}{n+1}+\text{C}.$$

107. Suppose we have $\dot y=(ax+b)^m\dot x$, we may expand $(ax+b)^m$ into a series, and multiply the series by $\dot x$, and find the fluent of each term of the result. But we may also find the fluent of this expression without employing the developement of $(ax+b)^m$, by proceeding thus. Put $ax+b=z$, then $x=\frac{z-b}{a}$, and $\dot x=\frac{\dot z}{a}$. Substitute now these values of $ax+b$, and $\dot x$, in the expression for $\dot y$, and it becomes $\dot y=\frac{z^m\dot z}{a}$; hence we have (§ 101.) $y=\frac{z^{m+1}}{a(m+1)}+\text{C}$, and consequently, by substituting $(ax+b)$ for $z$,

$$y=\frac{(ax+b)^{m+1}}{a(m+1)}+\text{C}.$$

108. Suppose that $\dot y=(ax^n+b)^m x^{n-1}\dot x$. By putting as before $ax^n+b=z$, we have $nax^{n-1}\dot x=\dot z$, and $x^{n-1}\dot x=\frac{\dot z}{na}$; hence $\dot y=\frac{z^m\dot z}{na}$, and $y=\frac{z^{m+1}}{na(m+1)}+\text{C}$, and substituting for $z$ its value $ax^n+b$,

$y=$

$$y=\frac{(ax^n+b)^{m+1}}{n\,a(m+1)}+C.$$

109. Let us now consider fractional functions, and to begin with a simple case let us suppose that $\dot y=\frac{Ax^m\dot x}{(ax+b)^n}$. Put $ax+b=z$, then $x=\frac{z-b}{a}$, $\dot x=\frac{\dot z}{a}$, and consequently,

$$\dot y=\frac{A(z-b)^m\dot z}{a^{m+1}z^n}.$$

We have now only to find the developement of $(z-b)^m$, to multiply each of its terms by $\dot z$ and divide it by $z^n$, and take the fluent of the result.

Let us take for example the case of $m=3$, and $n=2$, then

$$\dot y=\frac{A(z-b)^3\dot z}{a^4z^2},$$

$$=\frac{A}{a^4}\left\{z\dot z-3b\dot z+3b^2z^{-1}\dot z-b^3z^{-2}\dot z\right\}$$

Hence, taking the fluents of the several terms, as in § 105, we have

$$y=\frac{A}{a^4}\left\{\frac{z^2}{2}-3bz+3b^2\,\mathrm{l}.\,z+b^3z^{-1}\right\}+C.$$

Let us now restore the value of $z$, and then it appears that when

$$\dot y=\frac{Ax^3\dot x}{(ax+b)^2},$$

$$y=\frac{A}{a^4}\left\{\begin{array}{l}\frac{1}{2}(ax+b)^2-3b(ax+b)\\+3b^2\,\mathrm{l}.(ax+b)+b^3(ax+b^{-1}\end{array}\right\}+C.$$

110. If we suppose that

$$\dot y=\frac{Ax^n\dot x+Bx^p\dot x+Cx^q\dot x+\&c.}{(a+bx)^m},$$

then, we may write the equation thus,

$$\dot y=\frac{Ax^n\dot x}{(a+bx)^m}+\frac{Bx^p\dot x}{(a+bx)^m}$$

$$+\frac{Cx^q\dot x}{(a+bx)^m}+\&c.$$

and take the fluent of each term, in the same manner as we have found the fluent of $\frac{Ax^3\dot x}{(ax+b)^2}$.

### *Of the Fluents of rational Fractions.*

111. Every fluxion that is a rational fraction is comprehended under this general formula,

$$\frac{(Ax^m+Bx^n+Cx^p+\&c.)\dot x}{A'x^{m'}+B'x^{n'}+C'x^{p'}+\&c.},$$

which, by putting U to denote the expression between the parentheses in the numerator, and V the denominator, may be represented by $\frac{U\dot x}{V}$. Now in the first place, we remark that the greatest exponent of the powers of $x$ in the numerator may be supposed to be less than that of its powers in the denominator. For if it were not so, by dividing U by V, and calling Q the quotient, and R the remainder, we should have $\frac{U\dot x}{V}=Q\dot x+\frac{R\dot x}{V}$, and

$$\int\frac{U\dot x}{V}=\int Q\dot x+\int\frac{R\dot x}{V}.$$

Now, Q being a rational and integer function $\int Q\dot x$ may be found, as in § 104, and it only remains to find $\int\frac{R\dot x}{V}$, an expression in which the highest exponent of the powers of $x$ in R is less by unity than in N; so that the fraction $\frac{R\dot x}{V}$ may be generally expressed thus,

$$\frac{(Ax^{n-1}+Bx^{n-2}+Cx^{n-3}\ldots\ldots+T)\dot x}{x^n+A'x^{n-1}+B'x^{n-2}+C'x^{n-3}\ldots+T'}.$$

The general method of finding the fluent of a fractional expression of this form consists in decomposing it into a series of other fractions, the denominators of which are more simple. These fractions may be found by proceeding as follows: By putting the denominator of the proposed fraction equal to 0, we get this equation,

$$x^n+A'x^{n-1}+B'x^{n-2}\ldots+T'=0.$$

Suppose now that the roots of this equation are found, and that they are denoted by

$$-a,\ -a',\ -a'',\ -a''',\ \&c.$$

which quantities we shall suppose, in the first place, are all unequal. Then the expression which has been assumed as equal to 0, may (**Algebra**, Sect. X.) be considered as the product of $n$ factors

$$x+a,\ x+a',\ x+a'',\ x+a''',\ \&c.$$

Let the proposed fraction $\frac{R}{V}$ be now assumed as equal to the sum of the simple fractions

$$\frac{N}{x+a},\ \frac{N'}{x+a'},\ \frac{N''}{x+a''},\ \&c.$$

having for their denominators the simple factors of the denominator of the proposed fraction, and for their numerators quantities which are constant, but as yet are indetermined.

That we may avoid complicated calculations, and present a determinate object to the mind, let us suppose that the fluxion of which we are to find the fluent is

$$\frac{(Ax^2+Bx+C)\dot x}{x^3+A'x^2+B'x+C'},$$

and that we have by the resolution of the cubic equation $x^3+A'x^2+B'x+C'=0$ found

$$x^3+A'x^2+B'x+C'=(x+a)(x+a')(x+a'').$$

The

The fractions

$$\frac{N\dot{x}}{x+a},\ \frac{N'\dot{x}}{x+a'},\ \frac{N''\dot{x}}{x+a''},$$

when reduced to a common denominator are

$$\frac{N(x+a')(x+a'')\dot{x}}{(x+a)(x+a')(x+a'')},\ \frac{N'(x+a)(x+a'')\dot{x}}{(x+a)(x+a')(x+a'')}$$
$$\frac{N''(x+a)(x+a')\dot{x}}{(x+a)(x+a')(x+a'')}.$$

The common denominator of these fractions is the same as that of the proposed fraction, and each of the numerators, as well as their sum, is a function of $x$ of a degree lower than the denominator, that is, in the present case, it is a function of the second degree. By taking the actual products of the factors in the numerators, and adding the results, we find the sum of the fractions equal to

$$\frac{\dot{x}}{V}\left\{\begin{array}{l}(N+N'+N'')x^2 \\ +\left\{N(a'+a'')+N'(a+a'')+N''(a+a')\right\}x \\ +Na'a''+N'aa''+N''aa'\end{array}\right\}$$

where V denotes the common denominator $(x+a)(x+a')(x+a'')=x^3+A'x^2+B'x+C'$. Setting aside the factor $\frac{\dot{x}}{V}$ of the above expression, we are now to compare that part of it which involves the three indeterminate quantities N, N', N'', with $Ax^2+Bx+C$, the numerator of the proposed fraction, thus we obtain these three equations

$$N+N'+N''=A,$$
$$N(a'+a'')+N'(a+a'')+N''(a+a')=B,$$
$$Na'a''+N'aa''+N''aa'=C.$$

By these equations, which are all of the first degree, we may determine the values of N, N' and N'', and thus we have the proposed fraction $\frac{(Ax^2+Bx+C)\dot{x}}{x^3+A'x^2+B'x+C'}$ equal to

$$\frac{N\dot{x}}{x+a}+\frac{N'\dot{x}}{x+a'}+\frac{N''\dot{x}}{x+a''},$$

where N, N', N'', and $a$, $a'$, $a''$, are constant and known quantities.

Put $x+a=z$, then $\dot{x}=\dot{z}$, and the fraction $\frac{N\dot{x}}{x+a}$ is transformed to $\frac{N\dot{z}}{z}$, of which the fluent is $N\,\mathrm{l}.z=N\,\mathrm{l}.(x+a)$ (§ 103). In like manner we find $\int\frac{N'\dot{x}}{x+a'}=N'\,\mathrm{l}.(x+a')$, and $\int\frac{N''\dot{x}}{x+a''}=N''\,\mathrm{l}.(x+a'')$, and consequently

$$\int\frac{(Ax^2+Bx+C)\dot{x}}{x^3+A'x^2+B'x+C'}$$
$$=N\,\mathrm{l}.(x+a)+N'\,\mathrm{l}.(x+a')+N''\,\mathrm{l}.(x+a'')+const.$$
$$=\mathrm{l}.\left\{(x+a)^{N}(x+a')^{N'}(x+a'')^{N''}\right\}+const.$$

where by *const.* is meant a constant quantity.

It is easy to extend this mode of proceeding to the general formula given at the beginning of this §; and it is obvious, that as often as the denominator of a rational fraction can be decomposed into real and unequal factors, the determination of the fluent of that fraction is attended with no other difficulty than this decomposition, which requires the numerical resolution of equations.

112. We have supposed that the factors of the denominator of the proposed fraction are unequal among themselves, and it is only when this is the case that the fraction can be decomposed into others, having all this form $\frac{N}{x+a}$. If we suppose that the denominator $x^n+A'x^{n-1}+B'x^{n-2}\ldots+T'$ has a factor of the form $(x+a)^p$, then the proposed fraction

$$\frac{(Ax^{n-1}+Bx^{n-2}+Cx^{n-3}..T)\dot{x}}{x^n+A'x^{n-1}+B'x^{n-2}+C'x^{n-3}\ldots+T}$$

must be assumed equal to

$$\frac{(Px^{p-1}+Qx^{p-2}+Rx^{p-3}\ldots+Y)\dot{x}}{(x+a)^p}$$
$$+\frac{N'\dot{x}}{x+a'}=\frac{N''\dot{x}}{x+a''}\ldots.$$

where P, Q, R...Y, N', N'', &c. denote indeterminate but constant quantities, and $x+a'$, $x+a''$, &c. are the remaining factors of the denominator of the proposed fraction. To determine the quantities P, Q, R... Y, N', N'', &c. we must now proceed in all respects as in last §, that is, we must reduce the fractions involving these quantities to a common denominator, which will be the same as the denominator of the proposed fraction; then we must add the numerators, and put the coefficient of each power of $x$ in the sum equal to the coefficient of the same power in the numerator of the proposed fraction. Thus we shall have as many equations as indeterminate quantities, and by resolving these equations, the value of these quantities will be found.

Having thus determined all the quantities P, Q, R, ...Y, which enter into the fraction

$$\frac{(Px^{p-1}+Qx^{p-2}\ldots+Y)\dot{x}}{(x+a)^p}$$

its fluent may be found as shewn in § 109. But we may also assume it equal to

$$\frac{M\dot{x}}{(x+a)^p}+\frac{M'\dot{x}}{(x+a)^{p-1}}+\frac{M''\dot{x}}{(x+a)^{p-2}}$$
$$\ldots+\frac{M'''..\dot{x}}{x+a}$$

and, it is easy to see, that by reducing these fractions to

a

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a common denominator and adding them, the numerator of their sum will have the same form as that of the fraction whose fluent we are seeking; so that the values of the indeterminate quantities M, M', &c. will be found by putting the coefficients of the same power of $x$ in both numerators equal to each other. To find the fluent of $\frac{M\dot{x}}{(x+a)^p}$ we may assume $x+a=z$, then $\dot{x}=\dot{z}$, and

$$\int\frac{M\dot{x}}{(x+a)^p}=\int\frac{M\dot{z}}{z^p}=\frac{M z^{-p+1}}{1-p}$$

$$=\frac{M}{(1-p)(x+a)^{p-1}}.$$

In like manner

$$\int\frac{M'\dot{x}}{(x+a)^{p-1}}=\frac{M'}{(2-p)(x+a)^{p-2}}$$

and so on, all the fluents being algebraic, except the last $\int\frac{M'\ldots''\dot{x}}{x+a}$ which is M'''... l. $(x+a)$, a logarithmic function.

113. In resolving the equation

$$x^n+A'x^{n-1}+B'x^{n-2}\ldots+T=0,$$

it may happen that some of its roots $a$, $a'$, $a''$, &c. are imaginary quantities, and then some of the simple factors $x+a$, $x+a'$, $x+a''$, &c. will be imaginary. These factors always occur in pairs (ALGEBRA, § 179.) and have this form

$$x+\alpha+\beta\sqrt{-1}, \qquad x=\alpha-\beta\sqrt{-1},$$

so that their product

$$x^2+2\alpha x+\alpha^2+\beta^2$$

is a real factor of the second degree. As every corresponding pair of imaginary simple factors may be united in this manner into a real factor of the second degree, if these factors are all unequal, we may avoid introducing imaginary quantities into the fluent of the proposed fraction by proceeding thus. Let $x+\alpha+\beta\sqrt{-1}$ and $x+\alpha-\beta\sqrt{-1}$, denote two corresponding imaginary simple factors of the denominator. Instead of the two simple fractions

$$\frac{N\dot{x}}{x+a+\beta\sqrt{-1}}, \qquad \frac{N'\dot{x}}{x+a-\beta\sqrt{-1}},$$

which would have been assumed if the factors had been real, assume a single fraction

$$\frac{(Kx+L)\dot{x}}{x^2+2\alpha x+\alpha^2+\beta^2}$$

the denominator of which is a real function of $x$ of the second degree, viz. that which is the product of the two imaginary factors. Here K and L denote two constant but indeterminate coefficients, the values of which, as also those of the other indeterminate coefficients are to be found as before.

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If the denominator of the proposed fraction have several equal factors of the second degree resulting from its imaginary simple factors, so that the product of those equal factors is

$$(x^2+2\alpha x+\alpha^2+\beta^2)^q;$$

then, corresponding to this product, we must, among the fractions having indeterminate coefficients, assume one of this form

$$\frac{(Q'x^{2q-1}+R'x^{2q-2}\ldots+Y')\dot{x}}{(x^2+2\alpha x+\alpha^2+\beta^2)^q},$$

where Q', R'...Y' denote constant and indeterminate coefficients, the values of which will be found in all respects as those of the others.

We are now to find the fluents of these two fluxional expressions, beginning with the first, viz.

$$\frac{(Kx+L)\dot{x}}{x^2+2\alpha x+\alpha^2+\beta^2}, \text{ or } \frac{(Kx+L)\dot{x}}{(x+\alpha)^2+\beta^2},$$

Put $x+\alpha=z$, then it becomes

$$\frac{(Kz+L-K\alpha)\dot{z}}{z^2+\beta^2};$$

and this again, by putting $L-K\alpha=M$, is resolved into these two fluxions

$$\frac{Kz\dot{z}}{z^2+\beta^2}+\frac{M\dot{z}}{z^2+\beta^2}.$$

We can immediately find the fluent of the first of these, by putting $z^2+\beta^2=v$, for then $z\dot{z}=\frac{\dot{v}}{2}$, and

$$\int\frac{Kz\dot{z}}{z^2+\beta^2}=\frac{K}{2}\int\frac{\dot{v}}{v}=K\tfrac{1}{2}\,\text{l.}\,v, \text{ (§ 103.)},$$

$$=K\,\text{l.}\sqrt{(z^2+\beta^2)}.$$

With respect to the other fluxion, if we put $z=\beta y$, we have

$$\frac{M\dot{z}}{z^2+\beta^2}=\frac{M}{\beta}\frac{\dot{y}}{1+y^2},$$

but we have seen (§ 60.) that $\frac{\dot{y}}{1+y^2}$ is the fluxion of an arch of which the tangent is $y$, therefore

$$\int\frac{M}{\beta}\frac{\dot{y}}{1+y^2}=\frac{M}{\beta}\text{ arc (tan.}=y)+\text{const.}$$

$$=\frac{M}{\beta}\text{ arc (tan.}=\frac{z}{\beta}+\text{const.}$$

It is proper to remark, that if $\frac{z}{\beta}$ be the tangent of an arch, then the sine of that arch is $\frac{z}{\sqrt{(z^2+\beta^2)}}$, and its cosine is $\frac{\beta}{\sqrt{(z^2+\beta^2)}}$, thus we may express the fluent under

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under different forms, by introducing the sine or cosine of the arch instead of its tangent.

If instead of $z$ we substitute in these two fluents $x+\alpha$ we find that the fluent of $\frac{(Kx+L)\dot{x}}{x^2+2\alpha x+\alpha^2+\beta^2}$ is

$$K\,l.\sqrt{(x^2+2\alpha x+\alpha^2+\beta^2)}$$
$$+\frac{L-K\alpha}{\beta}\text{ arc }(\text{tan.}=\frac{\alpha+x}{\beta})+\text{const.}$$

114. To find the fluent of the expression

$$\frac{(Q'x^{2q-1}+R'x^{2q-2}\ldots+Y')\dot{x}}{(x^2+2\alpha x+\alpha^2+\beta^2)^q},$$

we first transform it to

$$\frac{(Kx+L)\dot{x}}{(x^2+2\alpha x+\alpha^2+\beta^2)}$$
$$+\frac{(K'x+L')\dot{x}}{(x^2+2\alpha x+\alpha^2+\beta^2)^{q-1}}$$
$$\ldots+\frac{(K'''\ldots x+L'''\ldots)\dot{x}}{x^2+2\alpha x+\alpha^2+\beta^2},$$

where K, L, K', L', &c. denote indeterminate but constant coefficients, which may be determined by reducing these fractions to a common denominator, and proceeding as in the two preceding § §. Then the whole difficulty is reduced to the finding of the fluxion of the expression

$$\frac{(Kx+L)\dot{x}}{(x^2+2\alpha x+\alpha^2+\beta^2)^q}=\frac{(Kx+L)\dot{x}}{((x+\alpha)^2+\beta^2)^q},$$

where $q$ denotes some integer number. To simplify this expression put $x+\alpha=z$, and $L-K\alpha=M$, then it becomes $\frac{(Kz\times M)\dot{z}}{(z^2+\beta^2)^q}$, which we shall now shew may be reduced to $\int\frac{H\dot{z}}{(z^2+\beta^2)^{q-1}}$. To effect this reduction we decompose its fluent into two parts

$$\int\frac{Kz\dot{z}}{(z^2+\beta^2)^q}+\int\frac{M\dot{z}}{(z^2+\beta^2)^q}.$$

The fluent of the first part may be immediately found by putting $z^2+\beta^2=v$; for then $z\dot{z}=\frac{\dot{v}}{2}$ and

$$\int\frac{Kz\dot{z}}{(z^2+\beta^2)^q}=\int\frac{K\dot{v}}{2v^q}=\frac{Kv^{-q+1}}{2(1-q)}.$$

Let us now suppose that the fluent of the second part $\frac{M\dot{z}}{(z^2+\beta^2)^q}$, is equal to the sum of the algebraic function $\frac{Gz}{(z^2+\beta^2)^{q-1}}$, and another function, which is the fluent of $\frac{H\dot{z}}{(z^2+\beta^2)^{q-1}}$, that is, let us assume

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$$\int\frac{M\dot{z}}{(z^2+\beta^2)}=\frac{Gz}{(z^2+\beta^2)^{q-1}}+\int\frac{H\dot{z}}{(z^2+\beta^2)^{q-1}},$$

where G and H are constant but indeterminate coefficients. To determine these, let the fluxion of each side of this equation be taken (observing that the fluxion of a quantity having the sign $\int$ prefixed to it is the same quantity only without that sign); thus we have

$$\frac{M\dot{z}}{(z^2+\beta^2)^q}=\frac{G\dot{z}}{(z^2+\beta^2)^{q-1}}-\frac{2(q-1)Gz^2\dot{z}}{(z^2+\beta^2)}$$
$$+\frac{H\dot{z}}{(z^2+\beta^2)^{q-1}},$$

and from this equation, by rejecting what is common to each term, we find

$$M=G(z^2+\beta^2)-2(q-1)Gz^2+H(z^2+\beta^2),$$

and hence

$$M=G\beta^2+H\beta^2+(G-2(q-1)G+H)z^2;$$

Therefore by comparing together like terms, we find

$$M=G\beta^2+H\beta^2,\qquad G-2(q-1)G+H=0;$$

and from these equations we get

$$G=\frac{M}{(2q-2)\beta^2},\qquad H=\frac{(2q-3)M}{(2q-2)\beta^2}.$$

Let these values of G and H be now substituted in our assumed equation, and it becomes

$$\int\frac{M\dot{z}}{(z^2+\beta^2)^q}=\frac{M}{(2q-2)\beta^2}\,\frac{z}{(z^2+\beta^2)^{q-1}}.$$
$$+\frac{M(2q-3)}{(2q-2)\beta^2}\int\frac{\dot{z}}{(z^2+\beta^2)^{q-1}}.$$

Thus we have reduced the determination of the fluent of $\frac{M\dot{z}}{(z^2+\beta^2)^q}$ to that of $\frac{\dot{z}}{(z^2+\beta^2)^{q-1}}$, and by proceeding in the same manner with this last fluxion, its fluent may be made to depend on that of $\frac{\dot{z}}{(z^2+\beta^2)^{q-2}}$; but this will be more readily effected by simply substituting $q-1$ instead of $q$, and supposing $M=1$ in the preceding equation.

Thus

Thus we shall obtain

$$\int\frac{\dot{x}}{(x^2+\beta^2)^{q-1}}=\frac{1}{(2q-4)\beta^2}\,\frac{\dot{x}}{(x^2+\beta^2)^{q-2}}$$
$$+\frac{(2q-5)}{(2q-4)\beta^2}\int\frac{\dot{x}}{(x^2+\beta^2)^{q-2}}.$$

Substituting now this value of $\int\frac{\dot{x}}{(x^2+\beta^2)^{q-1}}$ in the former equation, we have $\int\frac{M\dot{x}}{(x^2+B^2)^q}$ equal to

$$\frac{M}{(2q-2)\beta^2}\,\frac{x}{(x^2+\beta^2)^{q-1}}$$
$$=\frac{(2q-3)M}{(2q-2)\,(2q-4)\beta^4}\,\frac{x}{(x^2+\beta^2)^{q-2}}$$
$$+\frac{(2q-3)\,(2q-5)M}{(2q-2)\,(2q-4)\beta^4}\int\frac{\dot{x}}{(x^2+\beta^2)^{q-2}}.$$

It is easy to see, that like as we obtained an expression for the fluent of $\frac{\dot{x}}{(x^2+\beta^2)^{q-1}}$ by substituting $q-1$ for $q$, and supposing $M=1$, in the equation preceding the last but one; so by substituting $q-2$ for $q$, we shall obtain an expression for the fluent of $\frac{\dot{x}}{(x^2+\beta^2)^{q-2}}$, which expression will consist of two terms, one an algebraic function of $x$, and the other $\int\frac{\dot{x}}{(x^2+\beta^2)^{q-3}}$ multiplied by a constant and given coefficient. This value of $\frac{\dot{x}}{(x^2+\beta^2)^{q-2}}$ when substituted in the last equation will produce an expression for $\int\frac{M\dot{x}}{x^2+\beta^2)^q}$ consisting of algebraic quantities and $\int\frac{\dot{x}}{(x^2+\beta^2)^{q-3}}$. By continuing this process it is evident that we shall at last have $\int\frac{M\dot{x}}{(x^2+\beta^2)}$ expressed by a series of algebraic quantities, and $\int\frac{\dot{x}}{x^2+\beta^2}$, and here we must stop, for if we repeat the process with a view to make the fluent depend on $\int\frac{\dot{x}}{(x^2+\beta^2)}$ that is on $\int\dot{x}$, or $x$, we shall find that the coefficient of this quantity becomes infinite. As to the fluent of $\frac{\dot{x}}{x^2+\beta^2}$ we have exhibited the expression for it in last §.

In comparing together the results which have been obtained in the preceding articles, it must appear that when a fluxion is expressed by a rational fraction, if we grant the resolution of equations, the fluent may always be assigned either algebraically, or by means of arches of a circle or logarithms; and that to prepare it for a solution, we must decompose the fraction into others, whose denominators may be either binomial or trinomial quantities. This decomposition may always be effected by the method of indeterminate coefficients. There are, however, several analytical artifices by which the labour of calculation may be greatly shortened. These we now proceed to explain.

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115. Let us recur to the fraction $\frac{U}{V}$, and suppose that $x+a$ is one of the unequal factors of the denominator V, so that we have $V=(x+a)\,Q$. Let us now put $\frac{U}{V}=\frac{A}{x+a}+\frac{P}{Q}$, A being supposed a constant quantity, and P an indeterminate function of $x$, but such as not to be divisible by $x+a$. Then we have $U=AQ+P\,(x+a)$, and hence $P=\frac{U-AQ}{x+a}$. As P is an integer function with respect to $x$, it follows from this equation that $U-AQ$, which is also a rational and integer function of $x$, is divisible by $x+a$, and consequently has $x+a$ for a factor; therefore, the function $U-AQ$ will vanish when we substitute $-a$ in it instead of $x$, seeing that $-a$ is the value of $x$ that makes the factor $x+a=0$. Let us denote by $u$ and $q$, what U and Q become by this substitution, which however will not affect the indeterminate quantity A, because it is independent of $x$. We have therefore $u-Aq=0$, and consequently $A=\frac{u}{q}$.

This value of A requires that we should know the function Q given by the equation $V=(x+a)\,Q$, and we may always find it by dividing V by $a+x$. The direct method of fluxions affords also a very simple method of determining it. For by taking the fluxion of the above equation we have

$$\frac{\dot{V}}{\dot{x}}=Q+(x+a)\,\frac{\dot{Q}}{\dot{x}};$$

if in this result we make $x+a=0$, or $x=-a$, and denote by $v$ what $\frac{\dot{V}}{\dot{x}}$ becomes by that substitution, we shall have $v=q$, and consequently $A=\frac{u}{v}$.

The expression $A=\frac{u}{q}$ has always a finite value, for the numerator and denominator can never become $=0$, because we suppose the fraction $\frac{U}{V}$ reduced to its lowest terms, and consequently, that the numerator U has not for a factor $x+a$, which is a factor of the denominator, but which being contained in it only once does not enter into Q.

116. Let us now consider how the numerators of the fractions, into which the proposed fraction $\frac{U}{V}$ is to be decomposed, are to be found in the case of the denominator

nator V having equal factors of the first degree. In this case we have $V=Q\,(x+a)^n$, and we assume

$$\frac{U}{V}=\frac{A}{(x+a)^n}+\frac{B}{(x+a)^{n-1}}+\frac{C}{(x+a)^{n-2}}\cdots+\frac{N}{x+a}+\frac{P}{Q}.$$

By reducing to a common denominator, we find U equal to

$$Q\left\{\begin{matrix}A+B\,(x+a)+C\,(x+a)^2\\ \cdots+N(x+a)^{n-1}\end{matrix}\right\}+P(x+a)^n$$

and P equal to

$$\frac{U-Q(A+B\,(x+a)+C\,(x+a)^2\ldots+N\,(x+a)^{n-1})}{(x+a)^n}$$

and as P ought to be an integer function of $x$, the numerator of its value is necessarily divisible $n$ times successively by $x-a$; therefore, that numerator ought to be equal to 0, when $-a$ is substituted in it instead of $x$. Now this substitution being made, each of the terms of the numerator which is multiplied by $x+a$ vanishes, so that there remains only $U-AQ$, but that this quantity may be divisible by $x+a$, it is necessary that $u-q\,A=0$, where $u$ and $q$ denote the same as in last §, hence $A=\frac{u}{q}$.

This value of A changes $U-Q\,A$ into $U-\frac{u}{q}\,Q$, which must be divisible by $x+a$. Let us, with a view to abridge, put $U-\frac{u}{q}Q=U'\,(x+a)$, then substituting this quantity in the value of P, and dividing both numerator and denominator by $x+a$, we have P equal to

$$\frac{U'-Q\,(B+C\,(x+a)\ldots+N\,(x+a)^{n-2})}{(x+a)^{n-1}}.$$

Now to obtain B we make $x+a=0$, then, putting $u'$ to denote what $U'$ becomes by substituting $-a$ in it in place of $x$, we have $u'-q\,B=0$, and $B=\frac{u'}{q}$.

Instead of B let its value be substituted in $U'-QB$, and this quantity becomes $U'-\frac{u'}{q}\,Q$, which vanishing when $x+a=0$, will have $x+a$ for a divisor; therefore, we may put $U'-\frac{u'}{q}\,Q=U''\,(x+a)$, then, substituting this last quantity instead of the former in the value of P, and dividing the numerator and denominator by $x+a$, we have P equal to

$$\frac{U''-Q(C+D(x+a)\ldots+N\,(x+)a^{n-3})}{(x+a)^{n-2}}.$$

By continuing the same mode of reasoning, and the same notation, we find $u''-q\,C=0$, and $C=\frac{u''}{q}$. And so on with the remaining quantities.

The direct method of fluxions facilitates greatly the preceding operations. For the numerator of P being divisible by $(x+a)^n$ is necessarily of this form $X(a+x)^n$, X being an integer function of $x$, but which does not contain the factor $x+a$. Now agreeably to what has been shewn in § 88, the successive fluxions of this numerator, as far as the $n-1$ order inclusive, vanish when $x-a$ is supposed $=0$. By giving to the numerator the following form,

$$Q\left(\frac{U}{Q}-A-B\,(x+a)-C\,(x+a)^2\ldots\right)$$

and observing that the function Q does not contain the factor $x+a$, it is manifest that it is only the part of this expression between the parentheses which ought to be divisible by $(x+a)^n$. Let us put $\frac{U}{Q}=Z$, then the successive fluxions of that part are

$$\dot{Z}-B\dot{x}-2\,C\,(x+a)\dot{x}-3\,D\,(x+a)^2\dot{x}\ldots$$
$$\ddot{Z}-2\,C\dot{x}^2-2\,.\,3\,D\,(x+x)\dot{x}^2\ldots$$
$$\dddot{Z}-2\,.\,3\,D\,\dot{x}^3\ldots$$
&c.

and these results ought all to vanish when we put $x+a=0$. Thus we have

$$Z-A=0,\text{ and }A=\frac{u}{q},$$
$$\dot{Z}-B\,\dot{x}=0,\ B=\frac{\dot{Z}}{\dot{x}},$$
$$\ddot{Z}-2\,C\,\dot{x}^2=0,\ C=\frac{\ddot{Z}}{2\,\dot{x}^2},$$
$$\dddot{Z}-2\,.\,3\,D\,\dot{x}^3=0,\ D=\frac{\dddot{Z}}{2\,.\,3\dot{x}^3},$$
&c. &c.

observing that in each of these functions $\frac{\dot{Z}}{\dot{x}}$, $\frac{\ddot{Z}}{2\,\dot{x}^2}$, we must substitute $-a$ instead of $x$.

The most simple way to find the value of Q in this case is to divide V by $(x+a)^n$, but we may also find it by the direct method of fluxions, as in the preceding §; for, since $V=Q\,(x+a)^n$, if we take the fluxion of each side of this equation $n$ times, and then make $x+a=0$, we shall find, § 88, the $n$th fluxion of V equal to $1\,.\,2\,.\,3\ldots n\,Q\,\dot{x}^n$, and consequently

$$Q=\frac{n\text{th flux. of V}}{1\,.\,2\ldots n\,\dot{x}^n}$$

117. Let us now consider how we are to find the numerator of the fraction which forms a part of $\frac{U}{V}$ when it has this form

$$\frac{A\,x+B}{x^2+2\,\alpha\,x+\alpha^2+\beta^2}$$

Assume

Inverse Method.

Assume

$$\frac{U}{V}=\frac{Ax+B}{x^2+2\alpha x+\alpha^2+\beta^2}+\frac{P}{Q};$$

then, reducing the latter part of this equation to a common denominator, we find

$$U=Q\,(Ax+B)+P\,(x^2 2\alpha x+\alpha^2+\beta^2).$$

Hence we deduce

$$P=\frac{U-Q\,(Ax+B)}{x^2+2\alpha x+\alpha^2+\beta^2}.$$

As P is supposed to be an integer function with respect to $x$, it follows that $U-Q\,(Ax+B)$ is divisible by $x^2+2\alpha x+\alpha^2+\beta^2$; therefore, the former of these two quantities must contain among its factors those of the latter, and the quantities, which, being substituted for $x$, cause the latter to vanish, must also make the former vanish. But the factors of $x^2+2\alpha x+\alpha^2+\beta^2$ are $x+\alpha+\beta\sqrt{-1}$, and $x+\alpha-\beta\sqrt{-1}$, and these, being put each $=0$, gives us $x=-(\alpha+\beta\sqrt{-1})$, and $x=-(\alpha-\beta\sqrt{-1})$, therefore, each of these values of $x$ being substituted in $U-Q\,(Ax+B)$ ought to make that quantity vanish. Let us denote by $u\pm u'\sqrt{-1}$, and by $q\pm q'\sqrt{-1}$ what U and Q respectively become when $-(\alpha\pm\beta\sqrt{-1})$ is substituted in each instead of $x$, then, after this transformation, we have

$$\left.\begin{matrix} u\pm u'\sqrt{-1} \\ -(q\pm q'\sqrt{-1})\left\{-A\,(\alpha\pm\beta\sqrt{-1})+B\right. \end{matrix}\right\}=0.$$

This equation is twofold, because of the sign $\pm$ with which several of its terms are affected, and it is equivalent to those which would be formed by putting the real part equal to 0, and the imaginary part $=0$; from this consideration we have

$$u+q\alpha A-q'\beta A-qB=0,$$
$$u'+q\beta A+q'\alpha A-q'B=0,$$

two equations which give us the values of A and B.

The function Q may be found as in § 115. For, if we take the fluxions of each side of the equation

$$Q\,(x^2+2\alpha x+\alpha^2+\beta^2)=V,$$

and afterwards make

$$x^2+2\alpha x+\alpha^2+\beta^2=0,$$

we find $Q\,(2x\dot{x}+2\alpha\dot{x})=\dot{V}$, and hence

$$Q=\frac{\dot{V}}{2x\dot{x}+2\alpha\dot{x}};$$

Let the two values of $x$, to wit $-(\alpha\pm\beta\sqrt{-1})$, be substituted instead of it in this equation, then, putting $v\pm v'\sqrt{-1}$ to denote what the expression $\frac{\dot{V}}{\dot{x}}$ becomes by that substitution, and writing $q\pm q'\sqrt{-1}$ instead of Q, we have

$$q\pm q'\sqrt{-1}=\frac{v\pm v'\sqrt{-1}}{\mp 2\beta\sqrt{-1}},$$

which, by multiplying the terms of the fraction on the latter side of the equation by $\sqrt{-1}$, becomes

$$q\pm q'\sqrt{-1}=\frac{v\sqrt{-1}\mp v'}{\pm 2\beta}.$$

Hence by putting the real parts of each side of this equation equal to each other, and also the imaginary parts equal to each other, we find

$$q=-\frac{v'}{2\beta'},\ q'=\frac{v}{2\beta}.$$

118. If the factor $x^2+2\alpha x+\alpha^2+\beta^2$ is found several times in the denominator of V, so that $V=Q\,(x^2+2\alpha x+\alpha^2+\beta^2)^n$, then, § 113, we assume in this case $\frac{U}{V}$ equal to

$$\frac{Ax+B}{(x^2+2\alpha x+\alpha^2+\beta^2)^n}+\frac{A'x+B'}{(x^2+2\alpha x+\alpha^2+\beta^2)^{n-1}}\cdot$$
$$+\frac{A''x+B''}{(x^2+2\alpha x+\alpha^2+\beta^2)^{n-2}}\cdots+\frac{P}{Q}$$

reducing this expression to a common denominator, and so ordering the equation as to bring P to stand alone on one side, we find P equal to

$$\frac{U-Q\left\{\begin{matrix}Ax+B+(A'x+B')(x^2+2\alpha x+\alpha^2+\beta^2) \\ +\ (A''x+B'')\,(x^2+2\alpha x+\alpha^2+\beta^2)^2\ldots\end{matrix}\right\}}{(x^2+2\alpha x+\alpha^2+\beta^2)^n}.$$

By reasoning in this as in the preceding case, it may be concluded that the numerator of this expression ought to vanish when $-(\alpha\pm\beta\sqrt{-1}$ is substituted in it instead of $x$; therefore putting $u\pm u'\sqrt{-1}$, and $q\pm q'\sqrt{-1}$ to denote the same things as before, we deduce from that substitution

$$\left.\begin{matrix} u\pm u'\sqrt{-1} \\ -(q\pm q'\sqrt{-1})\,(-A\,(\alpha\pm\beta\sqrt{-1}+B) \end{matrix}\right\}=0$$

the very same equation for the determination of A and B, as we have already found in last §.

Having found the values of these quantities, they may be substituted in the numerator of P, and the terms $U-Q\,(Ax+B)$ becoming divisible by $x^2+2\alpha x+\alpha^2+\beta^2$, the whole expression becomes divisible by the same quantity. Calling therefore U′ the quotient arising from the division of $U-Q\,(Ax+B)$ by $x^2+2\alpha x+\alpha^2+\beta^2$, we have P equal to

$$\frac{U'-Q[A'x+B'+(A''x+B'')(x^2+2\alpha x+\alpha^2+\beta^2)\ldots]}{x^2+2\alpha x+\alpha^2+\beta^2)^{n-1}}$$

If in this numerator we substitute instead of $x$ its values deduced from the equation $x^2+2\alpha x+\alpha^2+\beta^2=0$, and put the result $=0$, we may determine A′ and B′ in the very same way that we have already determined A and B, and by proceeding in this manner we shall find the remaining coefficients A″, B″, &c.

This case is quite analogous to that which has been already treated in § 116, and the direct method of fluxions applies to it in the same manner as to the other. For since Q does not contain the factor $x^2+2\alpha x+\alpha^2+\beta^2$, if the numerator of P be divided by the function Q, the result, which may be denoted by $r$, ought to be of this form

form $r=X(x^2+2\alpha x+\alpha^2+\beta^2)^n$, and consequently ought to vanish, as well as all its fluxions, from the first order to the $n-1$ order, inclusively, when $x^2+2\alpha x+\alpha^2+\beta^2=0$; this being the case, we have these equations,

$$r=0, \dot r=0, \ddot r=0, \ldots$$

and so on to the $n-1$ fluxion of $r$, which ought also to be $=0$; each of these equations becomes twofold when we substitute, instead of $x$, the values of which it is susceptible in consequence of the equation $x^2+2\alpha x+\alpha^2+\beta^2=0$. By putting the real and the imaginary parts separately $=0$, we shall obtain as many equations as are sufficient to determine A, B, A′, B′, &c.

It may also be remarked, that from the equation

$$V=Q(x^2+2\alpha x+\alpha^2+\beta^2)^n$$

we find Q equal to the quotient arising from the division of the $n$th fluxion of V by the $n$th fluxion of $x^2+2\alpha x+\alpha^2+\beta^2$, observing to assume

$$x^2+2\alpha x+\alpha^2+\beta^2=0.$$

119. We shall now give some applications of what has been said relative to the fluents of rational fractions. Suppose the fraction to be

$$\frac{\dot x}{x^8+x^7-x^4-x^3}$$

The factors of its denominator are easily found, for it may be put under this form

$$x^3(x^5+x^4-x-1)=x^3(x+1)(x^4-1),$$

the factor $x^4-1$ may be decomposed into $x^2-1$ and $x^2+1$, or $x-1$, $x+1$, and $x^2+1$, thus we have the denominator equal to

$$x^3(x-1)(x+1)^2(x^2+1)$$

therefore (§ 111, § 112, and § 113.) the proposed fraction is to be decomposed as follows

$$\frac{A\dot x}{x-1}+\frac{B\dot x}{(x+1)^2}+\frac{C\dot x}{x+1}$$

$$\frac{D\dot x}{x^3}+\frac{E\dot x}{x^2}+\frac{F\dot x}{x}+\frac{(Gx+H)\dot x}{1+x^2}$$

By reducing these fractions to a common denominator, and comparing the numerator of their sum with that of the proposed fraction, we might determine the unknown quantities A, B, C, &c. we shall, however, rather employ the methods that have just been explained.

By comparing this particular example $\frac{\dot x}{x^8+x^7-x^4-x^3}$ with the general expression $\frac{U\dot x}{V}$, it appears that $U=1$, and $V=x^8+x^7-x^4-x^3$. First let us investigate the numerator of the fraction $\frac{A}{x-1}$, and for this purpose we employ the formula $A=\frac{u}{v}$ (§ 115.). As we have $U=1$, it is evident that $u=1$; and since $V=x^8+x^7-x^4-x^3$, therefore $\frac{\dot V}{\dot x}=8x^7+7x^6-4x^3-3x^2$. I this expression we substitute +1 instead of $x$ (viz. the value of $x$ deduced from the equation $x-1=0$) we the result to be 8, therefore $v=8$. So that

$$A=\frac{u}{v}=\frac{1}{8}, \text{ and } \frac{A}{x-1}=\frac{1}{8}\,\frac{1}{x-1}.$$

Let us next investigate the values of B and C in the fractions $\frac{B}{(x+1)^2}$, and $\frac{C}{x+1}$, by means of the § 116, and that we may make the symbols express the quantity under consideration agree with those employed in that formula, let us exchange the letters and C for A and B, so that we are to consider $\frac{A}{(x}$ $+\frac{B}{x+1}$. In the first place we have

$$Q=\frac{x^8+x^7-x^4-{}^3}{(x+1)^2}=x^6-x^5+x^4-x^3;$$

Put $x+1=0$, then $x=1$; substituting now this of $x$ in the value of Q, the result is $4=q$, there $A=\frac{u}{q}=\frac{1}{4}$. Let this value of A be substituted for in the expression for U′ in the § above cited, and we h

$$U'=\frac{U-AQ}{x+1}=\frac{4-x^6+x^5-x^4+x^3}{4(x+1)}$$

$$=\frac{-x^5+2x^4-3x^3+4x^2-4x+4}{4}$$

Hence putting $-1$ instead of $x$ in the expression for we have $u'=\frac{9}{2}$ and $B=\frac{u'}{q}=\frac{9}{8}$. Thus the two fr tions under consideration are found to be $\frac{1}{4}\cdot\frac{1}{(x+1)^2}$, $\frac{9}{8}\cdot\frac{1}{x+1}$. We might have deduced the value of B the formula $B=\frac{\dot z}{\dot x}$, § 116, where Z is put for for we have

$$Z=\frac{U}{Q}=\frac{1}{(x^6-x^5+x^4-x^3)},$$

$$\text{and } \frac{\dot Z}{\dot x}=-\frac{6x^5-5x^4+4x^3-3x^2}{(x^6-x^5+x^4-x^3)^2}$$

If in this expression we substitute $-1$ instead of $x$, becomes $\frac{18}{16}=\frac{9}{8}$, the same value for B as before.

Let us now consider the fractions $\frac{D}{x^3}+\frac{E}{x^2}+\frac{F}{x}$, exchanging the symbols D, E, F for A, B, C,

$$\frac{A}{x^3}+\frac{B}{x^2}+\frac{C}{x},$$

The numerators A, B, C may all be found from the formulas of § 116.

$$A=\frac{U}{Q}=Z,\ B=\frac{\dot{Z}}{\dot{x}},\ C=\frac{\ddot{Z}}{1.2\dot{x}^2},$$

observing that in this case $Q=x^5+x^4-x-1$; and that we must substitute 0 instead of $x$ in each formula, after taking the fluxions. Now we have

$$Z=\frac{U}{Q}=\frac{1}{x^5+x^4-x-1},$$

$$\frac{\dot{Z}}{\dot{x}}=-\frac{5x^4+4x^3-1}{(x^5+x^4-x-1)^2},$$

$$\frac{\ddot{Z}}{\dot{x}^2}=-\frac{20x^3+12x^2}{(x^5+x^4-x-1)^2}$$

$$+\frac{2(5x^4+4x^3-1)^2}{(x^5+x^4-x-1)^3};$$

Hence putting $x=0$, we find

$$A=-1,\ B=+1,\ C=-1,$$

so that

$$\frac{A}{x^3}+\frac{B}{x^2}+\frac{C}{x}=-\frac{1}{x^3}+\frac{1}{x^2}-\frac{1}{x}.$$

There yet remains the fraction $\frac{Gx+H}{x^2+1}$, or $\frac{Ax+B}{x^2+1}$ to be considered. It may be found by subtracting the sum of all the others from the proposed fraction; we proceed, however, to find it directly by the formulas of § 117. In the first place we have $Q=x^6+x^5-x^4-x^3$; next, the factor $x^2+1$ being put $=0$ gives $x=\pm\sqrt{-1}$ $\alpha=0$, $\beta=0$. Hence we find

$$q\pm q'\sqrt{-1}=-2\pm 2\sqrt{-1},\ a=1,\ \text{and}\ a'=0.$$

The equations which determine A and B thus become

$$1+2A+2B=0,\ 2A-2B=0,$$

therefore $A=B=-\frac{1}{4}$, and

$$\frac{Ax+B}{x^2+1}=-\frac{1}{4}.\frac{x+1}{x^2+1}.$$

Thus, upon the whole, the proposed fraction

$\frac{\dot{x}}{x^8+x^7-x^4-x^3}$ is decomposed into the following

$$\frac{1}{8}.\frac{\dot{x}}{x-1}+\frac{1}{4}.\frac{\dot{x}}{(x+1)^2}+\frac{9}{8}\frac{\dot{x}}{x+1}$$

$$-\frac{\dot{x}}{x^3}+\frac{\dot{x}}{x^2}-\frac{\dot{x}}{x}-\frac{1}{4}.\frac{(x+1)\dot{x}}{x^2+1};$$

The manner of finding the fluent of each of these has been already explained, and the result of taking all the fluents is

$$\left.\begin{aligned}&\frac{1}{8}\text{l.}\ (x-1)-\frac{1}{4}.\frac{1}{x+1}\\&+\frac{9}{8}\text{l.}\ (x+1)+\frac{1}{2x^2}-\frac{1}{x}-\text{l.}\ x\\&-\frac{1}{8}(x^2+1)-\frac{1}{4}\text{arc}\ (\text{tan.}=x)+\text{const.}\end{aligned}\right\}$$

The union of all the algebraic terms produces the fraction $\frac{2-2x-5x^2}{4x^2-(1+x)}$, and that of the logarithmic quantities gives

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$$\frac{1}{8}\text{l.}\ (x-1)+\frac{1}{8}\text{l.}\ (x+1)+\text{l.}\ (x+1)$$

$$-\frac{1}{8}\text{l.}\ (x^2+1)-\text{l.}\,x$$

$$=\frac{1}{8}\text{l.}\ \left(\frac{x^2-1}{x^2+1}\right)+\text{l.}\left(\frac{x+1}{x}\right).$$

We have therefore upon the whole $\int\frac{\dot{x}}{x^8+x^7-x^4-x^3}$

equal to

$$\frac{2-2x-5x^2}{4x^2(1+x)}+\frac{1}{8}\text{l.}\ \left(\frac{x^2-1}{x^2+1}\right)$$

$$+\text{l.}\left(\frac{x+1}{x}\right)-\frac{1}{4}\text{arc}\ (\text{tan.}=x)+\text{const.}$$

120 When a fluxion is a rational fraction having either of these forms

$$\frac{x^m\dot{x}}{x^n\pm a^n},\ \frac{\dot{x}}{x^{2n}\pm 2p\,a^nx^n+a^{2n}},$$

we can always, by the application of a particular theorem in analysis, resolve its denominator into real factors of the first and second degrees. The theorem to which we allude is this. Let $n$ be any positive integer, and let $z$ denote any arch of a circle, of which the radius is unity, then

$$(\text{cos.}\ z\pm\sqrt{-1}\ \text{sin.}\ z)^n=\text{cos.}\ nz\pm\sqrt{-1}\ \text{sin.}\ nz.$$

We proceed to prove this theorem. Because

$$(\text{cos.}\ z+\sqrt{-1}\ \text{sin.}\ z)\ (\text{cos.}\ z-\sqrt{-1}\ \text{sin.}\ z.$$

$$=\text{cos.}^2\,z+\text{sin.}^2\,z=1.$$

If we put $\text{cos.}\ z\pm\sqrt{-1}\ \text{sin.}\ z=v$,

Then $\text{cos.}\ z\mp\sqrt{-1}\ \text{sin.}\ z=\frac{1}{v}$;

Therefore taking the sum of these two equations,

$$2\ \text{cos.}\ z=v+\frac{1}{v}.$$

Now by the arithmetic of sines, (ALGEBRA, § 358.)

$$2\ \text{cos.}\ 2z=2\ (2\ \text{cos.}\ z\times\text{cos.}\ z-1),$$

$$2\ \text{cos.}\ 3z=2\ (2\ \text{cos.}\ z\times\text{cos.}\ 2z-\text{cos.}\ z),$$

$$2\ \text{cos.}\ 4z=2\ (2\ \text{cos.}\ z\times\text{cos.}\ 3z-\text{cos.}\ 2z),$$

$$2\ \text{cos.}\ 5z=2\ (2\ \text{cos.}\ z\times\text{cos.}\ 4z-\text{cos.}\ 3z),$$

&c.

Therefore, substituting in the first of these equations $v+\frac{1}{v}$ instead of 2 cos. $z$, we have

2 cos.

$$2\cos. 2z=\left(v+\frac{1}{v}\right)\left(v+\frac{1}{v}\right)-2$$

$$=v^2+\frac{1}{v^2}.$$

In like manner, substituting in the second equation, $v+\frac{1}{v}$ instead of 2 cos. $z$, and $v^2+\frac{1}{v^2}$ instead of 2 cos. $2z$, we have

$$2\cos. 3z=\left(v+\frac{1}{v}\right)\left(v^2+\frac{1}{v^2}\right)-\left(v+\frac{1}{v}\right)$$

$$=v^3+\frac{1}{v^3}.$$

Proceeding in the same way with the third and following equations, we find

$$2\cos. 4z=v^4+\frac{1}{v^4},$$

$$2\cos. 5z=v^5+\frac{1}{v^5};$$

so that we may conclude in general that

$$2\cos. nz=v^n+\frac{1}{v^n};$$

hence we have this quadratic equation

$$v^{2n}-2\cos. nz\times v^n+1=0,$$

from which, by completing the square, we find

$$v^n=\cos. nz\pm\sqrt{(\cos.^2 nz-1)};$$

therefore, by substituting for $v$ the quantity it was put to represent, and observing that $\sqrt{(\cos.^2 nz-1)}=\sqrt{(-\sin.^2 nz)}=\sqrt{-1}\sin. nz$, we have

$$(\cos. z\pm\sqrt{-1}\sin. z)^n=\cos. nz\pm\sqrt{-1}\sin. nz,$$

as was to be proved.

121. The function $x^n\pm a^n$ is transformed to $a^n(y^n\pm1)$ by putting $x=ay$, and to discover its factors, we must resolve the equation

$$y^n\pm1=0.$$

The expression $y=\cos. z+\sqrt{-1}\sin. z$ satisfies this equation, by a very simple determination of the arch $z$; for we have $y^n=(\cos. z+\sqrt{-1}\sin. z)^n=\cos. nz+\sqrt{-1}\sin. nz$, and as by putting $\pi$ to denote half the circumference, and $m$ any whole number, we have (ALGEBRA, § 352.)

$$\sin. m\pi=0,\quad \cos. m\pi=\pm1.$$

where the sign + is to be taken, if $m$ be an even number, but − if it be odd, we have only to suppose $nz=m\pi$, in order to obtain $y^n=\pm1$.

That we may distinguish the case in which $m$ is even, from that in which it is odd, we shall write for the first $2m$, and for the second $2m+1$; we therefore make

$$nz=2m\pi,\text{ and } nz=(2m+1)\pi.$$

By the first hypothesis, we find

$$y^n=+1,\quad y=\cos.\frac{2m\pi}{n}+\sqrt{-1}\sin.\frac{2m\pi}{n},$$

and by the second

$$y^n=-1,$$

$$y=\cos.\frac{(2m+1)\pi}{n}+\sqrt{-1}\sin.\frac{(2m+1)\pi}{n}.$$

122. By means of the indeterminate number $m$, each of these expressions for $y$ furnishes all the values of which this quantity is susceptible, for we may take successively

$$m=0,\ m=1,\ m=2,\ m=3,\ \&c.$$

The first formula gives

$$y=\cos. 0.\pi=1$$

$$y=\cos.\frac{2\pi}{n}+\sqrt{-1}\sin.\frac{2\pi}{n},$$

$$y=\cos.\frac{4\pi}{n}+\sqrt{-1}\sin.\frac{4\pi}{n},$$

&c.

It is evident that we shall always have different results as far as $m=n-1$. If, however, we suppose $m=n$; then we have $y=\cos. 2\pi=1$, which is the same as the first of the values already obtained, and if we suppose $m=n+1$, then (ALGEBRA, § 25.)

$$\text{Cos.}\frac{(2n+2)}{n}\pi=\cos.\left(2\pi+\frac{2\pi}{n}\right)=\cos.\frac{2\pi}{n},$$

$$\text{Sin.}\frac{(2n+2)\pi}{n}=\sin.\left(2\pi+\frac{2\pi}{n}\right)=\sin.\frac{2\pi}{n},$$

which is the same as the second value, and so on with respect to the others.

By this mode of proceeding we shall not only obtain the $n$ roots of the equation $y^n=1$, or $y^n-1=0$, but, with a little attention, we shall discover that these roots may be arranged in pairs, by bringing together those that only differ in the sign of the radical $\sqrt{-1}$; for since

$$\text{Cos.}(2\pi-p)=\cos. p,\text{ and }\sin.(2\pi-p)=-\sin. p,$$

it follows that

$$y=\cos.\frac{(2n-2m)\pi}{n}+\sqrt{-1}\sin.\frac{(2n-2m)\pi}{n}$$

$$=\cos.\frac{2m\pi}{n}-\sqrt{-1}\sin.\frac{2m\pi}{n}.$$

Hence it appears that we may comprehend all the roots of the equation $y^n-1=0$ in the single expressions

$$y=\cos.\frac{2m\pi}{n}\pm\sqrt{-1}\sin.\frac{2m\pi}{1},$$

by giving to $m$ only these values

$$0,\ 1,\ 2,\ \ldots\ \frac{n}{2},$$

if $n$ is even, and these values

$$0,\ 1,\ 2,\ \ldots\ \frac{n-1}{2},$$

if $n$ is odd; and it may be observed that in the former case the last value of $y$ is

$$y=\cos.\ \pi=-1,$$

because that then the equation $y^n-1=0$ has two real roots.

The two values comprehended in the formula,

$$y=\cos.\frac{2m\pi}{n}+\sqrt{-1}\ \sin.\ \frac{2m\pi}{n},$$

give for factors of the first degree of the quantity $y^n-1$, the two imaginary expressions

$$y-\left(\cos.\frac{2m\pi}{n}+\sqrt{-1}\ \sin.\frac{2m\pi}{n}\right),$$

$$y-\left(\cos.\ \frac{2m\pi}{n}-\sqrt{-1}\ \sin.\frac{2m\pi}{n}\right),$$

and the product of these is the expression

$$y^2-2y\cos.\frac{2m\pi}{n}+1,$$

which comprehends all the real factors of the second degree.

As an example of the formula

$$y=\cos.\ \frac{2m\pi}{n}\pm\sqrt{-1}\ \sin.\ \frac{2m\pi}{n},$$

the simple factors, or those of the first degree, contained in the function $y^6-1$ will be

$$y-1,$$

$$y-\left(\cos.\ \frac{2\pi}{6}\pm\sqrt{-1}\ \sin.\frac{2\pi}{6}\right),$$

$$y-\left(\cos.\ \frac{4\pi}{6}\pm\sqrt{-1}\ \sin.\frac{4\pi}{6}\right),$$

$$y+1.$$

The formula

$$y^2-2y\cos.\frac{2m\pi}{n}+1$$

gives as factors of the second degree

$$y^2-2y+1,$$

$$y^2-2y\cos.\frac{2\pi}{6}+1,$$

$$y^2-2y\cos.\frac{4\pi}{6}+1,$$

$$y^2+2y+1.$$

The first and the last of the factors of the second degree are the squares of $y-1$, and $y+1$, factors of the first degree, each of which only enters once into the proposed function; it will therefore be necessary, when we employ the factors of the second degree, to reject the first and last, and take instead of them

$$(y-1)\ (y+1)=y^2-1.$$

The factors of the first degree of the function $y^5-1$ are

$$y-1$$

$$y-\left(\cos.\frac{2\pi}{5}\pm\sqrt{-1}\ \sin.\ \frac{2\pi}{5}\right)$$

$$y-\left(\cos.\ \frac{4\pi}{5}\pm\sqrt{-1}\ \sin.\ \frac{4\pi}{5}\right).$$

Those of the third degree are

$$y^2-2y+1,$$

$$y^2-2y\cos.\frac{2\pi}{5}+1,$$

$$y^2-2y\cos.\frac{4\pi}{5}+1;$$

but it is to be observed that the first factor of the second degree is the square of $y-1$, which enters only once into the proposed function.

123. When the function to be decomposed into factors is $y^n+1$, the formula

$$y=\cos.\ \frac{(2m+1)\pi}{n}+\sqrt{-1}\ \sin.\ \frac{(2m+1)\pi}{n},$$

which corresponds to that case (§ 121.) is also susceptible of the double sign $\pm$, provided we stop at the value of $m$, which gives

$$2m+1=n,\text{ or }2m+1=n-1,$$

according as $n$ is odd or even; hence it follows that

$$m=\frac{n-1}{2},\ m=\frac{n-2}{2};$$

the facters of the first degree are

$$y-\left(\cos.\ \frac{(2m+1)\pi}{n}\pm\sqrt{-1}\ \sin.\ \frac{(2m+1)\pi}{n}\right),$$

and those of the second

$$y^2-2y\cos.\frac{(2m+1)\pi}{n}+1.$$

When among these last there is found some which are squares, we must take only one of their simple factors, in the same way as in the two preceding examples.

When the function is $y^5+1$, the factors of the first degree are

$$y-\left(\cos.\frac{\pi}{5}\pm\sqrt{-1}\ \sin.\ \frac{\pi}{5}\right),$$

$$y-\left(\cos.\ \frac{3\pi}{5}\pm\sqrt{-1}\ \sin.\frac{3\pi}{5}\right)$$

$$y+1;$$

and those of the second,

$$y^2-2y\cos.\frac{\pi}{5}+1,$$

$$y^2-2y\cos.\frac{3\pi}{5}+1,$$

$$y^2+2y+1.$$

The function $y^6+1$ has for factors of the first degree

$$y-\left(\cos.\frac{\pi}{6}\pm\sqrt{-1}\sin.\frac{\pi}{6}\right),$$

$$y-\left(\cos.\frac{3\pi}{6}\pm\sqrt{-1}\sin.\frac{3\pi}{6}\right),$$

$$y-\left(\cos.\frac{5\pi}{6}\pm\sqrt{-1}\sin.\frac{5\pi}{6}\right),$$

and those of the second,

$$y^2-2y\cos.\frac{\pi}{6}+1,$$

$$y^2-2y\cos.\frac{3\pi}{6}+,\text{ or }y^2+1,$$

$$y^2-2y\cos.\frac{5\pi}{6}+1.$$

124. Such functions as are of this form $x^{2n}+2px^n+q$ may be treated in the same manner as those which consist of only two terms. By putting the function $=0$, and resolving the equation which is thus produced, in the same manner as if it were of the second degree, we find the factors to be

$$x^n+(p\pm\sqrt{(p^2-q)});$$

if $p^2$ exceed $q$, the second term of these factors is real, and by making

$$\pm a^n=p\pm\sqrt{(p^2-q)},$$

we have the functions of the form

$$x\pm a^n$$

to decompose into factors.

When $p^2\angle q$, then we put $q=a^n$, $q=b^{2n}$, $x=by$, and the function becomes

$$b^{2n}y^{2n}+2a^nb^ny^n+b^n$$

$$=b^{2n}\left(y^{2n}+\frac{2a^n}{b^n}y^n+1\right);$$

but the condition $p^2\angle q$, or $a^{2n}\angle b^{2n}$, makes $a^n\angle b^n$, and $\frac{a^n}{b^n}\angle 1$, therefore $\frac{a^n}{b^n}$ may be represented by the cosine of a given arch $\partial$, and the proposed function will be reduced to

$$b^{2n}(y^{2n}+2y^n\cos.\partial+1),$$

we have then only to resolve the equation

$$y^{2n}+2y^n\cos.\partial+1=0,$$

and we immediately find

$$y^n=-\cos.\partial\pm\sqrt{-1}\sin.\partial;$$

we now assume, as in § 121,

$$y=\cos.z\pm\sqrt{-1}\sin.z;$$

then we find (§ 120),

$$y^n=\cos.nz\pm\sqrt{-1}\sin.nz,$$

which expression for $y^n$, being compared with its other value, gives

$$\cos.nz=\cos.\partial,\ \sin.nz=\sin.\partial.$$

These relations will be satisfied if we suppose $nz$ $-2m+\partial$, $=m$ being any whole number whatever, for

$$\cos.(2m\pi+\partial)=\cos.\partial,\ \sin.(2m\pi+\partial)=\sin.\partial;$$

we have therefore

$$z=\frac{2m\pi+\partial}{n},$$

$$y=\cos.\frac{2m\pi+\partial}{n}\pm\sqrt{-1}\sin.\frac{2m\pi+\partial}{n}.$$

The factors of the first degree of the function

$$y^{2n}+2y^n\cos.\partial+1$$

will consequently be comprehended in this formula,

$$y-\left\{\cos.\frac{2m\pi+\partial}{n}\pm\sqrt{-1}\sin.\frac{2m\pi+\partial}{n}\right\}.$$

If $p$ the coefficient of the second term of the proposed function be negative, the only change necessary is to make $p=-a^n$, and to take the arch $\partial$ greater than a quadrant.

### *Of the Fluents of Irrational Functions.*

125. When a fluxionary expression involves irrational functions, we must endeavour either to transform it into another that is rational, or to reduce it to a series of irrational terms of this form $Ax^{\frac{m}{n}}\dot{x}$, and then, in either case its fluent may be found by the rules already delivered.

Let us take for example the fluxion $\frac{(1+\sqrt{x}-\sqrt[3]{x^2})\dot{x}}{1+\sqrt[3]{x}}$.

It is evident that by putting $x=z^6$, all the extractions indicated by the radical signs may be effected, and the fluxion may be transformed to $\frac{6z^5(1+z^3-z^4)\dot{z}}{1+z^2}$, which, by dividing the numerator by $1+z^2$, may be otherwise expressed thus,

$$-6\left(z^7\dot{z}-z^6\dot{z}-z^5\dot{z}+z^4\dot{z}-z^3\dot{z}+\dot{z}-\frac{\dot{z}}{1+z^2}\right).$$

The fluent of which is

$$-6\left\{\begin{matrix}\frac{z^5}{8}-\frac{z^7}{7}-\frac{z^6}{6}+\frac{z^5}{5}-\frac{z^3}{3}\\+z-\text{arc }(\tan.=z)\end{matrix}\right\}+\textit{const.}$$

126. We shall first consider such fluxions as contain the irrational function $\sqrt{(A+Bx+Cx^2)}$, and which have necessarily one or other of these forms.

$$X\dot{x}\sqrt{(A+Bx+Cx^2)},\ \frac{X\dot{x}}{\sqrt{(A+Bx+Cx^2)}},$$

X being put for any rational function of $x$; and it may be remarked, that the latter form comprehends the former, which may be written thus:

$$\frac{X\dot{x}\sqrt{(A+Bx+Cx^2)}\times\sqrt{(A+Bx+Cx^2)}}{\sqrt{(A+Bx+Cx^2)}}$$

$$=\frac{X(A+Bx+Cx^2)\dot{x}}{\sqrt{(A+Bx+Cx^2)}};$$

and here the numerator of the fluxion is a rational function of $x$.

Before we transform the expression $\sqrt{(A+Bx+Cx^2)}$ into another that is rational with respect to the variable quantity it contains, we shall put the quantity $A+Bx+Cx^2$ under this form,

$$C\left(\frac{A}{C}+\frac{B}{C}x+x^2\right);$$

and, in order to abridge, we shall put

$$C=c^2,\ \frac{A}{C}=a,\ \frac{B}{C}=b,$$

then we have

$$\sqrt{(A+Bx+Cx^2)}=c\sqrt{(a+bx+x^2.)}$$

Let us now assume $\sqrt{(a+bx+x^2)}=x+z$, then, squaring both sides of the equation, we find $a+bx=2xz+z^2$, hence we get $x=\frac{a-z^2}{2z-b}$, and consequently

$$\sqrt{(A+Bx+Cx^2)}=c\,(x+z)=c\left(\frac{a-bz+z^2}{2z-b}\right)$$

$$\dot{x}=-\frac{2(a-bz+z^2)\dot{z}}{(2z-b)^2}.$$

By means of these values the fluxion $\frac{X\dot{x}}{\sqrt{(A+Bx+Cx^2}}$ is transformed into another fluxion $Z\dot{z}$, where Z denotes a rational function of $z$, which is real when C or $c^2$ is positive; but as when C is negative $c$ becomes imaginary, the fluxion $Z\dot{z}$ which involves $c$ becomes also imaginary.

In this case we have to consider $\sqrt{(A+Bx-Cx^2)}$, and making

$$C=c^2,\ \frac{A}{C}=a,\ \frac{B}{C}=b,$$

it becomes $c\sqrt{(a+bx-x^2)}$. The quantity $x^2-bx-a$ may always be decomposed into real factors of the first degree; let us represent these factors by $x-\alpha$, and $x-\alpha'$, then it is evident that

$$\begin{aligned}a+bx-x^2&=-(x^2-bx-a)\\&=(x-\alpha)\,(\alpha'-x).\end{aligned}$$

Let us now assume

$$\sqrt{(x-\alpha)\,(\alpha'-x)}=(x-\alpha)z,$$

then squaring both sides of the equation it becomes divisible by $x-\alpha$, and we have $\alpha'-x=(x-\alpha)\,z^2$, from which we find

$$x=\frac{\alpha z^2+\alpha'}{z^2+1},\ (x-\alpha)\,z=\frac{(\alpha'-\alpha)\,z}{z^2+1},$$

$$\dot{x}=\frac{2(\alpha-\alpha')z\dot{z}}{(z^2+1)^2},$$

values which render the proposed fluxion $\frac{X\dot{x}}{\sqrt{(A+Bx+Cx^2)}}$ rational.

127. Let us now take for example the fluxion $\frac{\dot{x}}{\sqrt{(A+Bx+Cx^2}}$; by applying to it the first of the preceding transformations it becomes $\frac{-2\dot{z}}{c(2z-b)}$, the fluent of which is $-\frac{1}{c}$ l. $(2z-b)+const.$ Substituting now for $z$ its value $-x+\sqrt{(a+bx+x^2)}$, and for $x$, $b$, and $c$, the quantities they severally represent, the fluent becomes

$$\frac{-1}{\sqrt{C}}\,\text{l.}\left\{\frac{1}{\sqrt{C}}\left(\begin{array}{l}-\frac{B}{\sqrt{C}}-2x\sqrt{C}\\+2\sqrt{(A+Bx+Cx^2}\end{array}\right)\right\}+const.$$

a result to which we may also give this form,

$$\frac{-1}{\sqrt{C}}\,\text{l.}\left\{\begin{array}{l}\frac{-B}{2\sqrt{C}}-x\sqrt{C}\\+\sqrt{(A+Bx+Cx^2}\end{array}\right\}$$

$$+\,\text{l.}\,\frac{2}{\sqrt{C}}+const.$$

By uniting the constant quantities into one, and observing that the radical quantity $\sqrt{C}$ may have the sign ∓ prefixed to it, we have at last

$$\int\frac{\dot{x}}{\sqrt{(A+Bx+Cx^2}}\ \text{equal to}$$

$$\frac{1}{\sqrt{C}}\,\text{l.}\left\{+\frac{B}{2\sqrt{C}}+x\sqrt{C}+\sqrt{(A+Bx+Cx^2)}\right\}.$$
$$+\,const.$$

128. Let us take for the second example $\frac{\dot{x}}{\sqrt{(A+Bx-Cx^2)}}$. By employing the latter transformation of § 126, we have $\frac{-2\dot{z}}{c(z^2+1)}$, of which the fluent is

$$-\frac{2}{c}\,\text{arc}\ (\tan. = z)+const.$$

Substituting now instead of $z$ its value $\frac{\sqrt{(\alpha'-x)}}{\sqrt{(x-\alpha)}}$ deduced from the equation $\alpha'-x=(x-\alpha)z^2$, and putting $\sqrt{C}$ for $c$, we get $\int\frac{\dot{x}}{\sqrt{(A+Bx-Cx^2)}}$ equal to

$$-\frac{2}{\sqrt{C}}\text{ arc }\left(\tan.=\frac{\sqrt{(\alpha'-x)}}{\sqrt{(x-\alpha)}}\right)+const.$$

$\alpha$ and $\alpha'$ being the roots of the equation

$$x^2-\frac{B}{C}x-\frac{A}{C}=0.$$

Let us suppose that $A=C=1$ and $B=0$, then the proposed fluxion becomes in this particular case $\frac{\dot{x}}{\sqrt{(1-x^2)}}$, and the preceding formula gives for its fluent $-2$ arc. $\left(\tan.=\frac{\sqrt{(1-x)}}{\sqrt{(1+x)}}\right)+$ *const.* for $\alpha$ and $\alpha'$ being the roots of the equation $x^2-1=0$, we must take $\alpha=-1$, and $\alpha'=1$.

We may, however, give this fluent another form by proceeding thus: Let $v$ be the arch whose tan. $=\frac{\sqrt{(1-x)}}{\sqrt{(1+x)}}$, then $\tan.^2v=\frac{1-x}{1+x}$, and $x=\frac{1-\tan.^2v}{1+\tan.^2v}$ $=\frac{2}{1+\tan.^2v}-1=\frac{2}{\sec.^2v}-1=2\cos.^2v-1$, but $2\cos.^2v-1=\cos.\ 2v$ (ALGEBRA, § 358.), therefore, $x=\cos.\ 2v$. Put $s$ for the arch whose sine is $x$, and $\pi$ for half the circumference, then $x=\cos\ (\frac{1}{2}\pi-s)$, therefore $2v=\frac{1}{2}\pi-s$, and since it has been shewn that $\int\frac{\dot{x}}{\sqrt{(1-x^2)}}=-2v+$ *const.* therefore $\int\frac{\dot{x}}{\sqrt{(1-x^2)}}$ $=s-\frac{1}{2}\pi+const.$ or, by including the arch $\frac{1}{2}\pi$ in the constant quantity, $\int\frac{\dot{x}}{\sqrt{(1-x^2)}}=s+const.$ This conclusion agrees with what has been shewn in § 59.

Instead of finding the fluent of

$$\frac{\dot{x}}{\sqrt{(A+Bx-Cx^2)}}=\frac{\dot{x}}{c\sqrt{(a+bx-x^2)}}$$

by first transforming it to a rational expression, we may reduce it directly to an arch of a circle by proceeding as follows. Put $x-\frac{b}{2}=z$, then $\dot{x}=\dot{z}$, and the fluxion is transformed to $\frac{\dot{z}}{c\sqrt{(a+\frac{1}{4}b^2-z^2)}}$; again, put $a+\frac{1}{4}b^2$ $=g^2$, and $z=g\,u$, then $\dot{z}=g\,\dot{u}$, and this last fluxion is transformed to $\frac{\dot{u}}{c\sqrt{(1-u^2)}}$, the fluent of which is $\frac{1}{c}$ arc $(\sin.=u)+const.$

### *Of the Fluents of Binomial Fluxions.*

129. Let us now consider such fluxions as have this form,

$$x^{m-1}\dot{x}(a+bx^n)^{\frac{p}{q}},$$

and which are sometimes called *binomial* fluxions. We may here suppose $m$ and $n$ to be whole numbers, without affecting the generality of the expre

For if we had $x^{\frac{1}{3}}\dot{x}(a+bx^{\frac{1}{2}})^{\frac{p}{q}}$, we may assume

then $\dot{x}=6z^5\dot{z}$, and the fluxion becomes

$(a+bz^3)^{\frac{p}{q}}$. We may also suppose $n$ to be positive

if it were negative, so that the fluxion were

$(a+bx^{-n})^{\frac{p}{q}}$ we have only to assume $x=\frac{1}{z}$, and

fluxion is transformed to $-z^{-m-1}\dot{z}(a+z^n)^{\frac{p}{q}}$.

Let us inquire in what case the fluxion

$(a+bx^n)^{\frac{p}{q}}$ may become rational. Assume $a+bx^n=$

then $(a+bx^n)^{\frac{p}{q}}=z^p$, $x^n=\frac{z^q-a}{b}$, $x^m=\left(\frac{z^q-a}{b}\right)$

and $x^{m-1}\dot{x}=\frac{q}{nb}z^{q-1}\left(\frac{z^q-a}{b}\right)^{\frac{m}{n}-1}\dot{z}$; hence the pro-

posed fluxion is transformed to

$$\frac{q}{nb}z^{p+q-1}\dot{z}\left(\frac{z^{q-a}}{b}\right)^{\frac{m}{n}-1};$$

this expression is evidently rational as often as $\frac{m}{n}$

whole number.

There are yet other cases in which the fluxion may become rational, and which may be determined by assuming $a+bx^n=x^nu^q$, thus we have

$$x^n=\frac{a}{u^q-b},\ x^m=\frac{a^{\frac{m}{n}}}{(u^q-b)^{\frac{m}{n}}},\ldots\ldots$$

$x^{m-1}\dot{x}=\frac{-q\,a^{\frac{m}{n}}u^{q-1}\dot{u}}{n(u^q-b)^{\frac{m}{n}+1}}$, and because that $(a+b$

$=-\frac{a^{\frac{p}{q}}u^p}{(u^q-)^{\frac{p}{q}}}$ the fluxion $x^{m-1}\dot{x}(a+bx^n)^{\frac{p}{q}}$ is

formed to

$$\frac{-qa^{\frac{m}{n}+\frac{p}{q}}u^{p+q-1}\dot{u}}{n(u^q-b)^{\frac{m}{n}+\frac{p}{q}+1}},$$

an expression which is rational if $\frac{m}{n}+\frac{p}{q}$ is a

number.

130. As it is not possible, in every case, to

in finite terms the formula $\int x^{m-1}\dot{x}(a+bx)^{\frac{p}{q}}$,

may try to reduce it to its most simple case,

Inverse Method.

done with respect to $\int \frac{\dot{x}}{(x^2+\beta^2)}$, in § 114, which we have succeeded in reducing to $\int \frac{\dot{x}}{x^2+\beta^2}$. To effect this reduction, we remark, that, since when $u$ and $v$ denote any functions of a variable quantity, the fluxion of $u\,v$ is $u\dot{v}+v\dot{u}$, (§ 37.) therefore $\int u\,\dot{v} = u\,v - \int v\,\dot{u}$. Now if we can decompose the expression $x^{m-1}\,\dot{x}\,(a+b\,x^n)^{\frac{p}{q}}$ into two factors, such that we can find the fluent of one of them, then denoting that factor by $\dot{v}$, and the other by $u$, the fluent of the proposed fluxion will be made to depend on that of $v\,\dot{u}$, which in some cases will be more simple than the proposed fluxion. That we may abridge a little the results, we shall write $p$ instead of $\frac{p}{q}$, so that $p$ will represent any fraction; the proposed fluxion thus simplified in its form is

$$x^{m-1}\,\dot{x}\,(a+b\,x^n)^p.$$

Among the different ways of resolving this fluxion nto two factors, we shall choose that which diminishes he exponent of $x$ without the parentheses, we therefore write the fluxion thus

$$x^{m-n} \times x^{n-1}\,\dot{x}\,(a+b\,x^n)^p,$$

now the fluent of the factor $x^{n-1}\,\dot{x}\,(a+b\,x^n)^p$ may always be determined, whatever be the value of $p$, by § 108; let us denote this factor by $\dot{v}$, then

$$v = \frac{(a+b\,x^n)^{p+1}}{(p+1)\,nb}, \text{ and } u = x^{m-n},$$

hus the formula $\int u\,\dot{v} = u\,v - \int v\,\dot{u}$ give us $\int x^{m-1}\,\dot{x}$ $(a+bx^n)^p$ equal to

$$\frac{x^{m-n}\,(a+b\,x^n)^{p+1}}{(p+1)\,n\,b}$$

$$-\frac{m-n}{(p+1)\,nb}\int x^{m-n-1}\,\dot{x}\,(a+bx^n)^{p+1}.$$

$$\text{But} \int x^{m-n-1}\,\dot{x}\,(a+bx^n)^{p+1} =$$

$$\int x^{m-n-1}\,\dot{x}\,(a+bx^n)^p\,(a+bx^n) =$$

$$a\int x^{m-n-1}\,\dot{x}\,(a+bx^n)^p$$

$$+b\int x^{m-1}\,\dot{x}\,(a+bx^n)^p.$$

Substituting now this last value in the preceding equation, and collecting into one the terms involving the fluent $\int x^{m-1}\,\dot{x}\,(a+bx^n)^p$, we find

$$\left(1+\frac{m-n}{(p+1)n}\right)\int x^{m-1}\,\dot{x}\,(a+bx^n)^p =$$

$$\frac{1}{(p+1)\,nb}\left\{\begin{matrix} x^{m-n}(a+bx^n)^{p+1} \\ -a(m-n)\int x^{m-n-1}\,\dot{x}\,(a+bx^n)^p \end{matrix}\right\}$$

hence at last we get

(A)

$$\int x^{m-1}\,\dot{x}\,(a+bx^n)^p =$$

$$\frac{1}{b(pn+m)}\left\{\begin{matrix} x^{m-n}(a+bx^n)^{p+1} \\ -a(m-n)\int x^{m-n-1}\,\dot{x}\,(a+bx^n)^p \end{matrix}\right\}$$

It is easy to see that, as we have, by this formula, reduced the determination of the fluent of $x^{m-1}\,\dot{x}$ $(a+b\,x^n)^p$ to that of $x^{m-n-1}\,\dot{x}\,(a+b\,x^n)^p$, we may reduce this last to that of $x^{m-2n-1}\,\dot{x}\,(a+b\,x^n)^p$ by writing $m-n$ in place of $m$ in equation (A), then by changing $m$ into $m-2\,n$ we may reduce the fluent of $x^{m-2n-1}\,x\,(a+bx^n)^p$ to that of $x^{m-3n-1}\,\dot{x}\,(a+bx^n)^p$, and so on.

In general, if $r$ denote the number of reductions, we shall at last come to

$\int x^{m-rn-1}\,\dot{x}\,(a+b\,x^n)^p$, and the last formula will be

$$\int x^{m-(r-1)n-1}\,\dot{x}\,(a+b\,x^n)^p =$$

$$\frac{x^{m-rn}\,(a+b\,x^n)^{p+1}}{b(pn+m-(r-1)n)}$$

$$-\frac{a(m-rn)\int x^{m-rn-1}\dot{x}(a+bx^n)^p}{b(pn+m-(r-1)n)}.$$

It appears by the last formula, that if $m$ is a multiple of $n$, then $\int x^{m-1}\dot{x}(a+b\,x^n)^p$ will be an algebraic quantity, for in that case the coefficient $m-rn$ will be $=0$, and therefore the term containing $\int x^{m-rn-1}\,\dot{x}$ $(a+bx^n)^p$ will vanish. This result coincides with what we have already found, § 129.

131. We may also obtain a reduction, by which the exponent $p$ will be diminished by unity. For this purpose it is sufficient to observe that $\int x^{m-1}\,\dot{x}\,(a+bx^n)^p$ is equal to

$$\int x^{m-1}\,\dot{x}\,(a+bx^n)^{p-1}\,(a+bx^n) =$$

$$a\int x^{m-1}\,\dot{x}\,(a+bx^n)^{p-1}$$

$$+b\int x^{m+n-1}\,\dot{x}\,(a+bx^n)^{p-1},$$

and that the formula (A) by changing $m$ into $m+n$, and $p$ into $p-1$ gives

$$\int x^{m+n-1}\dot{x}\,(a+bx^n)^{p-1}=$$

$$\frac{x^m(a+bx^n)^p = am\int x^{m-1}\dot{x}\,(a+bx^n)^{p-1}}{b(pn+m)}.$$

Substitute now this value in the preceding equation, we have

(B)

$$\int x^{m-1}\dot{x}(a+bx^n)^p=$$

$$\frac{x^m(a+bx^n)^p+pna\int x^{m-1}\dot{x}(a+bx^n)^{p-1}}{pn+m}.$$

By means of this general formula we may take away successively from $p$ as many units as it contains, and by the application of this formula, and formula (A), we may cause the fluent $\int x^{m-1}\dot{x}\,(a+bx^n)^p$ to depend on $\int x^{m-rn-1}\dot{x}\,(a+bx^n)^{p-s}$, $rn$ being the greatest multiple of $r$ contained in $m-1$, and $s$ the greatest whole number contained in $p$.

The fluent $\int x^7\dot{x}\,(a+bx^3)^{\frac{5}{2}}$, for example, may, by the application of formula (A), be reduced successively to

$$\int x^4\dot{x}\,(a+bx^3)^{\frac{7}{2}},\ \text{and} \int \dot{x}x\,(a+bx^3)^{\frac{9}{2}},$$

and by formula (B) $\int x\dot{x}\,(a+bx^3)^{\frac{9}{2}}$ is reduced successively to

$$\int \dot{x}x\,(a+bx^3)^{\frac{7}{2}},\ \text{and} \int \dot{x}x\,(a+bx^3)^{\frac{5}{2}}.$$

132. It is evident, that if $m$ and $n$ were negative, the formulas (A) and (B) would not answer the purpose for which they have been investigated, because, in that case, they would increase the exponents instead of diminishing them. If, however, we reverse them, we shall find that they then apply to the case under consideration.

From formula (A) we get

$$\int x^{m-n-1}\dot{x}\,(a+bx^n)^p=$$

$$\frac{x^{m-n}(a+bx^n)^{p+1}}{a(m-n)}$$

$$-\frac{b(m+np)\int x^{m-1}\dot{x}(a+bx^n)^p}{a(m-n)};$$

Substitute now $m+n$ in place of $m$, and it becomes

(C)

$$\int x^{m-1}\dot{x}(a+bx^n)^p=$$

$$\frac{x^m(a+bx^n)^{p+1}}{am}$$

$$-\frac{b(m+n+np)\int x^{m+n-1}\dot{x}\,(a+bx^n)^p}{am},$$

This formula diminishes the exponents without the parentheses, because $m+n-1$ becomes $-m+n-1$, when $-m$ is substituted instead of $m$.

To reverse formula (B) we first take

$$\int x^{m-1}\dot{x}(a+bx^n)^{p-1}=$$

$$\frac{-x^m(a+bx^n)^p}{pna}$$

$$+\frac{(m+np)\int x^{m-1}\dot{x}\,(a+bx)^p}{pna};$$

Then, writing $p+1$ instead of $p$, we find

(D)

$$\int x^{m-1}\dot{x}\,(a+bx^n)^p=$$

$$-\frac{x^m(a+bx^n)^{p+1}}{(p+1)na}$$

$$+\frac{(m+n+np)\int x^{m-1}\dot{x}(a+bx^n)^{p+1}}{(p+1)na}.$$

This formula answers the purpose we have in view, because $p+1$ becomes $-p+1$ when $p$ is negative.

These formulas (A), (B), (C), (D), are inapplicable when their denominators vanish. This is the case with formula (A); for example, when $m=-np$; but, in every such case, the proposed fluxion may have its fluent determined either algebraically or by logarithms.

133. Let the fluent be $\int\frac{x^{m-1}\dot{x}}{\sqrt{(1-x^2)}}$, $m$ being a whole positive number. Formula (A) immediately applies to this case, so that by putting $a=1$, $b=-1$, $n=2$, $p=-\frac{1}{2}$, we have

$$\int\frac{x^{m-1}\dot{x}}{\sqrt{(1-x^2)}}=\left\{\begin{array}{l}-\frac{x^{m-2}\sqrt{(1-x^2)}}{m-1}\\[2ex]+\frac{m-2}{m-1}\int\frac{x^{m-3}\dot{x}}{\sqrt{(1-x^2)}}\end{array}\right.$$

or, substituting $m$ in place of $m-1$,

$$\int\frac{x^m\dot{x}}{\sqrt{(1-x^2)}}=\left\{\begin{array}{l}-\frac{x^{m-1}\sqrt{(1-x^2)}}{m}\\[2ex]+\frac{m-1}{m}\int\frac{x^{m-2}\dot{x}}{\sqrt{(1-x^2)}}\end{array}\right.$$

Let

Let us suppose, for example, that $m=1$, then

$$\int\frac{x\dot{x}}{\sqrt{(1-x^2)}}=-\sqrt{(1-x^2)}+const.$$

Let us now suppose that $m=3$, then

$$\int\frac{x^3\dot{x}}{\sqrt{(1-x^2)}}=\begin{cases}-\frac{1}{3}x^2\sqrt{(1-x^2)}\\+\frac{2}{3}\int\frac{x\dot{x}}{\sqrt{(1-x^2)}}\end{cases}$$

or, substituting for $\int\frac{x\dot{x}}{\sqrt{(1-x^2)}}$ its value,

$$\int\frac{x^3\dot{x}}{\sqrt{(1-x^2)}}=-\left(\frac{1}{2}x^2+\frac{2}{3}\right)\sqrt{(1-x^2)}+const.$$

If we suppose $m=2$, then

$$\int\frac{x^2\dot{x}}{\sqrt{(1-x^2)}}=\begin{cases}-\frac{1}{2}x\sqrt{(1-x^2)}\\+\frac{1}{2}\int\frac{\dot{x}}{\sqrt{(1-x^2)}}.\end{cases}$$

But we have already found, § 128, that

$$\int\frac{\dot{x}}{\sqrt{(1-x^2)}}=\text{arc }(\sin.=x),$$

therefore, putting A for arc (sin. $=x$),

$$\int\frac{x^2\dot{x}}{\sqrt{(1-x^2)}}=-\tfrac{1}{2}x\sqrt{(1-x^2)}+\tfrac{1}{2}A+const.$$

In the very same way we find that

$$\int\frac{x^4\dot{x}}{\sqrt{(1-x^2)}}\text{ is equal to}$$

$$-\left(\frac{1}{4}x^3+\frac{3}{8}x\right)\sqrt{(1-x^2)}+\frac{3}{8}A+const.$$

134. In the case of $m$, a negative number, we must have recourse to formula (C), from which we find

$$\int\frac{x^{-m-2}\dot{x}}{\sqrt{(1-x^2)}}=\begin{cases}-\frac{x^{-m}\sqrt{(1-x^2)}}{m}\\+\frac{m-1}{m}\int\frac{x^{-m+1}\dot{x}}{\sqrt{(1-x^2)}}\end{cases}$$

which formula, by writing $-m$ instead of $-m-1$, becomes

$$\int\frac{\dot{x}}{x^m\sqrt{(1-x^2)}}=\begin{cases}-\frac{\sqrt{(1-x^2)}}{(m-1)x^{m-1}}\\+\frac{m-2}{m-1}\int\frac{\dot{x}}{x^{m-2}\sqrt{(1-x^2)}},\end{cases}$$

We cannot here suppose $m=1$, for that value would render the denominator $=0$; therefore, before we can apply this formula, it is necessary to investigate the fluent of $\frac{\dot{x}}{x\sqrt{(1-x^2)}}$. We may easily find it from § 126, or otherwise thus, put $1-x^2=z^2$, then

$$x=\sqrt{(1-z^2)},\ \dot{x}=\frac{-z\dot{z}}{\sqrt{(1-z^2)}}.$$

Therefore

$$\frac{\dot{x}}{x\sqrt{(1-x^2)}}=\frac{-\dot{z}}{1-z^2}=\frac{-\frac{1}{2}\dot{z}}{1+2}-\frac{\frac{1}{2}\dot{z}}{1-z}.$$

The fluent of the right hand side of this equation is evidently (§ 103.)

$$-\tfrac{1}{2}\,\text{l.}\,(1+z)+\tfrac{1}{2}\,\text{l.}\,(1-z)=-\tfrac{1}{2}\,\text{l.}\left(\frac{1+z}{1-z}\right);$$

or, since $\frac{1+z}{1-z}=\frac{(1+z)^2}{1-z^2}$, the same fluent may be expressed thus,

$$-\tfrac{1}{2}\,\text{l.}\,\frac{(1+z)^2}{1-z^2}=-\text{l.}\,\frac{1+z}{\sqrt{(1-z^2)}};$$

therefore, by substituting $\sqrt{(1-x^2)}$ for $z$, and $x$ for $\sqrt{(1-z^2)}$, we have

$$\int\frac{\dot{x}}{x\sqrt{(1-x^2)}}=-\text{l.}\left(\frac{1+\sqrt{(1-x^2)}}{x}\right)+const.$$

If we suppose $m=2$, the formula becomes

$$\int\frac{\dot{x}}{x^2\sqrt{(1-x^2)}}=-\frac{\sqrt{(1-x^2)}}{x}+const.$$

If we suppose $m=3$, then

$$\int\frac{\dot{x}}{x^3\sqrt{(1-x^2)}}=\begin{cases}-\frac{\sqrt{(1-x^2)}}{2x^2}\\+\frac{1}{2}\int\frac{\dot{x}}{x\sqrt{(1-x^2)}},\end{cases}$$

which expression, by substituting for

$$\int\frac{\dot{x}}{x\sqrt{(1-x^2)}}\text{ its value, becomes}$$

$$\int\frac{\dot{x}}{x^3\sqrt{(1-x^2)}}=\begin{cases}-\frac{\sqrt{(1-x^2)}}{2x^2}\\+\frac{1}{2}\,\text{l.}\left(\frac{1+\sqrt{(1-x^2)}}{x}\right)\\+const.\end{cases}$$

### *Of Finding Fluents by Series.*

135. We can always easily find an expression for the fluent $\int X\dot{x}$, where X denotes any function of $x$; when that function is expanded into a series, each term of which is some power of $x$ multiplied by a constant quantity; thus suppose

$$X=Ax^m+Bx^{m+n}+Cx^{m+2n}+\&c.$$

then $X\dot{x}$ is equal to

$Ax^m$.

$$A x^m \dot{x} + B x^{m+n} \dot{x} + C x^{m+2n} \dot{x} + \&c.$$

and taking the fluent of each term by § 101,

$$\int X\dot{x} = \frac{A x^{m+1}}{m+1} + \frac{B x^{m+n+1}}{m+n+1}$$
$$+ \frac{C x^{m+2n+1}}{m+2n+1} + \&c. + \textit{const.}$$

If in the developement of $x$ there be any term of this form $\frac{A}{x}$, the fluent corresponding to that term will be A l. $x$ (§ 103).

136. The most simple function of $x$ that can be expanded into a series is $\frac{1}{a+x}$, which becomes

$$\frac{1}{a} - \frac{x}{a^2} + \frac{x^2}{a^3} - \frac{x^3}{a^4} + \&c.$$

Hence we find

$$\frac{\dot{x}}{a+x} = \frac{\dot{x}}{a} - \frac{x\dot{x}}{a^2} + \frac{x^2\dot{x}}{a^3} - \frac{x^3\dot{x}}{a^4} + \&c.$$

and taking the fluents

$$\int\frac{\dot{x}}{a+x} = \frac{x}{a} - \frac{x^2}{2a^2} + \frac{x^3}{3a^3} - \frac{x^4}{4a^4} + \&c. + \textit{const.}$$

Now we know that $\int\frac{\dot{x}}{a+x} = \text{l.}\,(a+x)$ (§ 57.) therefore

$$\text{l.}\,(a+x) = \frac{x}{a} - \frac{x^2}{2a^2} + \frac{x^3}{3a^3} - \frac{x^4}{4a^4} + \&c. + \textit{const.}$$

To find the value of the constant quantity we have only to make $x=0$, for then the equation becomes l. $a =$ *const.* therefore

$$\text{l.}\,(a+x) = \text{l.}\,a + \frac{x}{a} - \frac{x^2}{2a^2} + \frac{x^3}{3a^3} - \&c.$$

hence, if we subtract l. $a$ from each side, and observe that l. $(x+a)$ — l. $a =$ l. $\left(\frac{x+a}{a}\right) =$ l. $\left(1+\frac{x}{a}\right)$ we get

$$\text{l.}\,\left(1+\frac{x}{a}\right) = \frac{x}{a} - \frac{x^2}{2a^2} + \frac{x^3}{3a^3} - \frac{x^4}{4a^4} + \&c.$$

From this conclusion we may deduce rules for computing the logarithms of numbers.

137. Let the fluxion be $\frac{a\dot{x}}{a^2+x^2}$, which may be put under this form $\frac{\frac{\dot{x}}{a}}{1+\frac{x^2}{a^2}}$, and which consequently belongs to the arch of which the tangent $= \frac{x}{a}$ (§ 60.). By reducing $\frac{a}{a^2+x^2}$ into a series, we find

$$\frac{a}{a^2+x^2} = \frac{1}{a} - \frac{x^2}{a^3} + \frac{x^4}{a^5} - \frac{x^6}{a^7} + \&c.$$

Hence, multiply both sides by $\dot{x}$, and taking the fluent of each term, we get

$$\int\frac{a\dot{x}}{a^2+x^2} = \text{arc}\left(\text{tan.} = \frac{x}{a}\right) + \textit{const.} =$$
$$\frac{x}{a} - \frac{x^3}{3a^3} + \frac{x^5}{5a^5} - \frac{x^7}{7a^7} + \&c. + \textit{const.}$$

If we wish to deduce from this equation, the value of the least arch whose tangent is $\frac{x}{a}$, it is necessary to suppress the arbitrary constant quantity, for when that arch $=0$, then $x=0$; thus we have the arch whose tangent is $\frac{x}{a}$ expressed by the infinite series

$$\frac{x}{a} - \frac{x^3}{3a^3} + \frac{x^5}{5a^5} - \frac{x^7}{7a^7} + \&c.$$

Let $\pi$ denote the circumference of a circle whose diameter is unity, or half the circumference of a circle whose radius is unity, then, as the sine of 30 degrees, or $\frac{1}{6}\pi$, is $\frac{1}{2}$, and its cosine $\sqrt{(1-\frac{1}{4})} = \frac{1}{2}\sqrt{3}$, we have tan. $\frac{\pi}{6} = \frac{\sin.\,\frac{1}{6}\pi}{\cos.\,\frac{1}{6}\pi} = \sqrt{\frac{1}{3}}$. Let $\sqrt{\frac{1}{3}}$ be substituted instead of $x$ in the above series, and $a$ be supposed $=1$, thus we get

$$\frac{\pi}{6} = \sqrt{\tfrac{1}{3}} \times \left(1 - \frac{1}{3\cdot3} + \frac{1}{5\cdot3^2} - \frac{1}{7\cdot3^3} + \&c.\right)$$

and therefore

$$\pi = \sqrt{12} \times \left(1 - \frac{1}{3\cdot3} + \frac{1}{5\cdot3^2} - \frac{1}{7\cdot3^3} + \&c.\right);$$

by taking the sum of about fifteen terms of this series, we shall find $\pi=3.1415927$. The determination of this number is of great importance in every branch of mathematics.

138. By proceeding with the fluxion $\frac{x^m\dot{x}}{a^n+x^n}$, in the same manner as we have done with $\frac{a\dot{x}}{a^2+x^2}$, we get

$$\int\frac{x^m\dot{x}}{a^n+x} = \frac{x^{m+1}}{(m+1)a^n} - \frac{x^{m+n+1}}{(m+n+1)a^{2n}}$$
$$+ \frac{x^{m+2n+1}}{(m+2n+1)a^{3n}} \&c.$$

This series proceeds by the positive powers of $x$, or is an ascending series, but we may also expand $\frac{1}{a^n+x^n}$ into a series proceeding by the negative powers of $x$, and which will therefore be called a *descending* series. Thus because

$$\frac{1}{x^n+a^n}$$

Inverse Method.

$$\frac{1}{x^n+a^n}=\frac{1}{x^n}-\frac{a^n}{x^{2n}}+\frac{a^{2n}}{x^{3n}}-\frac{a^{3n}}{x^{4n}}+\&c.$$

we have, after multiplying both sides by $x^m\dot{x}$, and taking the fluents

$$\int\frac{x^m\dot{x}}{x^n+a^n}=-\frac{1}{(n-m-1)x^{n-m-1}}$$

$$+\frac{a^n}{(2n-m-1)x^{2n-m-1}}-\frac{a^{2n}}{(3n-m-1)x^{3n-m-1}}$$
$$+\&c.+const.$$

This last series will be convergent when $x$ is greater than $a$, and at the same time $m\angle n$, and $n\triangleright 1$. But besides, that it may contain algebraic terms only, it is necessary that none of the divisors $n-m-1$, $2n-m-1$, $3n-m-1$, &c. become $=0$; this circumstance will take place as often as $m+1$ is a multiple of $n$, and in which case

the series $\frac{\dot{x}}{x^{n-m}}-\frac{a^n\dot{x}}{x^{2n-m}}+\&c.$ which is the developement of the fluxion, will contain a term of this form, $\frac{a^m\dot{x}}{x}$, the fluent of which is $a^m$ l. $x$.

If in this result we put $m=2$, $n=0$, and $a=1$, we get

$$\int\frac{\dot{x}}{1+x^2}=-\frac{1}{x}+\frac{1}{3x^3}-\frac{1}{5x^5}+\&c.+const.$$

But although the expression $\frac{\dot{x}}{1+x^2}$ is the fluxion of the arch having $x$ for its tangent, we must not conclude that this series is the developement of that arch, for $x$ being supposed $=0$, each of the terms of the series becomes infinite.

The consideration of the constant quantity added to the fluent will remove this apparent difficulty, if we remark, that to know the true value of a series, it is always necessary to begin with the case in which it is convergent. Now the series

$$-\frac{1}{x}+\frac{1}{3x^3}-\frac{1}{5x^5}+\&c.$$

converges so much the faster as $x$ is greater, and it vanishes when $x$ is infinite; but in this extreme case the equation

$$\text{arc (tan.}=x)=-\frac{1}{x}+\frac{1}{3x^3}-\frac{1}{5x^5}+\&c.$$
$$+const.$$

becomes simply arc $\frac{\pi}{2}=const.$ where $\pi$ denotes half the circumference of the circle; therefore, substituting this value of the constant quantity, we have

$$\text{arc (tan.}=x)=\frac{\pi}{2}-\frac{1}{x}+\frac{1}{3x^3}-\frac{1}{5x^5}+\&c.$$

We may easily find an expression for the fluent of the rational fraction $\frac{U\dot{x}}{V}$ (§ 111.) by expanding the quantity $\frac{U}{V}$ into a series, but the result thus obtained is in general very complicated, and seldom convergent; besides, this manner of finding the fluent is hardly of any use, since it may be expressed by means of arches of a circle and logarithms, both of which are readily obtained from the common trigonometrical tables.

139. The fluent of $x^{m-1}\dot{x}\,(a+bx^n)^{\frac{p}{q}}$ is easily obtained by first expanding the quantity $(a+bx^n)^{\frac{p}{q}}$ into a series by the binomial theorem, then multiplying each term of that series by $x^{m-1}\dot{x}$, and taking the fluents of the results by § 101. Thus we have $\int x^{m-1}\dot{x}$

$$(a+bx^n)^{\frac{p}{q}}=$$

$$a^{\frac{p}{q}}\left\{\frac{x^m}{m}+\frac{pb}{qa}\,\frac{x^{m+n}}{m+n}+\frac{p(p-q)b^2}{1.2q^2a^2}\,\frac{x^{m+2n}}{m+2n}\right.$$

$$\left.+\frac{p(p-q)(p-2q)b^3}{1.2.3\,q^3a^3}\,\frac{x^{m+3n}}{m+3n}+\&c.\right\}+const.$$

This is an ascending series, but to get a descending series we must divide $(a+bx^n)^{\frac{p}{q}}$ by $x^{\frac{np}{q}}$ and multiply $x^{m-1}\dot{x}$, the remaining part of the fluxional expression, by the same quantity, thus the fluxion is transformed to

$$x^{m+\frac{np}{q}-1}\,\dot{x}\,(b+ax^{-n})^{\frac{p}{q}}$$

the fluent of which, by proceeding as in the former case, is

$$b^{\frac{p}{q}}\left\{\frac{qx^{m+\frac{np}{q}}}{mq+np}-\frac{pa}{qb}\,\frac{qx^{m+\frac{(p-q)n}{q}}}{mq+(p-q)n}\right.$$

$$\left.\frac{p(p-q)a^2qx^{m+\frac{(p-2q)n}{q}}}{1.2q^2b^2\,mq+(p-2q)n}=\&c.\right\}+const.$$

either of these series may be employed if $a$ and $b$ are both positive, or $q$ an odd number, but if $q$ be an even number, the first formula becomes imaginary on account of the factor $a^{\frac{p}{q}}$ if $a^n$ be negative, and the same thing happens to the second formula if $a^n$ be negative.

140. Let it be required to express by a series the fluent of $\frac{\dot{x}}{\sqrt{(1-x^2)}}$. That we may develope the radical quantity $\frac{1}{\sqrt{(1-x^2)}}$ we put it under this form,

$(1-x^2)^{-\frac{1}{2}}$, an expression which when expanded by the binomial theorem, is

$$1+\frac{1}{2}x^2+\frac{1.3}{2.4}x^4+\frac{1.3.5}{2.4.6}x^6+\&c.$$

therefore, multiplying each term of this series by $\dot{x}$, and taking the fluent, we get

$$\int\frac{\dot{x}}{\sqrt{(1-x^2)}}=x+\frac{1.x^3}{2.3}+\frac{1.3.x^5}{2.4.5}$$

$$+\frac{1.3.5.x^7}{2.4.6.7}+const.$$

If we suppose $x$ to denote the sine of an arch, then $\sqrt{(1-x^2)}$ is its cosine, and $\frac{\dot{x}}{\sqrt{(1-x^2)}}$ is the fluxion of the arch itself (§ 59.); therefore the series which we have just found, expresses the length of the arch of a circle, radius being unity, and the sine of the arch $x$. If we suppose the series to express the smallest arch that corresponds to the sine $x$, then, as when the sine of that arch $=0$, the arch itself $=0$, the series expressing the arch must vanish when $x=0$, therefore we must suppress the constant quantity added to complete the fluent; or suppose it $=0$. The same series has already been found by the direct method of fluxions in § 72.

Let $\pi$ denote the same as in § 137, then, as the sine of 30 degrees, or of $\frac{1}{6}\pi$, is $\frac{1}{2}$, we have, by substituting $\frac{1}{2}$ instead of $x$ in the preceding series, and multiplying both sides by 6,

$$\pi=3\left(1+\frac{1}{2.3.2^3}+\frac{1.3.}{2.4.5.2^4}+\frac{1.3.5.}{2.4.6.7.2^6}+\&c.\right)$$

by means of this series, which involves only rational numbers, we may compute (but with more labour), the value of $\pi$ as before.

Suppose the fluxion to be $\dot{x}\sqrt{(ax-x^2)}$, which may be otherwise expressed thus, $\dot{x}a^{\frac{1}{2}}x^{\frac{1}{2}}\left(1-\frac{x}{a}\right)^{\frac{1}{2}}$. By the binomial theorem $\left(1-\frac{x}{a}\right)^{\frac{1}{2}}=$

$$1-\frac{x}{2a}-\frac{1.1\,x^2}{2.4\,a^2}-\frac{1.1.3\,x^3}{2.4.6\,a^3}-\&c.$$

Let each term of this series be multiplied by $a^{\frac{1}{2}}x^{\frac{1}{2}}\dot{x}$, and the fluent taken by § 101, thus we get $\int\dot{x}\sqrt{(ax-x^2)}=$

$$a^{\frac{1}{2}}\left(\frac{2x^{\frac{3}{2}}}{3}-\frac{1}{2}\frac{2x^{\frac{5}{2}}}{5a}-\frac{1.1}{2.4}\frac{2x^{\frac{7}{2}}}{7a^2}\right.$$

$$\left.-\frac{1.1.3}{2.4.6}\frac{2x^{\frac{9}{2}}}{9a^3}-\&c.\right)+const.$$

141. By resolving a fluxion into an infinite series, the object in view is to transform it into a series of other fluxions, each of which may have its fluent determined by known methods; but it is not always necessary that the terms of the series should be a power of $x$ multiplied by $\dot{x}$ and constant

If for example we have this fluxion

$$\frac{\dot{x}\sqrt{(1-e^2x^2)}}{\sqrt{(1-x^2)}},$$

in which $e$ is supposed to denote a small

tity, we may expand $\sqrt{(1-e^2x^2)}$ or $(1-e^2$

series, which will thus become

$$1-\frac{1}{2}e^2x^2-\frac{1.1}{2.4}e^4x^4-\frac{1.1.3}{2.4.6}e^6x^6-$$

and the fluxion $\frac{\dot{x}\sqrt{(1-e^2x^2)}}{\sqrt{(1-x^2)}}$ will be

$$\frac{\dot{x}}{\sqrt{(1-x^2)}}\left\{1-\frac{1}{2}e^2x^2-\frac{1.1}{24}\right.$$

$$\left.-\frac{1.1.3}{2.4.6}e^6x^6-\&c.\right\}$$

the series will converge very fast when $e$ is that $\sqrt{(1-e^2x^2)}$ may be a real quantity, $e^2$ than 1. We must now multiply each term

by the common factor $\frac{\dot{x}}{\sqrt{(1-x^2)}}$ and take the

which being all contained in the general

$\int\frac{x^m\dot{x}}{\sqrt{(1-x^2)}}$, will be found by § 133. Thus

A to denote an arch of which $x$ is the sine,

$$\int\frac{\dot{x}\sqrt{(1-e^2x^2)}}{\sqrt{(1-x^2)}}=$$

$$A$$

$$+\frac{1}{2}e^2\left\{\frac{1}{2}x\sqrt{(1-x^2)}-\frac{1}{2}A\right\}$$

$$+\frac{1.1}{2.4}e^4\left\{\left(\frac{1}{4}x^3+\frac{1.3}{2.4}x\right)\sqrt{(1-x^2)}-\frac{1.3}{24}\right.$$

$$+\frac{1.1.3}{2.4.6}e^6\left\{\begin{array}{l}\left(\frac{1}{6}x^5+\frac{1.3}{4.6}x^3+\frac{1.3.5}{2.4.6}x\right)\sqrt{(1-x^2)}\\-\frac{1.3.5}{2.4.6}A\end{array}\right.$$

$$+\&c.\qquad+const.$$

### *Of the Fluents of such Fluxions as involve and Exponential functions.*

142. Let it be required to find the fluent of where l. $x$ denotes the Napierean logarithm this case, as well as in some following shall have recourse to the principle already § 130, namely, that if $v$ and $z$ denote any a variable quantity $x$, then

$$\int z\dot{v}=vz-\int v\dot{z}.$$

Let us therefore assume $x^m\dot{x}=\dot{v}$, and l.

(§ 101.), $\frac{x^{m+1}}{m+1}=v$, and (§ 57), $\frac{\dot{x}}{x}=\dot{z}$,

Inverse Method.

substituting these values of $v$, $z$, $\dot{v}$, $\dot{z}$ in the formula becomes

$$\int x^m \dot{x}\,(\mathrm{l.}\,x) = \frac{x^{m+1}\,\mathrm{l.}x}{m+1} - \int \frac{x^m \dot{x}}{m+1},$$

or, since $\int \frac{x^m \dot{x}}{m+1} = \frac{x^{m+1}}{(m+1)^2} + \mathit{const.}$

$$\int x^m \dot{x}\,(\mathrm{l.}\,x) = x^{m+1}\left\{\frac{\mathrm{l.}\,x.}{m+1} - \frac{1}{(m+1)^2}\right\} + \mathit{const.}$$

Let us next suppose that the proposed fluxion is $x^m \dot{x}\,(\mathrm{l.}\,x)^n$. Put $x^m \dot{x} = \dot{v}$, and $(\mathrm{l.}\,x)^n = z$, then (§ 101.) $\frac{x^{m+1}}{m+1} = v$, and (§ 57.) $\frac{n\dot{x}\,(\mathrm{l.}\,x)^{n-1}}{x} = \dot{z}$, therefore, substituting as before these values in the formula $\int z\dot{v} = vz - \int v\dot{z}$, we get

$$\int x^m \dot{x}\,(\mathrm{l.}\,x)^n = \frac{x^{m+1}.(\mathrm{l.}\,x)^n}{m+1} - \int \frac{n x^m \dot{x}\,(\mathrm{l.}\,x)^{n-1}}{m+1}.$$

It is evident, that by this formula the determination of the fluent of $x^m \dot{x}\,(\mathrm{l.}\,x)^2$ is reduced to that of $x^m \dot{x}\,(\mathrm{l.}\,x)$ which we have already found, and in like manner that the determination of the fluent of $x^m \dot{x}\,(\mathrm{l.}\,x)^3$ is reduced to that of $x^m \dot{x}\,(\mathrm{l.}\,x)^2$, and so on, from which it appears that the fluent of $x^m \dot{x}\,(\mathrm{l.}\,x)^n$ is expressible in finite terms when $n$ is a whole positive number. The formula, however, will not apply when $m = -1$, because of the denominator $m+1 = -1+1 = 0$, But in this case we have

$$\int \frac{\dot{x}}{x}(\mathrm{l.}\,x)^n = \frac{1}{n+1}(\mathrm{l.}\,x)^{n+1} + \mathit{const.}$$

If $n$ be negative or fractional, the fluent of $x^m \dot{x}\,(\mathrm{l.}\,x)^n$ can only be expressed by an infinite series.

143. As an example of an exponential function, let it be required to find the fluent of $a^x x^n \dot{x}$. Here we may put $\dot{v}$ for $x^n \dot{x}$, and $z$ for $a^x$, then we have $v = \frac{x^{n+1}}{n+1}$, § 101, and $\dot{z} = (\mathrm{l.}\,a)\,a^x \dot{x}$, (§ 56.) therefore, substituting these values of $v$, $z$, $\dot{v}$, $\dot{z}$ in the formula $\int z\dot{v} = vz - \int v\dot{z}$, we get

$$\int a^x x^n \dot{x} = \frac{a^x.x^{n+1}}{n+1} - \int \frac{(\mathrm{l.}\,a)\,a^x x^{n+1}\dot{x}}{n+1};$$

therefore, substituting $n-1$ everywhere instead of $n$,

$$\int a^x x^{n-1} \dot{x} = \frac{a^x x^n}{n} - \int \frac{(\mathrm{l.}\,a)\,a^x x^n \dot{x}}{n};$$

hence, bringing $\int a^x x^n \dot{x}$ to stand alone one side of the equation

$$\int a^x x^n \dot{x} = \frac{a^x x^n}{\mathrm{l.}\,a.} - \frac{n}{\mathrm{l.}\,a}\int a^x x^{n-1}\dot{x}.$$

If we suppose $n = 1$, then observing that $\int a^x \dot{x} = \frac{a^x}{\mathrm{l.}\,a}$ (§ 56.),

Inverse Method.

$$\int a^x x\dot{x} = \frac{a^x x}{\mathrm{l.}\,a} - \frac{a^x}{(\mathrm{l.}\,a)^2} + \mathit{const.}$$

If $n = 2$, then

$$\int a^x x^2 \dot{x} = \frac{a^x x^2}{\mathrm{l,}\,a} - \frac{2}{\mathrm{l.}\,a}\int u^x x\dot{x}.$$

In this expression we substitute the value of $\int a^x x\dot{x}$ just found, thus it becomes

$$\int a^x x^2 \dot{x} = a^x\left\{\frac{x^2}{\mathrm{l.}\,a} - \frac{2x}{(\mathrm{l.}\,a)^2} + \frac{2}{(\mathrm{l.}\,a)^3}\right\} + \mathit{const.}$$

Proceeding in this way, we may find the fluent when $n = 3$, or when $n = 4$, or in general, when $n$ is any integer number whatever, the number of terms in the fluent being in this case always finite; it is not so however when $n$ is either negative or fractional.

### *Of the Fluents of such Fluxions as contain functions related to a circle.*

144. Let suppose that $z$ is an arch whose sine is $x$, and that it is required to find the fluent of $z x^n \dot{x}$. Put $x^n \dot{x} = \dot{v}$, then

$$\int z x^n \dot{x} = \int z\dot{v} = zv - \int v\dot{z};$$

but since $\dot{v} = x^n \dot{x}$, we have $v = \frac{x^{n+1}}{n+1}$, § 101, and since $x = \sin.\,z$, we have $\dot{x} = \dot{z}\cos.\,z = \dot{z}\sqrt{(1-x^2)}$ (§ 59.), and therefore $\dot{z} = \frac{\dot{x}}{\sqrt{(1-x^2)}}$; thus we have

$$\int z x^n \dot{x} = \frac{z x^{n+1}}{n+1} - \frac{1}{n+1}\int \frac{x^{n+1}\dot{x}}{\sqrt{(1-x^2)}};$$

hence the determination of the proposed fluent is reduced to $\int \frac{x^{n+1}\dot{x}}{\sqrt{(1-x^2)}}$ which we have already considered in § 133. By the same mode of reasoning we may determine the fluent when $x$ denotes the cosine of the arch $z$.

145. It appears from § 59. that $nz$ being put to denote any arch of a circle to radius unity, the fluxion of the sine of that arch is $n\dot{z}\cos.\,nz$; therefore, on the contrary,

$$\int \dot{z}\cos.\,nz = \frac{1}{n}\sin.\,nz + \mathit{const.}$$

In like manner, from the formulas of § 59. and § 60. we find

$$\int \dot{z}\ \text{sin.}\ n z = \frac{-1}{n} \text{cos.}\ n z + \textit{const.}$$

$$\int \frac{\dot{z}}{\text{cos.}^2\ n z} = \frac{1}{n} \text{tan.}\ n z + \textit{const.}$$

$$\int \frac{\dot{z}}{\text{sin.}^2\ n z} = \frac{-1}{n} \text{cot.}\ n z + \textit{const.}$$

$$\int \frac{\dot{z}\ \text{sin.}\ n z}{\text{cos.}^2\ n z} = \frac{1}{n} \text{sec.}\ n z + \textit{const.}$$

$$\int \frac{\dot{z}\ \text{cos.}\ n z}{\text{sin.}^2\ n z} = \frac{-1}{n} \text{cosec.}\ n z + \textit{const.}$$

146. By the second of these expressions we find the fluent of

$$\dot{z}\ (A + B\ \text{sin.}\ z + C\ \text{sin.}\ 2 z + \&c.)$$

to be

$$A z - B\ \text{cos.}\ z - \tfrac{1}{2} C\ \text{cos.}\ 2 z - \&c. + \textit{const.}$$

and from the first expression we find the fluent of

$$\dot{z}\ (A + B\ \text{cos.}\ z + C\ \text{cos.}\ 2 z + \&c.)$$

to be

$$A z + B\ \text{sin.}\ z + \tfrac{1}{2} C\ \text{sin.}\ 2 z + \&c. + \textit{const.}$$

147. It has been shewn in the Arithmetic of Sines, (see ALGEBRA, § 356.) that

$$\text{sin.}^2 z = \tfrac{1}{2}\ (-\text{cos.}\ 2 z + 1),$$

therefore, by what has been shewn in § 145.

$$\int \dot{z}\ \text{sin.}^2 z = \tfrac{1}{2} \int (-\dot{z}\ \text{cos.}\ 2 z + \dot{z})$$

$$= \tfrac{1}{2} (-\tfrac{1}{2}\ \text{sin.}\ 2 z + z) + \textit{const.}$$

It has also been shewn that

$$\text{sin.}^3 z = \tfrac{1}{4}\ (-\text{sin.}\ 3 z + 3\ \text{sin.}\ z),$$

therefore, multiplying each term of this expression by $\dot{z}$, and taking the fluents,

$$\int \dot{z}\ \text{sin.}^3 z = \tfrac{1}{4}\ (\tfrac{1}{3}\ \text{cos.}\ 3 z - 3\ \text{cos.}\ z) + \textit{const.}$$

In the same manner may the fluent of $\dot{z}\ \text{sin.}^n z$ be found, $n$ being any positive integer number whatever.

Again, it has been shewn (ALGEBRA, § 356.), that

$$\text{cos.}^2 z = \tfrac{1}{2}\ (\text{cos.}\ 2 z + 1);$$

therefore

$$\int \dot{z}\ \text{cos.}^2 z = \tfrac{1}{2} \int (\dot{z}\ \text{cos.}\ 2 z + \dot{z})$$

$$= \tfrac{1}{2}\ (\tfrac{1}{2}\ \text{sin.}\ 2 z + z) + \textit{const.}$$

and because

$$\text{cos.}^3 z = \tfrac{1}{4}\ (\text{cos.}\ 3 z + 3\ \text{cos.}\ z)$$

therefore, multiplying by $\dot{z}$, and taking the fluents,

$$\int \dot{z}\ \text{cos.}^3 z = \tfrac{1}{4}\ (\tfrac{1}{3} \text{sin.}\ 3 z + 3\ \text{sin.}\ z) + \textit{const.}$$

and proceeding in this way we may find the fluents of $\dot{z}\ \text{cos.}^n z$, $n$ being any positive integer number.

148. The fluents of $\dot{z}\ \text{sin.}^n z$, and $\dot{z}\ \text{cos.}^n z$ may be expressed under another form, by proceeding as in § 142. Thus, beginning with $\dot{z}\ \text{sin.}^n z$, and resolving it into $\dot{z}\ \text{sin.}\ z \times \text{sin.}^{n-1} z$, if we put $\dot{z}\ \text{sin.}\ z = \dot{v}$, and $\text{sin.}^{n-1} z = t$, we have by § 145, $v = -\text{cos.}\ z$, and (by § 26 and § 59) $\dot{t} = (n-1)\ \dot{z}\ \text{cos.}\ z\ \text{sin.}^{n-2} z$, therefore, substituting in the formula $\int t \dot{v} = v t - \int v \dot{t}$, we have

$$\int \dot{z}\ \text{sin.}^n z = -\text{cos.}\ z\ \text{sin.}^{n-1} z$$

$$+ (n-1) \int \dot{z}\ \text{cos.}^2 z\ \text{sin.}^{n-2} z;$$

but $\text{cos.}^2 z = 1 - \text{sin.}^2 z$, therefore $\int \dot{z}\ \text{sin.}^n z$ is equal to

$$-\text{cos.}\ z\ \text{sin.}^{n-1} z + (n-1) \int \dot{z}\ \text{sin.}^{n-2} z$$

$$-(n-1) \int \dot{z}\ \text{sin.}^n z;$$

which expression, by bringing together the terms containing $\int \dot{z}\ \text{sin.}^n z$ becomes

$$\int \dot{z}\ \text{sin.}^n z = -\frac{1}{n} \text{cos.}\ z\ \text{sin.}^{n-1} z$$

$$+ \frac{n-1}{n} \int \dot{z}\ \text{sin.}^{n-2} z.$$

By giving particular values to $n$ we have

$$\int \dot{z}\ \text{sin.}^2 = -\frac{1}{2}\ \text{cos.}\ z\ \text{sin.}\ z + \frac{1}{2} \int \dot{z}$$

$$= -\frac{1}{2} \text{cos.}\ z\ \text{sin.}\ z + \frac{1}{2} z + \textit{const.}$$

$$\int \dot{z}\ \text{sin.}^3 z = -\frac{1}{3}\ \text{cos.}\ z\ \text{sin.}^2 z + \frac{2}{3} \int \dot{z}\ \text{sin.}\ z$$

$$= -\frac{1}{3}\ \text{cos.}\ z\ \text{sin.}^2 z - \frac{2}{3}\ \text{cos.}\ z + \textit{const.}$$

We may proceed in this way as far as we please, deducing the fluent of $\dot{z}\ \text{sin.}^4 z$ from that of $\dot{z}\ \text{sin.}^2 z$, and the fluent of $\dot{z}\ \text{sin.}^5 z$ from that of $\dot{z}\ \text{sin.}^3 z$, and so on.

If in the general formula we substitute every where $2-n$ instead of $n$, it becomes

$$\int \dot{z}\ \text{sin.}^{2-n} z = \frac{1}{n-2}\ \text{cos.}\ z\ \text{sin.}^{1-n} z$$

$$+ \frac{n-1}{n-2} \int \dot{z}\ \text{sin.}^{-n} z,$$

an

an expression which, by bringing $\int \dot{z}\,\sin.^{-n} z$ or $\int \frac{\dot{z}}{\sin.^n z}$ to stand on one side of the equation, becomes

$$\int \frac{\dot{z}}{\sin.^n z} = -\frac{1}{(n-1)} \frac{\cos. z}{\sin.^{n-1} z}$$
$$+ \frac{n-2}{n-1} \int \frac{\dot{z}}{\sin.^{n-2} z}.$$

This formula is not applicable to the case of $n=1$, because then each of the terms of the fluent is divided by $n-1=0$, and therefore becomes infinite. In order to obtain the expression for the fluent in this particular case, we proceed thus. It is evident that $\frac{1}{\sin.^2 z} = \frac{1}{1-\cos^2 z}$, but $\frac{1}{1-\cos^2 z} = \frac{1}{2(1-\cos. z} + \frac{1}{2(1+\cos. z)}$, as will be found by reducing the fractions to a common denominator, therefore $\frac{1}{\sin. z} = \frac{\sin. z}{2(1-\cos. z)} + \frac{\sin. z.}{2(1+\cos. z)}$, and consequently,

$$\int \frac{\dot{z}}{\sin. z} = \frac{1}{2}\int \frac{\dot{z}\sin. z}{1-\cos. z} + \frac{1}{2}\int \frac{\dot{z}\sin. z}{1+\cos. z};$$

but if it be considered that the fluxion of cos. $z$ is $-\dot{z}$ sin. $z$ (§ 59.) it will appear by § 103 that $\int \frac{\dot{z}\sin. z}{1-\cos. z} = \text{l.}\,(1-\cos. z)$, and that $\int \frac{\dot{z}\sin. z}{1+\cos. z} = -\text{l}(1+\cos. z)$, therefore

$$\int \frac{\dot{z}}{\sin. z} = \frac{1}{2}\text{l.}\,(1-\cos. z) - \frac{1}{2}\text{l.}\,(1+\cos. z) + \mathit{const.}$$
$$= \frac{1}{2}\text{l.}\left(\frac{1-\cos. z}{1+\cos. z}\right) + \mathit{const.}$$
$$= \text{l.}\frac{\sqrt{(1-\cos. z)}}{\sqrt{(1+\cos. z)}} + \mathit{const.}$$

If in the general formula for $\int \frac{\dot{z}}{\sin.^n z}$ we suppose $n=2$ we have

$\int \frac{\dot{z}}{\sin.^2 z} = -\frac{\cos. z}{\sin. z} = -\text{cotan.}\,z + \mathit{const.}$ which agrees with what has been already observed (§ 145.), and if we suppose $n=3$, then

$$\int \frac{\dot{z}}{\sin.^3 z} = -\frac{\cos. z}{2\sin.^2 z} + \frac{1}{2}\int \frac{\dot{z}}{\sin. z}$$
$$= -\frac{\cos. z}{2\sin.^2 z} + \frac{1}{4}\text{l.}\left(\frac{1-\cos. z}{1+\cos. z}\right) + \mathit{const.}$$

In this way we proceed as far as we please, deducing $\int \frac{\dot{z}}{\sin.^4 z}$ from $\int \frac{\dot{z}}{\sin.^2 z}$, and so on.

149. If in the general formulas for $\int \dot{z}\,\sin.^n z$ and $\int \frac{\dot{z}}{\sin.^n z}$ we substitute $\frac{1}{2}\pi - z$ instead of $z$, (where $\frac{1}{2}\pi$ denotes a quadrant), and observe that

$$\sin.\,(\tfrac{1}{2}\pi - z) = \cos. z,\ \cos.\,(\tfrac{1}{2}\pi - z) = \sin. z,$$

and that the fluxion of $(\frac{1}{2}\pi - z)$ is $-\dot{z}$, we shall immediately obtain

$$\int \dot{z}\cos.^n z = \frac{1}{n}\sin. z\cos.^{n-1} z$$
$$+ \frac{n-1}{n}\int \dot{z}\cos.^{n-2} z$$
$$\int \frac{\dot{z}}{\cos.^n z} = \frac{1}{n-1}\frac{\sin. z}{\cos.^{n-1} z}$$
$$+ \frac{n-2}{n-1}\int \frac{\dot{z}}{\cos.^{n-2} z};$$

and in like manner from the formula expressing the fluent of $\int \frac{\dot{z}}{\sin. z}$ we deduce

$$\int \frac{\dot{z}}{\cos. z} = \frac{1}{2}\text{l.}\left(\frac{1+\sin. z}{1-\sin. z}\right) + \mathit{const.}$$
$$= \text{l.}\frac{\sqrt{(1+\sin. z)}}{\sqrt{(1-\sin. z)}} + \mathit{const.}$$

150. It has been shewn in ALGEBRA, § 357, that $16\cos.^2 z\,\sin.^3 = -\sin. 5z + \sin. 3z + 2\sin. z$, therefore

$$\int \dot{z}\cos.^2 z\,\sin.^3 z = \frac{1}{16}\left(\frac{1}{5}\cos. 5z - \frac{1}{3}\cos. 3z - 2\cos. z\right) + \mathit{const.}$$

The same mode of finding the fluent will apply to any fluxion of this form $\dot{z}\sin.^m z\cos._n z$; or by resolving the fluxion into two parts, the determination of its fluent may be reduced to that of a fluxion in which the exponents $m$ and $n$ are less than in the proposed fluxion, by the method of proceeding already employed in § 148.

151. Let us now denote sin. $z$ by $x$, then cos. $z = \sqrt{(1-x^2)}$, and since $\dot{z}\cos. z = \dot{x}$ (§ 59.) therefore $\dot{z} = \frac{\dot{x}}{\sqrt{(1-x^2)}}$; these values being substituted in any function involving $\dot{z}$, sin. $z$ and cos. $z$ will immediately reduce it to an algebraic form. Thus, for example, we shall have $\dot{z}\sin.^m z\cos^n z$ transformed to

$$\dot{x}\,x^m(1-x^2)^{\frac{n-1}{2}}$$

an expression which may have its fluent determined by the formulas of § 133 and § 134.

## SECT. II. *Application of the Inverse Method of Fluxions to the Resolution of Problems.*

### *To find the Areas of Curves.*

152. It has been shewn in § 61, that if the abscissa of a curve be denoted by $x$, the ordinate by $y$, and the area

area by $s$, then $\dot{s}=y\dot{x}$. Therefore the general formula expressing the area of any curve will be

$$s=\int y\dot{x}.$$

Hence to find the area of any curve, we must either find from the equation of the curve the value of $y$ in terms of $x$, or else the value of $\dot{x}$ in terms of $\dot{y}$, and $y$, and either the one or the other of these being substituted in the above formula, and the fluent found by the methods already explained, we shall have a general expression for the curvilineal area as required.

Fig. 19. N° 1. *Ex.* 1. Let it be required to find the area of any curve of the parabolic kind, of which, putting the abscissa AB$=x$, and the ordinate BP$=y$, the equation is $y^n=ax^m$.

Then we have $y=a^{\frac{1}{n}}x^{\frac{m}{n}}$, and

$$s=\int y\dot{x}=a^{\frac{1}{n}}\int x^{\frac{m}{n}}\dot{x}$$

$$=\frac{na^{\frac{1}{n}}}{m+n}x^{\frac{m+n}{n}}+C,$$

where C denotes the constant quantity that may be required to complete the fluent. As in the present case, it is required to find the area of the portion of the curve next its vertex, so that when $s=0$, then $x=0$, therefore, also $C=0$, and the area is simply $\frac{na^{\frac{1}{n}}}{m+n}x^{\frac{m+n}{n}}$.

If it be required to find the area comprehended between two ordinates PB, $p\,b$, put AB$=d$, then when $s=0$, we have $x=d$, therefore the general expression $s=\frac{na^{\frac{1}{n}}}{m+n}x^{\frac{m+n}{n}}+C$ becomes in this case $0=\frac{na^{\frac{1}{n}}}{m+n}d^{\frac{m+n}{n}}+C$, hence $C=-\frac{na^{\frac{1}{n}}}{m+m}d^{\frac{m+n}{n}}$,

and consequently the area BP$p\,b$, or $s$, is equal to

$$\frac{na^{\frac{1}{n}}}{m+n}\left\{x^{\frac{m+n}{n}}-d^{\frac{m+n}{n}}\right\}.$$

When $n$ is an even number, the expression for the area, viz. $\frac{na^{\frac{1}{n}}}{m+n}x^{\frac{m+n}{n}}$ may be considered as negative as well as positive, on account of the radical quantity $x^{\frac{m+n}{n}}$, or $\sqrt[n]{x^{m+n}}$, which has then a twofold value, it may therefore have the sign $\pm$ prefixed to it; but in this case the same abscissa AB belongs to two branches of the curve AP$p$ and AP$'p'$, as in fig. 19. N° 1, therefore the two values of the expression $\pm\frac{na^{\frac{1}{n}}}{m+n}x^{\frac{m+n}{n}}$ may be considered as indicating the two areas APB, AP$'$B, on each side of the axis, corresponding the one to the positive, and the other to the negative ordinates.

When the exponents $m$ and $n$ are both odd numbers, the quantity $x^{\frac{m+n}{n}}$ has only one sign, and remains always positive whatever be the sign of $x$, but in this case one of the two branches of the curve has its abscissas and its ordinates negative at the same time (as in fig. 19. N° 2.): it follows therefore that the areas corresponding to the negative abscissas and ordinates ought to be regarded as positive. Plate CCXX. fig. 19. N° 2.

If $n$ alone is odd, then the quantity $x^{\frac{m+n}{n}}$, becomes negative at the same time as $x$, but in this case the two branches of the curve are on the same side of the line in which the abscissas are taken (as in fig. 19. N° 3.) and the ordinates remain always positive. Fig. 19. N° 3.

Upon the whole it may be concluded, *that the area of a curve is positive when the abscissas and the ordinates have the same sign, and negative when they have contrary signs.*

If we suppose $m=1$, and $n=2$, then the curve is the common parabola, the area of which from the general formula is found to be $\frac{2}{3}a^{\frac{1}{2}}x^{\frac{3}{2}}=\frac{2}{3}xy$; hence it appears that the parabola is $\frac{2}{3}$ of its circumscribing parallelogram.

*Ex.* 2. Suppose the curve to be a circle. Put Fig. 20. AB$=x$, BP$=y$, the diameter AD$=a$, the area ABP$=s$. From the nature of the circle $y^2=ax-x^2$, therefore $y=\surd(ax-x^2)$, and

$$s=\int y\dot{x}=\int\dot{x}\surd(ax-x^2).$$

In this case the fluxion is not of such a form as to admit of an algebraic fluent in finite terms, we must therefore have recourse to the method of series, but we have already found the fluent in this way in § 140, therefore, from the series there brought out we have

$$s=\sqrt{ax}\Big(\frac{2x}{3}-\frac{1}{2}\,\frac{2x^2}{5a}-\frac{1.1}{2.4}\,\frac{2x^3}{7a^2}$$

$$-\frac{1.1.3}{2.4.6}\,\frac{2x^4}{9a^3}-\&c.\Big)$$

this expression does not require a constant quantity to be added to it, because when $x=0$ we must also have $s=0$.

If we suppose the arch AP to be $\frac{1}{3}$ of the quadrant AE, then it is known that PB$=\frac{1}{2}$ the rad. AC$=\frac{1}{2}a$, therefore, if we suppose the radius $=1$, we have in this case BC$=\frac{1}{2}\surd3$, and AB$=1-\frac{1}{2}\surd3=0.1339746$ nearly. If this number be substituted instead of $x$, and a few terms of the series computed, we shall find the area ABP $=·0452931$; to this add the triangle CBP$=\frac{1}{4}\times\surd\frac{3}{4}=0·2165063$, and we have the sector ACP$=·2617994$, which number when multiplied by 3 gives ·7853982 for the area of the quadrant. This number also expresses the area of a circle of which the diameter is 1.

*Ex.* 3. Suppose the curve to be an ellipse. Put Fig. 21. the

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the transverse axis AD$=a$, the conjugate axis 2CE$=b$, also AB$=x$, BP$=y$; then by the nature of the curve $y=\frac{b}{a}\sqrt{(ax-x^2)}$, and $\dot{s}=y\dot{x}=\frac{b\dot{x}}{a}\sqrt{(ax-x^2)}$; but if a circle be described on AD as a diameter, and BP the ordinate of the ellipse be produced to meet the circle, it appears from last example that $\dot{x}\sqrt{(ax-x^2)}$ is the fluxion of AQB the segment of the circle corresponding to the elliptic area APB or $s$; therefore, putting $v$ for the segment AQB, we have $\dot{s}=\frac{b\dot{v}}{a}$ and $s=\frac{bv}{a}$, here the constant quantity $c$ must be suppressed, because $s$ and $v$ must vanish together. Hence it appears that the area of any segment of an ellipse is to the area of the corresponding segment of its circumscribing circle as the lesser axis of the ellipse is to the greater; therefore the whole ellipse must be to the whole circle in the same ratio.

Fig. 22. *Ex.* 5. Let the curve be a hyperbola, of which C is the centre. Put the semi-transverse axis CA$=a$, the semiconjugate axis $=b$, CB$=x$, BP$=y$, the area APB$=s$. From the nature of the curve $y=\frac{b}{a}\sqrt{(x^2-a^2)}$, therefore

$$s=\int y\dot{x}=\frac{b}{a}\int\dot{x}\sqrt{(x^2-a^2)}.$$

But it appears from formula B (§.131.) that

$$\int\dot{x}\sqrt{(x^2-a^2)}=\tfrac{1}{2}x\sqrt{(x^2-a^2)}-\tfrac{1}{2}a^2\int\frac{\dot{x}}{\sqrt{(x^2-a^2)}}$$

and again by § 127,

$$\int\frac{\dot{x}}{\sqrt{(x^2-a^2)}}=\mathrm{l.}\left\{x+\sqrt{(x^2-a^2)}\right\}+c,$$

therefore

$$s=\frac{b}{2a}x\sqrt{(x^2-a^2)}-\frac{ab}{12}\mathrm{l.}\left\{x+\sqrt{(x^2-a^2)}\right\}+c.$$

To discover the value of the constant quantity $c$, we must consider that when $x=a$, then $s=0$, and in this extreme case the general equation just found becomes

$$0=-\frac{ab}{2}\mathrm{l.}a+c,$$

hence $c=\frac{ab}{2}\mathrm{l.}\,a$, and consequently, observing that

$$-\frac{ab}{2}\mathrm{l.}\left\{x+\sqrt{(x^2-a^2)}\right\}+\frac{ab}{2}\mathrm{l.}a$$
$$=-\frac{ab}{2}\mathrm{l.}\left\{\frac{x+\sqrt{(x^2-a^2)}}{a}\right\}$$

we get

$$s=\frac{b}{2a}x\sqrt{(x^2-a^2)}-\frac{ab}{2}\mathrm{l.}\left\{\frac{x+\sqrt{(x^2-a^2)}}{a}\right\}.$$

It immediately follows from this formula that

$$\frac{b}{2a}x\sqrt{(x^2-a^2)}-s=\frac{ab}{2}\mathrm{l.}\left\{\frac{x+\sqrt{(x^2-a^2)}}{a}\right\}$$

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but if a straight line be drawn from C to P so as to form the triangle CBP, it is manifest that $\frac{b}{2a}x\sqrt{(x^2-a^2)}$ is equal to $\frac{1}{2}$ CB$\times$BP, that is, to the triangle CBP, therefore the excess of the triangle CBP above the area $s$, that is the hyperbolic sector CAP, is equal to the logarithmic function

$$\frac{ab}{2}\mathrm{l.}\left\{\frac{x+\sqrt{(x^2-a^2)}}{a}\right\}.$$

*Ex.* 5. Suppose the curve to be an equilateral hyperbola, that is a hyperbola whose axes are equal, and that it is required to find the curvilineal area DCBP comprehended between DC, a perpendicular from D (a given point in the curve) to one of the asymptotes, and PB, a perpendicular from any other point in the curve to the same asymptote. Fig. 23.

Let A be the centre, put AC$=a$, CD$=b$, AB$=x$, BP$=y$, the area DCBP$=s$. From the property of the asymptotes we have $xy=ab$, and therefore $y=\frac{ab}{x}$, hence (§ 103.)

$$s=\int y\dot{x}=\int\frac{ab\dot{x}}{x}=ab\,\mathrm{l.}\,x+c.$$

To find the value of $c$, let us suppose $x=a$, then $s=0$, and the general formula becomes in this case

$$0=ab\,\mathrm{l.}\,a+c\text{, and hence }c=-ab\,\mathrm{l.}\,a,$$

therefore

$$s=ab\,\mathrm{l.}\,x-ab\,\mathrm{l.}\,a=ab\,\mathrm{l.}\,\frac{x}{a}.$$

If we suppose $a=b=1$, then $s=\mathrm{l.}\,x$, from which it appears that in this case the hyperbolic area DCBP represents the Napierean logarithm of the number $x$; it was from the consideration of this property that the logarithms originally invented by *Napier* were called *hyperbolical* logarithms.

But the logarithms of any other system may also be represented by areas of the same hyperbola; for this purpose it is only necessary to determine the magnitudes of $a$, and $b$, so that $\frac{b}{a}=$M, where M denotes the *modulus* of the system, thus we shall have $ab=a^2$M, and $s=a^2$M l. $\frac{x}{a}$, or, putting $a=1$, $s=$M l. $x$, an expression for the logarithm of $x$ according to any system whatever of which the *modulus* is M (ALGEBRA, § 287.)

*Ex.* Let the curve be the cycloid of which AE is the axis and A the vertex, let a semicircle be described on AE as a diameter, draw AG perpendicular to the axis, and from any point in the curve draw PB perpendicular to AG and PD perpendicular to AE, meeting the circle in Q, and draw QC to C the centre of the circle. Put AC$=a$, AB$=x$, BP$=y$, the area ABP$=s$, and put $v$ for the angle ACQ, that is for the arch of a circle which measures ACQ, the radius Fig. 24.

of

of that circle being unity, then AD$=a$ (1—cos. $v$), DQ$=a$ sin. $v$, and arch AQ$=a\,v$, and since from the nature of the curve, PD$=$ arch BQ$+$DQ, therefore PD$=a\,v+a$ sin. $v=a$ ($v+$sin. $v$); hence

$$x=a\,(v+\text{sin. }v),\ \dot{x}=a\dot{v}\,(1+\text{cos. }v),\ (\S\ 59.)$$

$$y=a\,(1-\text{cos. }v)$$

$$s=\int\dot{x}y=\int a^2\dot{v}\,(1-\text{cos.}^2\,v)$$

$$=a^2\int\dot{v}\ \text{sin.}^2\,v=\tfrac{1}{2}a^2\,v-\tfrac{1}{2}a^2\ \text{sin. }v\ \text{cos. }v\ (\S\ 148.)$$

$$=\tfrac{1}{2}\,\text{AC}\times\text{ arch AQ}-\tfrac{1}{2}\,\text{CD}\times\text{DQ};$$

and here no constant quantity is wanted to complete the fluent; because upon the supposition that AQ$=0$ both sides of the equation vanish as they ought to do; now it is obvious that $\frac{1}{2}$ AC$\times$AQ$=$area of sector ACQ, and $\frac{1}{2}$ CD$\times$DQ$=$ area of triangle DCQ, therefore

$s=$ area of circ. seg. ADQ.

Let AG be the greatest value of $x$; complete the parallelogram AGFE, then from the general expression for the cycloidal area, it follows that the whole cycloidal space APFG is equal to the semicircle AQE; but from the nature of the curve, EF is equal to AQE, half the circumference, therefore the rectangle EG is equal to four times the semicircle AQE; from these equals take away the external cycloidal space AGF, and the semicircle AQE, which have been shewn to be equal, and the remainders, viz. the internal cycloidal space APFE, and three times the semicircle AQE, are equal to each other.

153. In some cases it is more convenient to refer a curve line to a fixed point than to an axis. Thus instead of expressing the nature of the circle by the equation $y^2=a\,x-x^2$, where $y$ denotes a perpendicular from any point of the curve upon $a$ the diameter, and $x$ the distance of that perpendicular from one end of the diameter, we may otherwise express it by the equation $z=r\,v$, where $z$ denotes a variable arch of the circle reckoned from one end of its diameter, $r$ its radius, and $v$ the angle contained by a line drawn from the centre of the circle through the extremity of $z$, which angle is measured by an arch of a circle having its radius unity.

Fig. 25. The nature of the different conic sections may be defined in the same manner. Let P be any point in a conic section, of which F is one focus, and FA a part of the axis; let DC the directrix of the section meet FA in C, join PF, and draw PB perpendicular to the axis, and PD to the directrix; then from the nature of the curve (Conic Sections) PF has a given ratio to PD, that is to FC—FB; put FC$=a$, FP$=r$, the angle PFC$=v$, and suppose PF : PD :: $n$ : 1, then PF$=$ $n$.PD$=n$.FC—$n$.FB, hence observing that FB$=$FP $\times$cos. $v$, we get $r=a\,n-n\,r$ cos. $v$, and $r=\dfrac{a\,n}{1+n\text{ cos. }v}$ which equation expresses generally the nature of a conic section.

154. The formula which we have found for the fluxion of a curvilinear area, in § 61, is not immediately applicable when the nature of a curve is expressed in this way, we shall therefore investigate another formula suited to this particular manner of considering curves.

Let us suppose that APR is a curve the position of any point P of which is determined by PF, its distance from a given point F, and the angle which PF makes with AF a line given by position. Let a circle be described on F as a centre with a rad. $=1$, then FP, as also the area FAP, may be considered as functions of BD the arch of that circle which measures the angle PFA. From F draw FP′ to any other point P′ of the curve meeting the circle BD in D′. Put FP$=r$, the area FAP$=s$, the angle AFP, or the arch BD$=v$, then the area PFP′, and the arch DD′, will be the corresponding increments of $s$ and $v$, therefore, § 21, Fig. 26.

$$\frac{\dot{s}}{\dot{v}}=\text{limit of }\frac{\text{area FPP}'}{\text{DD}'\times\text{FD}}.$$

Here DD′ the increment of $v$ is multiplied by FD$=1$, to render the terms of the ratio homogeneous. On F as a centre, with FP as a radius, describe an arch of a circle meeting FP′ in Q, then, as the sectors FDD′, FPQ are similar, we have

$$\text{FE}^2:\text{FP}^2::\text{FD}\times\text{DD}':\text{FP}\times\text{PQ}=2\text{ sect. FPQ},$$

$$\text{hence DD}'\times\text{FD}=\frac{2\,\text{FD}^2}{\text{FP}^2}\text{ sect. FPQ}=\frac{2}{r^2}\text{ sect. FPQ}$$

$$\text{and }\frac{\dot{s}}{\dot{v}}=\frac{r^2}{2}\times\text{lim.}\frac{\text{area FP}'\text{P}}{\text{sect. FPQ}};$$

but the point P′ being supposed to approach continually to P, it is manifest that the limit of $\dfrac{\text{area FPP}'}{\text{sect. FPQ}}$ is unity, or 1, therefore

$$\frac{\dot{s}}{\dot{v}}=\frac{r^2}{2},\text{ and }\dot{s}=\frac{1}{2}r^2\dot{v}.$$

154. By means of this formula we may find the areas of that class of curves called *spirals*. Let us take for example the spiral of Archimedes, which may be defined thus. Conceive a straight line FR to revolve about F the centre of a given circle, departing from a given position FB; conceive also a point P to move in the revolving line, so that PF its distance from the centre may be to BD the arch of the circle passed over by the revolving line, as $m$ to $n$, then the point P will generate the spiral. Fig. 27.

Put BF$=a$, the angle BFR$=v$, the line FP$=r$, and the area generated by the line FP$=s$, then the arch BD$=a\,v$, and since from the nature of the curve

$r:a\,v::m:n$, therefore $v=\dfrac{n\,r}{a\,m}$, and $\dot{v}=\dfrac{n\,\dot{r}}{a\,m}$, hence the general formula $\dot{s}=\dfrac{1}{2}r^2\dot{v}$ becomes $\dot{s}=\dfrac{n\,r^2\,\dot{r}}{2\,a\,m}$, therefore,

$$s=\int\frac{n\,r^2\dot{r}}{2\,a\,m}=\frac{n\,r^3}{6\,a\,m}$$

this fluent does not require a constant quantity to be added,

added, as both $s$ and $r$ evidently vanish at the same time.

Fig. 28. 156. As the general expression for a curvilineal area BCPD is $\int y\dot{x}$, where $x$=AB the abscissa reckoned from a given point A in the axis, and $y$=BC the ordinate, it follows that X being put to denote any function of a variable quantity $x$, the fluent of X$\dot{x}$ may always be exhibited by means of a curvilineal area. Thus let CP$p$ be a curve of such a nature that AD and DP the co-ordinates being denoted by $x$ and $y$, the equation of the curve is $y$=X, then, assuming any ordinate BC as given by position, we have evidently

$$\int X\dot{x}=\text{area CBDP}.$$

As the ordinate BC (which is assumed as given by position) may be taken any where, the fluxion of the area being the same wherever it is taken, it appears, as has been already observed (§ 101) that the function $\int X\dot{x}$ may be considered as indeterminate, for it admits of innumerable values corresponding to any particular value of $x$, and in this respect it differs from an algebraic function, which for a given value of $x$ has always a determinate number of values. If however $x$ be supposed to increase from any determinate magnitude $a$, to any other determinate magnitude $a'$, then, taking the abscissa AD=$a$, and A$d$=$a'$, and drawing the ordinates DP, $dp$, we have

$$\text{when } x=a,\ \int X\dot{x}=\text{ area CBDP},$$

$$\text{and when } x=a',\ \int X\dot{x}=\text{ area CB}\,dp,$$

therefore, while $x$ increases from $a$ to $a'$, or receives the increment $a'-a$, the function $\int X\dot{x}$ increases from area CBDP to area CB$dp$, and thus receives the increment area PD$dp$, which is of a determinate magnitude, as the ordinates PD, $pd$ have both a determinate position. Hence it appears that in assigning the fluent of X$\dot{x}$, we only determine the change that takes place in the value of the function $\int X\dot{x}$ while $x$ passes from one particular value to another particular value.

157. As there are general and known methods by which an approximate value of any curvilineal area may be found, when a fluent is expressed by such an area, those methods may be applied to find an approximate value of the fluent. Let PD$dp$ be a curvilineal area,

Fig. 29. supposed to represent the fluent $\int X\dot{x}$ between the limits of $x$=AD and $x$—A$d$. Conceive D$d$ to be divided into a number of equal parts DD′, D′D″, D$d$, and the ordinates P′D′, P″D″ drawn, and the two sets of parallelograms DE, D′E′, D″E″ and D′$e$, D″$e'$, $de''$ to be completed, the former constituting a rectilineal figure circumscribed about the curvilineal space DPP′P″$pd$, and the latter a rectilineal figure inscribed in that space; then as the circumscribed figure must necessarily be greater than the curvilineal space, that is, greater than $\int X\dot{x}$ taken between the limits of $x$=AD and $x$=A$a$, and the inscribed figure must be less, it follows that if we compute the areas of the circumscribed and inscribed figures we shall obtain two limits, the one greater, and the other less than $\int X\dot{x}$. And as by increasing the number of equal parts into which D$d$ is divided we may bring the circumscribed and inscribed rectilineal figures as near to a ratio of equality as we please, it is always possible to find two limits which shall differ from each other, and consequently from $\int X\dot{x}$ (which lies between them), by less than any assignable quantity.

158. If we join P, P′, P″, $p$, the tops of the ordinates, the rectilineal space formed by the trapeziums DPP′D′, D′P′P″D″, D″P″$pd$ will be more nearly equal to the curvilineal area, than the circumscribed rectilineal figure formed by the parallelograms DE, D′E′, D″E″; therefore, the sum of those trapeziums being found, it will be equal to the fluent $\int X\dot{x}$ nearly.

Suppose, for example, that it is required to find the value of $\int\frac{\dot{x}}{1+x^2}$ between the limits of $x$=0, and $x$=1. In this case $X=\frac{1}{1+x^2}$, so that the equation of the curve P$p$ is $y=\frac{1}{1+x^2}$; let us suppose D$d$ the distance between the extreme ordinates to be divided into ten equal parts, then putting 0, ·1, ·2, &c. to ·1 instead of $x$ in the formula $y=\frac{1}{1+x^2}$, we obtain eleven successive values of $y$, or eleven equidistant ordinates, the numeral values of which will be as follows,

The first = 1·00000
the 2d = ·99010
the 3d = ·96154
the 4th = ·91743
the 5th = ·86207
the 6th = ·80000
the 7th = ·73529
the 8th = ·67114
the 9th = ·60975
the 10th = ·55249
the 11th = ·50000

By the elements of geometry the area of the rectilineal figure formed by the trapeziums is found by adding together all the ordinates except the first and last, and half the sum of the first and last, and multiplying that sum by the breadth of one of the trapeziums; now the sum of the ordinates, with the exception of the first and last, together with half the sum of the first and last, is 7·84981, and the common breadth of the trapezinms is ·1, therefore $\int\frac{\dot{x}}{1+x^2}=7{\cdot}84981\times{\cdot}1={\cdot}758$ nearly, as required. It is evident from § 137, that $\int\frac{\dot{x}}{1+x^2}$ taken between the limits of $x$=0, and $x$=1, is accurately equal to an arch of 45°, radius being unity, which arch being $\frac{1}{4}\pi$ will be found = ·7854 nearly.

If we recur to the series which has been found to express the above fluent in § 137, and put $a$=1, and $x$=1, we shall have $\int\frac{\dot{x}}{1+x^2}$ taken between the prescribed limits equal to

$1-\frac{1}{3}$

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$$1-\tfrac{1}{3}+\tfrac{1}{5}-\tfrac{1}{7}+\text{\&c.}$$

It is impossible, however, to compute the fluent simply by the addition of the terms of this series, on account of the slowness of its convergency.

159. As the curvilineal area DP$pd$ is the limit of the sum of the parallelograms DP′, D′P″, &c. which constitute the rectilineal figure inscribed in that area; as also the limit of the sum of the parallelograms DE, D′E, &c. which constitute the circumscribed figure, the number of parts into which D$d$ is divided being in either case conceived to be increased indefinitely, so that each may be continually diminished (and this being the case it is of no consequence whether those parts be conceived as all equal or as unequal) so from analogy we may conclude that if $x', x'', x''', \ldots x^{(n)}$ be put to denote successive values of a variable quantity $x$, and X′, X″, X‴, ... $\mathrm{X}^{(n)}$ the corresponding values of X any function of $x$, the limit of the sum of the products $\mathrm{X}(x'-x)$, $\mathrm{X}'(x''-x')$, $\mathrm{X}''(x'''-x'')$, &c. when the number of successive values of $x$ and X is continually increased, so that the difference between any two of them immediately following each other may be continually diminished, is equal to $\int \mathrm{X}\dot{x}$, the fluent to be taken between the two extreme values of $n$.

160. It was in this manner that the first writers on the differential calculus conceived a fluent; as the difference between any two of its succeeding values is the product of the function X by $x'-x$ the increment of $x$, they called that product (when $x'-x$ was conceived to be infinitely diminished) the *Differential* of the fluent; and as the fluent is the sum of all the products, or differentials, instead of calling it a fluent they called it an *Integral;* the process by which an integral is found from its differential or fluxion they called *Integration.* The terms *Integral* and *Integration* are sometimes employed by writers in applying the method of fluxions to mathematical enquiries.

*To find the Lengths of Curves.*

161. It has been shewn in § 63. that if the abscissa of a curve be denoted by $x$, the ordinate by $y$, and the curve line by $z$, then $\dot{z}=\sqrt{(\dot{x}^2+\dot{y}^2)}$, hence the general formula for finding the length of a curve is

$$z=\int\sqrt{(\dot{x}^2+\dot{y}^2)}.$$

Therefore, if from the equation expressing the nature of a curve we find the value of $\dot{y}$ in terms of $x$ and $\dot{x}$, or else the value of $\dot{x}$ in terms of $\dot{y}$ and $y$, and substitute the one or the other in the above general formula, we shall obtain a fluxion the fluent of which will be the length of the curve.

Fig. 19. *Ex.* 1. Suppose the curve to be a parabola, and that AB$=x$, BP$=y$, the arch AP$=z$, the parameter $=a$, then the equation of the curve being $ax=y^2$, we have $\dot{x}=\frac{2y\dot{y}}{a}$, and

$$z=\int\sqrt{(\dot{x}^2+\dot{y}^2)}=\int\sqrt{\left(\frac{4y\dot{y}^2}{a^2}+\dot{y}^2\right)}$$

$$=\frac{1}{a}\int\dot{y}\sqrt{(a^2+4y^2)}.$$

By comparing this expression with formula (B) in § 131, we find

$$\int\dot{y}\sqrt{(a^2+4y^2)}=\tfrac{1}{2}y\sqrt{(a^2+4y^2)}$$

$$+\tfrac{1}{2}a^2\int\frac{\dot{y}}{\sqrt{(a^2+4y^2)}};$$

again by § 127,

$$\int\frac{\dot{y}}{\sqrt{(a^2+4y^2)}}=\tfrac{1}{2}\,\mathrm{l.}\left\{2y+\sqrt{(a^2+4y^2)}\right\}$$

therefore

$$z=\frac{y\sqrt{(a^2+4y^2)}}{2a}$$

$$+\frac{a}{4}\,\mathrm{l.}\left\{2y+\sqrt{(a^2+4y^2)}\right\}+\mathrm{C}.$$

To determine the value of C, we must consider that when $y=0$, then $z=0$, so that then the general formula will become simply

$$0=\frac{a}{4}\,\mathrm{l.}\,a+\mathrm{C}, \text{ and hence } \mathrm{C}=-\frac{a}{4}\,\mathrm{l.}\,a,$$

therefore, substituting the value of C, and bringing together the logarithmic quantities,

$$z=\frac{y\sqrt{(a^2+4y^2)}}{2a}$$

$$+\frac{a}{4}\,\mathrm{l.}\left\{\frac{2y+\sqrt{(a^2+4y^2)}}{a}\right\}.$$

*Ex.* 2. Suppose the curve to be a circle, and that C is its centre, and AE a quadrant of the circle. Put CB$=x$, BP$=y$, the arch EP$=z$, the radius of the circle $=a$, then $x^2+y^2=a^2$, and $y=\sqrt{(a^2-x^2)}$, and $\dot{y}=\frac{-x\dot{x}}{\sqrt{(a^2-x^2)}}$, hence Fig. 20.

$$z=\int\sqrt{(\dot{x}^2+\dot{y}^2)}=\int\sqrt{\left(\dot{x}^2+\frac{x^2\dot{x}^2}{a^2-x^2}\right)}$$

$$=\int\frac{a\dot{x}}{\sqrt{(a^2-x^2)}}.$$

This fluent can only be expressed by an infinite series, under which form it has been already exhibited in § 140, the radius being there supposed unity.

*Ex.* 3. Let the curve be an ellipse, and let it be required to find the length of the curve between E the vertex of the lesser axis, and P any point in the curve. To simplify the calculation, let us suppose that the semi-transverse axis AC$=1$; put the semi-conjugate axis CE$=b$, the excentricity (that is $\sqrt{(1-b^2)}=e$, the abscissa CB$=x$, the ordinate PB$=y$, the arch EP$=z$; then, the equation of the curve being $y^2=b^2(1-x^2)$, we have Fig. 21

have $y=b\sqrt{(1-x^2)}$, and $\dot{y}=\frac{-bx\dot{x}}{\sqrt{(1-x^2)}}$, and therefore

$$z=\int\sqrt{(\dot{x}^2+\dot{y}^2)}=\int\sqrt{\left(\dot{x}^2+\frac{b^2x^2\dot{x}^2}{1-x^2}\right)}$$

$$=\int\frac{\dot{x}\sqrt{(1-e^2x^2)}}{\sqrt{(1-x^2)}}.$$

This fluent can only be expressed by means of an infinite series, and it has been already given in this form in § 141.

If we take $x=1$, then all the quantities in that series which are multiplied by $\sqrt{(1-x^2)}$ will vanish, but in this particular case $z$ is the elliptic quadrant EA, and A is a quadrant of the circumscribing circle, or $\frac{1}{2}\pi$, therefore the elliptic quadrant is equal to

$$\tfrac{1}{2}\pi\left(1-\frac{1}{2.2}e^2-\frac{1.1.3}{2.2.4.4}e^4-\frac{1.1.3.3.5}{2.2.4.4.6.6}e^6-\&c.\right)$$

This series converges very fast if $e$ be a small fraction.

Fig. 11. *Ex.* 4. Suppose the curve to be a cycloid. Let a circle be described on its axis meeting the ordinate PB in Q, and draw CQ to the centre of the circle. Put AB$=x$, BP$=y$, the cycloidal arch AP$=z$, the radius AC$=a$, the angle ACQ$=v$, then AB$=a$ $(1-\cos. v)$, BQ$=a\sin. v$, the circ. arch AQ$=av$, so that $x=a$ $(1-\cos. v)$, and from the nature of the curve $y=a$ $(v+\sin. v)$, therefore (§ 59.)

$$\dot{x}=a\dot{v}\sin. u,\ \dot{y}=a\dot{v}(1+\cos. v),$$

$$\dot{x}^2+\dot{y}^2=a^2\dot{v}^2\left\{\sin.^2 v+(1+\cos. v)^2\right\}$$

$$=a^2\dot{v}^2(2+2\cos. v);$$

but $2+2\cos. v=4\cos.^2\frac{1}{2}v$ (ALGEBRA, § 356.) therefore

$$z=\int\sqrt{(\dot{x}^2+\dot{y}^2)}=2a\int\dot{v}\cos.\tfrac{1}{2}v$$

$$=4a\sin.\tfrac{1}{2}v+C,\ (\S\ 145.)$$

but as when $v=0$, then $z=0$, therefore $C=0$, and $z=4a\sin.\frac{1}{2}v$; but if the chord AQ be drawn, $2a\sin.\frac{1}{2}v=$ chord AQ, therefore $z=2$ chord AQ.

162. The formula $z=\int\sqrt{(\dot{x}^2+\dot{y}^2)}$ not being applicable in its present form to curves of the spiral kind, we shall here investigate another suited to that particular class of curves.

Fig. 30. Let APR be a curve of such a nature that the position of any point P in the curve is determined by PF, its distance from a given point F, and by the angle which PF makes with AF a line given in position. We shall employ the same construction and notation here as in § 154, with the addition of drawing the chords DD′, PQ, PP′, and putting the arch AP$=z$; then it is manifest that the simultaneous increments of $v$, $z$, and $r$ will be the arches DD′ PP′, and the straight line P′Q respectively. Hence

$$\frac{\dot{z}}{\dot{v}}=\text{limit of }\frac{\text{arch PP}'}{\text{arch DD}'}$$

but it is evident from § 62, that the limiting ratio of those arches must be the same as that of their chords, therefore,

$$\frac{\dot{z}}{\dot{v}}=\text{limit of }\frac{\text{chord PP}'}{\text{chord DD}'};$$

now the limit of the angle PQD being evidently a right angle, we have

$$\text{lim.}\frac{\text{PP}'}{\text{DD}'}=\text{lim.}\frac{\sqrt{(\text{PQ}^2+\text{QP}'^2)}}{\text{DD}'}$$

$$=\text{lim.}\sqrt{\left\{\frac{\text{PQ}^2}{\text{DD}'^2}+\frac{\text{P}'\text{Q}^2}{\text{DD}'^2}\right\}}$$

but $\frac{\text{PQ}^2}{\text{DD}'^2}=\frac{\text{FP}^2}{\text{FD}^2}=r^2$, and lim. $\frac{\text{P}'\text{Q}^2}{\text{DD}'^2}=\frac{\dot{r}^2}{\dot{v}^2}$ therefore

$$\frac{\dot{z}}{\dot{v}}=\sqrt{\left(r^2+\frac{\dot{r}^2}{\dot{v}^2}\right)},\ \text{and}\ \dot{z}=\sqrt{\left(r^2\dot{v}^2+\dot{r}^2\right)}.$$

Let us apply this formula to the spiral of Archimedes, Fig 27. the equation of which (§ 155.) is $amv=nr$, and therefore

$$v=\frac{nr}{am},\ \text{and}\ \dot{v}^2=\frac{n^2r^2}{a^2m^2};\ \text{hence}$$

$$z=\int\sqrt{(\dot{r}^2+r^2\dot{v}^2)}=\frac{1}{a}\int\dot{r}\sqrt{\left(a^2+\frac{n^2}{m^2}r^2\right)}.$$

This fluent may be found by formula B, § 131, and it is worthy of remark that the fluxion has the same form as that which we have found in § 161 for an arch of a parabola; thus the length of any portion of the spiral of Archimedes may be exhibited by means of an arch of a parabola.

### *To find the Contents of Solids.*

163. If AD the abscissa of a curve be denoted by $x$, Fig 4. and PD the ordinate by $y$, and the solid generated by the revolution of the curve APD about AD as an axis by $s$, it has been shewn, in § 64, that $\dot{s}=\pi y^2\dot{x}$, therefore the general formula for finding the content of a solid is

$$s=\pi\int y^2\dot{x}.$$

*Ex.* 1. Suppose the solid to be a paraboloid, or that which is generated by the revolution of a parabola about its axis; in this case $y^2=ax$, and taking the fluent so that when $x=0$, then $s=0$,

$$s=\pi\int y^2\dot{x}=\pi a\int x\dot{x}=\tfrac{1}{2}\pi ax^2,$$

or $s=\frac{1}{2}\pi xy^2$; but $\pi xy^2$ is the content of a cylinder having $y$ for the radius of its base and $x$ for its altitude, therefore the content of a paraboloid is half that of a cylinder having the same base and altitude.

*Ex.* 2. Suppose the solid to be a parabolic spindle, Fig. 31. which is generated by the revolution of APB an arch of a parabola about AC an ordinate to its axis. In this case let AD$=x$, DP$=y$, AB$=b$, the parameter of the

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axis $=a$, then from the nature of the parabola AD × DB $=a\times$ PD, that is $x(b-x)=ay$, hence $y=\frac{(b-x)x}{a}$, and taking the fluent, so that $s$ and $x$ may vanish together;

$$s=\pi\int y^2\dot{x}=\frac{\pi}{a^2}\int x^2(b-x)^2\dot{x}$$

$$=\frac{\pi}{a^2}\int(b^2x^2\dot{x}-2bx^3\dot{x}+x^4\dot{x})$$

$$=\frac{\pi}{a^2}\left(\frac{b^2x^3}{3}-\frac{bx^4}{2}+\frac{x^5}{5}\right)$$

or, since $a^2=\frac{(b-x)^2x^2}{y^2}$,

$$s=\frac{\pi y^2}{(b-x)^2}\left\{\frac{b^2x}{3}-\frac{bx^2}{2}+\frac{x^3}{5}\right\},$$

which expression (by supposing $x=\text{AC}=\frac{1}{2}b$, and putting $d$ for CE, the greatest value of $y$) gives $\frac{4\pi d^2b}{15}$ for the content of half the solid generated by the curve AEB, therefore the entire spindle is $\frac{8\pi a^2 b}{15}$, or (by observing that $\pi d^2b$ is the content of a cylinder having $d$ for the radius of its base and $b$ for its length) it is $\frac{8}{15}$ of the circumscribing cylinder.

Fig. 32. and 33. *Ex.* 3. Suppose the solid to be a spheroid produced by the revolution of an ellipse about either of its axes; put $a$ for $\frac{1}{2}$AB the axis round which the curve revolves, $b$ for $\frac{1}{2}$EF the other axis, $x$ for AD the height of any segment made by a plane perpendicular to the axis of the solid, $y$ for PD the radius of its base, and $s$ for its content. Then from the nature of the curve $y^2=\frac{b^2}{a^2}(2ax-x^2)$, therefore taking the fluent upon the supposition that $s$ and $x$ vanish together,

$$s=\pi\int y^2\dot{x}=\frac{\pi b^2}{a^2}\int(2ax\dot{x}-x^2\dot{x})$$

$$=\frac{\pi b^2}{a^2}\left(ax^2-\frac{x^3}{3}\right).$$

To find the content of the whole spheroid, we have only to take $x=2a$, thus the formula becomes $s=\frac{4\pi b^2a}{3}$, and as $2\pi b^2a$ expresses the content of a cylinder having $2b$ for the diameter of its base, and $2a$ for its height, it follows that the contents of a spheroid is $\frac{2}{3}$ that of its circumscribing cylinder.

It is obvious that what has been found for the spheroid will apply also to the sphere, by supposing the axes equal, or $a=b$.

Fig. 4. 164. If instead of supposing the solid APQ$p$ to be formed by the revolution of a curve round its axis (in which case it is called a solid of *revolution*) we had supposed it to have any figure whatever, then by referring the solid to some straight line AC, given by position, as an axis, and in which A is a given point, and supposing PQ$p$ to be a section of the solid made by a plane perpendicular to that axis, meeting it in D, an ting AD $=x$, and the variable solid APQ$p$ (consi as a function of $x$) $=s$, by proceeding as in § would have found the limit of $\frac{\text{increment of } s}{\text{increment of } x}$, an sequently $\frac{\dot{s}}{\dot{x}}$, equal to the area of the section of the made by the plane PQ$p$; therefore putting V for function of $x$ which expresses the area of the sect have $\dot{s}=\text{V}\dot{x}$, and $s=\int\text{V}\dot{x}$.

Let us suppose for example that AEFG is bounded by any plane figure EFG as a base, the surface which will be generated if we su straight line drawn from A any given point abo plane to revolve in the circumference of the bas

Let AC be a perpendicular drawn from the of the figure to its base, and let PQ$p$ be a sec the solid by a plane parallel to the base, meeti perpendicular in D. Put $a=$ the area of the the solid, V $=$ the area of the section PQ$p$, $b=$ altitude of the whole solid, $x=$AD the altitu part cut off by the plane PQ$p$, and $s=$ the co that part; then, as from the nature of the so pretty evident that the part of it cut off by th PQ$p$ is similar to the whole, and as the bases of solids are as the squares of their altitudes,

$a:\text{V}::b^2:x^2$, hence $\text{V}=\frac{ax^2}{b^2}$, and

$$s=\int\text{V}\dot{x}=\frac{a}{b^2}\int x^2\dot{x}=\frac{ax^3}{3b^2},$$

this expression for $s$ does not require the additi constant quantity, for by putting $x=0$, we have it ought to be. Suppose now $x=b$, then $s=\frac{ab}{3}$ from which it appears that the content of th solid is $\frac{1}{3}$ of the product of the base by the p cular. It is evident that pyramids and cones a of the kind we have been considering.

### *To find the Surfaces of Solids.*

165. The altitude AD of a solid, generated volution of a curve about AD as an axis, bein fore denoted by $x$, and PD the radius of its ba let us now put $s$ to denote the curved surface solid, then, as it has been shewn, § 65, that $\dot{z}=$ $\sqrt{(\dot{x}^2+\dot{y}^2}$, we have

$$s=2\pi\int y\sqrt{(\dot{x}+\dot{y}^2)}$$

as a general formula for the surface of a solid.

*Ex.* 1. Suppose the solid to be a sphere, gene the revolution of a circle about its diameter A the radius of the sphere $=a$, then AD being the by $x$, and PD by $y$, we have from the nature curve $y^2=2ax-x^2$, therefore

$$y=\sqrt{(2ax-x^2)}, \text{ and } \dot{y}=\frac{(a-x)\dot{x}}{\sqrt{(2ax-x^2)}}$$

$$\dot{x}^2+\dot{y}^2=\dot{x}^2\left(1+\frac{(a-x)^2}{2ax-x^2}\right)$$

$$=\frac{a^2\dot{x}^2}{2ax-x^2}=\frac{a^2\dot{x}^2}{y^2},$$

therefore, $y\sqrt{(\dot{x}^2+\dot{y}^2)}=a\dot{x}$, and taking the fluent, so that when $x=0$, then $s=0$,

$$s=2\pi\int y\sqrt{(\dot{x}^2+\dot{y}^2)}=2\pi a x;$$

now if it be considered that $2\pi a$ is the circumference of a great circle of the sphere, it will immediately appear that the surface of a segment of a sphere is equal to the circumference of a great circle of the sphere multiplied into the height of the segment. Hence it follows that the whole surface of the sphere is equal to four times the area of one of its great circles.

Fig. 5. *Ex.* 2. Suppose the curve to be a parabola, then putting AD $=x$, DP$=y$, the parameter of the axis $=a$, we have (§ 161. example 1.)

$$\sqrt{(\dot{x}^2+\dot{y}^2)}=\frac{1}{a}\dot{y}\sqrt{(a^2+4y^2)}, \text{ therefore}$$

$$s=2\pi\int y\sqrt{(\dot{x}^2+\dot{y}^2)}$$

$$=\frac{2\pi}{a}\int y\dot{y}\sqrt{(a^2+4y^2)}$$

$$=\frac{\pi}{6a}(a^2+4y^2)^{\frac{3}{2}}+C, \text{ by § 108.}$$

To discover the value of the constant quantity C, we must observe that when $x=0$, then $y=0$, and $s=0$, therefore putting 0 instead of $s$ and $y$, the above equation becomes $0=\frac{\pi a^3}{6}+C$, hence $C=-\frac{\pi a^3}{6}$, and

$$s=\pi\left\{\frac{(a^2+4y^2)^{\frac{3}{2}}-a^3}{6a}\right\}.$$

### *To find the Centre of Gravity of any Line, Surface, or Solid.*

166. It belongs to the theory of Mechanics to explain what is meant by the centre of gravity, and to demonstrate its general properties, and here it is only necessary to shew how the method of fluxions may be applied to deduce from some one of those properties rules for finding that centre in any proposed case.

The properties of centres of gravity which we shall employ as the foundation of the application of the method of fluxions to its determination may be enunciated shortly thus.

Fig. 36. Let C be the centre of gravity of a mass of matter denoted by M, and $c$ the centre of gravity of another mass $m$, and D the centre of gravity of the two masses M and $m$, from these points let perpendiculars CA, $c\,a$, DE be drawn to any straight line PQ, then

$$\text{M}\times\text{CA}+m\times c\,a=(\text{M}+m)\times\text{DE}.$$

Fig. 37. 167. Let us now suppose that AP is any curve line (having weight), of which the centre of gravity is required, and that PB, PD are co-ordinates drawn from any point in the curve perpendicular to AB, AD two axes at right angles to each other; let the arch AP receive any increment P$p$, let C be the centre of gravity of AP, G the centre of gravity of P$p$, and C′ the centre of gravity of AP$p$. From C and G draw CE, CF, GH, GK perpendicular to the axes AB, AD. Put PD$=x$, PB$=y$, CF$=$X, CE$=$Y, AP$=z$, also let the arch AP$p=z'$, and let the distances of C′ its centre of gravity from the axes AD, AB be denoted by X′, and Y′ respectively; then, observing that the arch P$p=z'-z$, by the proposition in last §,

$$z\,\text{X}+(z'-z)\times\text{GK}=z'\text{X}';$$

$$\text{hence } \frac{z'\text{X}'-z\,\text{X}}{z'-z}=\text{GK}.$$

If we now suppose the arch P$p$ to be continually diminished, and observe that $z'\text{X}'-z\text{X}$, and $z'-z$, are the simultaneous increments of $z\text{X}$ and $z$, it will appear (§ 23.) that

$$\frac{\text{flux. of }(z\text{X})}{\dot{z}}=\text{limit of GK.}$$

By the very same way of reasoning we find

$$\frac{\text{flux. of }(z\text{Y})}{\dot{z}}=\text{limit of GH,}$$

but the point $p$ approaching to P, it is manifest that the point G will also approach to P, so that the limit of GK is PD or $x$, and the limit of GH is PB or $y$, hence

$$\frac{\text{flux. }(z\text{X})}{\dot{z}}=x,\quad \frac{\text{flux. }(z\text{Y})}{\dot{z}}=y;$$

$$\text{flux. }(z\text{X})=x\dot{z},\ \text{flux. }(z\text{Y})=y\dot{z}.$$

Taking now the fluents of each side of these equations, and dividing by $z$,

$$\text{X}=\frac{\int x\dot{z}}{z},\quad \text{Y}=\frac{\int y\dot{z}}{z};$$

it is evident that by these two equations the position of C the centre of gravity is determined.

168. Let us next suppose that it is required to find C Fig. 37. the centre of gravity of the plane area APB. As the arch AP was in last § supposed to receive the increment P$p$, so let the area APB now receive the increment BP$pb$, and let C, C′ and G (which in the former case were supposed to be the centres of gravity of the arches AP, AP$p$, and P$p$ respectively) now be supposed to be the centres of gravity of the areas APB, A$pb$, and BP$pb$; put the area APB$=s$, the area A$pb=s'$, and let X, Y, X′, Y′, denote as before. Then, reasoning exactly as in last case, we have (by § 116.),

$$s\,\text{X}+(s'-s)\times\text{GK}=s'\text{X}'$$
$$s\,\text{Y}+(s'-s)\times\text{GH}=s'\text{Y}'$$

hence

hence

$$\frac{s'X'-sX}{s'-s}=GK,\ \frac{s'Y'-sY}{s'-s}=GH;$$

and the point $p$ being supposed to approach to P, so that $s'X'-sX$, $s'Y'-sY$, and $s'-s$, the simultaneous increments of X, Y and $s$, may be continually diminished,

$$\frac{\text{flux. }(sX)}{\dot{s}}=\text{lim. }GK,\ \frac{\text{flux. }(sY)}{\dot{s}}=\text{lim. }GH;$$

but as the ordinate $pb$ approaches to PB, it is manifest that the ultimate position of G, the centre of gravity of the area BP$pb$, will be the middle of PB, therefore the limit of GK is $x$, and the limit of GH is $\frac{1}{2}y$, thus we have

$$\frac{\text{flux. }(sX)}{\dot{s}}=x,\ \frac{\text{flux. }(sY)}{\dot{s}}=\tfrac{1}{2}y,$$

and consequently,

$$X=\frac{\int x\dot{s}}{s},\ Y=\frac{\int y\dot{s}}{2s}$$

or since $\dot{s}=y\dot{x}$, and $s=\int y\dot{x}$ (§ 61.),

$$X=\frac{\int yx\dot{x}}{\int y\dot{x}},\ Y=\frac{\int y^2\dot{x}}{2\int y\dot{x}}.$$

Fig. 37. 169. Let it next be required to find the centre of gravity of the surface of a solid generated by the revolution of the curve AP about AB as an axis. Let the surface of the solid be conceived to receive an increment generated by P$p$ an arch of the curve. In this case it is evident that the centres of gravity of the surface generated by the curve AP, the surface generated by the curve AP$p$, and the surface generated by the arch P$p$, will each be in AB, the axis of the solid; suppose them to be at E, E′ and H respectively. Put AE$=$X, AE′$=$X′, also put $s$ for the surface generated by AP, and $s'$ for the surface generated by AP$p$, then as before (from § 166.) we have

$$sX+(s'-s)\,AH=s'X',$$

$$\text{hence }\frac{s'X'-sX}{s'-s}=AH,$$

$$\text{and }\frac{\text{flux. }(sX)}{\dot{s}}=\text{lim. }AH;$$

but the point $p$ approaching to P, the limit of AH is manifestly AB or $x$, therefore

$$\frac{\text{flux. }(sX)}{\dot{s}}=x,\text{ and }X=\frac{\int x\dot{s}}{s}$$

or since $\dot{s}=2\pi y\dot{z}$ (§ 65.),

$$X=\frac{2\pi\int xy\dot{z}}{2\pi\int y\dot{z}}=\frac{\int xy\dot{z}}{\int y\dot{z}}.$$

170. If instead of the centre of gravity of the face generated by AP, the centre of grav solid generated by the revolution of the pla APB about AB as an axis be required, the rea will be the very same as in last §, substitut solid generated by the plane figure instead of face generated by the curve line; so that p for the content of the solid, and X for AE stance of its centre of gravity from the vertex, w also

$$X=\frac{\int x\dot{s}}{s},$$

but in this case $\dot{s}=\pi y^2\dot{x}$ (§ 64.) therefore

$$X=\frac{\pi\int y^2x\dot{x}}{\pi\int y^2\dot{x}}=\frac{\int y^2x\dot{x}}{\int y^2\dot{x}}.$$

171. We shall now apply these formulas to ex amples.

*Example* 1. Let it be required to find the ce gravity of AP an arch of a circle. Suppose be a part of the diameter, and in addition to the tion of § 167. put $a$ for the radius of the circle, from the nature of the curve, $y^2=2ax-$

(proceeding as in § 165. Ex. 1.) we have $\dot{z}=$

therefore $\dot{z}y=a\dot{x}$, and $\dot{z}x=\frac{ax\dot{x}}{y}$, but from the tion $y^2=2ax-x^2$, by taking the fluxions $y\dot{y}=a\dot{x}-x\dot{x}$, and hence $\frac{x\dot{x}}{y}=\frac{a\dot{x}}{y}-\dot{y}$ therefore $\dot{z}x=a(\dot{z}-\dot{y})$; substituting now the of $\dot{z}x$ and $\dot{z}y$ in the formula of § 167, we have

$$X=\frac{\int x\dot{z}}{z}=\frac{a}{z}\int(\dot{z}-\dot{y})$$

$$=\frac{a}{z}(z-y+c)$$

$$Y=\frac{\int y\dot{z}}{z}=\frac{a}{z}\int\dot{x}$$

$$=\frac{a}{z}(x+c').$$

To discover the values of the constant qu c, c′, we have from the equations in which they

$$ac=Xz-az+ay,\ ac'=Yz-ax;$$

but when $z=0$, then $x$, $y$, X and Y are each therefore $c=0$, and $c'=0$, thus we have simply

$$X=\frac{a(z-y)}{z},\ Y=\frac{ax}{z},$$

Inverse Method.

Fig. 37.

*Ex.* 2. Let it be required to find the centre of gravity of APB an area bounded by AP an arch of a circle and PB, BA its sine and versed sine. Let $a$ denote the radius, and let the remaining notation be as in § 168. Then, because $\dot{s}=y\dot{x}$, we have $x\dot{s}=yx\dot{x}$, but from the equation $y^2=2ax-x^2$ (which expresses the nature of the curve), we find

$$x\dot{x}=a\dot{x}-y\dot{y}, \text{ therefore}$$

$$x\dot{s}=ay\dot{x}-y^2\dot{y}=a\dot{s}-y^2\dot{y}.$$

We have also $y\dot{s}=y^2\dot{x}=(2ax-x^2)\dot{x}$, therefore,

$$X=\frac{\int x\dot{s}}{s}=\frac{\int(a\dot{s}-y^2\dot{y})}{s}$$

$$=\frac{1}{s}(as-\tfrac{1}{3}y^3+c)$$

$$Y=\frac{\int y\dot{s}}{2s}=\frac{\int(2ax-x^2)\dot{x}}{2s}$$

$$=\frac{1}{2s}(ax^2-\tfrac{1}{3}x^3+c').$$

By proceeding as in the last example we find $c$ and $c'$ each $=0$, thus we have

$$X=a-\frac{y^3}{3s}, \; Y=\frac{3ax^2-x^3}{6s}.$$

Fig. 37.

*Ex.* 3. Suppose now the figure to be the surface generated by the revolution of AP an arch of a circle about the diameter AB, and that the centre of gravity of the generated surface is required. Then because from the nature of the circle $\dot{z}=\frac{a\dot{x}}{y}$ we have $y\dot{z}=a\dot{x}$, and $xy\dot{z}=ax\dot{x}$, therefore, substituting these values in the formula of § 169. it becomes

$$X=\frac{\int xy\dot{z}}{\int y\dot{z}}=\frac{\int x\dot{x}}{a\int\dot{x}}$$

$$=\frac{\frac{1}{2}x^2+c}{x+c'}.$$

To find the values of the constant quantities $c$, $c'$, we have

$$c=X(x+c')-\tfrac{1}{2}x^2,$$

$$c'=\frac{\frac{1}{2}x^2+c}{X}-x,$$

but as when $x=0$, then $X=0$, it is manifest that $c$ and $c'$ are each $=0$, thus we have

$$X=\tfrac{1}{2}x.$$

Fig. 37.

*Ex.* 4. Let us now suppose that it is required to find the centre of gravity of the solid generated by the revolution of AP an arch of a circle about the diameter. In this case, because $y^2=2ax-x^2$, we have from § 170,

$$X=\frac{\int y^2x\dot{x}}{\int y^2\dot{x}}=\frac{\int\dot{x}(2ax^2-x^3)}{\int\dot{x}(2ax-x^2)}$$

$$=\frac{\frac{2}{3}ax^3-\frac{1}{4}x^4+c}{ax^2-\frac{1}{3}x^3+c'},$$

and reasoning as in the last example, we find $c=0$, and $c'=0$, and therefore

$$X=\frac{8ax-3x^2}{12a-4x}.$$

If the segment be a hemisphere, in which case $x=a$, then $X=\frac{5}{8}a$.

## SECT. III. *Of Fluxional Equations.*

172. IT has been shewn (§ 49.), how, from an equation being given, expressing the relation between $x$ a variable quantity, and $y$ a function of that quantity, we may deduce the equation that expresses the relation of their fluxions. We are now to show how from the latter, or *fluxional equation*, we may return to the equation of the fluents, which, relatively to the other, may be called its *primitive equation*.

173. As any primitive equation and the fluxional equation derived from it both hold true at the same time, and as the constant quantities which enter into the former retain the same values in the latter, it follows that by means of the two equations we may exterminate any one of the constant quantities, and thus from any proposed primitive equation deduce a fluxional equation, in which one of the constant quantities contained in that primitive shall not at all be found.

For example, let the primitive equation be $y+ax+b=0$, by taking the fluxions we have $\dot{y}+a\dot{x}=0$, a fluxional equation in which $b$ is not found; if, however, it be required to find an equation in which $a$ shall be wanting, we have only to eliminate $a$ by applying the common rules of Algebra (ALGEBRA, Sect. vii.) to the two equations

$$y+ax+b=0, \quad \dot{y}+a\dot{x}=0;$$

and hence we have $y\dot{x}-x\dot{y}+b\dot{x}=0$, thus it appears that from the primitive equation $y+ax+b=0$ we may deduce a fluxional equation which may be expressed under either of these forms,

$$\dot{y}+a\dot{x}=0, \quad y\dot{x}-x\dot{y}+b\dot{x}=0;$$

these hold true at the same time as the primitive equation, they are alike related to, and any two of the three being given the other necessarily follows from them.

As a second example, suppose the primitive equation to be $x^2-2ay-a^2-b=0$, by passing to the fluxions we immediately find $x\dot{x}-a\dot{y}=0$, an equation in which $b$ is not found. If, however, it be required that the fluxional equation shall want $a$, we have only to apply the common rules of elimination to the two equations; thus from the second we get $a=\frac{x\dot{x}}{\dot{y}}$, and this being substituted in the first it becomes

$$x^2 - \frac{2xy\dot{x}}{\dot{y}} - \frac{x^2\dot{x}^2}{\dot{y}^2} - b = 0,$$

from which we have

$$(x^2-b)\dot{y}^2 - 2xy\dot{y}\dot{x} - x^2\dot{x}^2 = 0$$

and taking the square root, having previously reduced the equation to a proper form,

$$\dot{y}\sqrt{(x^2+y^2-b} - y\dot{y} - x\dot{x} = 0.$$

174. It is evident that by proceeding in this manner we shall, in some cases, arrive at a fluxional equation involving the second and higher powers of $\frac{\dot{y}}{\dot{x}}$, and when this happens we can only find the value of $\frac{\dot{y}}{\dot{x}}$ by the resolution of an equation; but this may be avoided by preparing the primitive equation in such a manner, that the constant quantity to be eliminated may be entirely separated from the variable quantities, so as to form one of the terms of the equation, then, upon taking the fluxions, this term being constant will vanish, and thus we shall obtain an equation entirely free from the constant quantity contained in that term. Thus the primitive equation $y+ax+b=0$ has already such a form that by taking the fluxions we get $\dot{y}+a\dot{x}=0$ an equation in which $b$ is not found. If it be required, that upon taking the fluxions, $a$ shall vanish; we must put the equation under this form $\frac{y+b}{x}+a=0$, and then taking the fluxion, we find immediately

$$\frac{x\dot{y}-(y+b)\dot{x}}{x^2}=0,$$

an expression in which $a$ is not found, and which by rejecting the divisor $x^2$ becomes $y\dot{x}-x\dot{y}+b\dot{x}=0$, and these two forms of the fluxional equation are the very same as have been found in the last §. In the second example, viz. $x^2-2ay-a^2-b=0$, the equation has already the form suited to the elimination of $b$, for the fluxional equation is $x\dot{x}-a\dot{y}=0$, but in order that $a$ may vanish, we must resolve the equation with respect to $a$, so as to give it this form,

$$y-\sqrt{(x^2+y^2-b)}+a=0;$$

passing now to the fluxional equation, $a$ disappears, and we have

$$\frac{\dot{y}\sqrt{(x^2+y^2-b)}-y\dot{y}-x\dot{x}}{\sqrt{(x^2+y^2-b)}}=0.$$

It is evident that we have only to reject the denominator to give the equation this form,

$$\dot{y}\sqrt{(x^2+y^2-b)}-y\dot{y}-x\dot{x}=0,$$

the same as was found in the conclusion of last §.

175. From what has been now shewn we may infer, that as from any proposed primitive equation we can deduce a fluxional equation that shall contain one constant quantity less than the primitive contains, so on the contrary any fluxional equation being given, its primitive equation may contain one constant quantity more than the fluxional equation, but it can contain only one, for no more than one constant quantity can be made to disappear by returning from the primitive to its fluxional equation.

176. The fluxional equation expressing the value of $\frac{\dot{y}}{\dot{x}}$, which is derived from any primitive equation involving $x$, and $y$ a function of $x$, may be called a fluxional equation of the *first order*; and as from this equation considered as a primitive, we may in like manner derive an equation that shall involve $\frac{\ddot{y}}{\dot{x}^2}$ (§ 50.), this last may be called a fluxional equation of the *second order*, and the fluxional equation from which it is derived may be called its primitive equation of the *first order*, to distinguish it from the absolute primitive equation, from which all the others are conceived to be derived. A similar mode of definition is to be applied to the higher orders.

177. As any primitive equation and the fluxional equations of the first and second orders derived from it must all hold true at the same time, it is evident, that by means of the three equations, we may exterminate any two of the constant quantities contained in them that we please, and thus produce a fluxional equation of the second order that contains two constant quantities less than the primitive equation. There are however two other ways by which we may arrive at the very same fluxional equation of the second order. For as from the given primitive equation we may deduce two different fluxional equations of the first order, one of which shall contain one only of the two quantities to be eliminated, and the other shall contain the other quantity only; we may consider each of these equations in its turn as a primitive, and, by proceeding in the manner explained in § 173 and § 174, derive from it a fluxional equation, in which that particular constant quantity which remained in its primitive, but which was to be finally eliminated, shall not be found; thus, from each of these primitives we shall deduce the very same fluxional equation of the second order, that shall be freed from two of the constant quantities contained in the absolute primitive equation.

Let us take for example the equation

$$x^2-2ay+b^2=0;$$

by proceeding as explained in § 173, or § 174, we find these two fluxional equations of the first order,

$$x\dot{x}-a\dot{y}=0, \quad (x^2+b^2)\dot{y}-2xy\dot{x}=0,$$

in the one of these the constant quantity $a$ is wanting, and in the other $b$ is wanting. Taking the first equation $x\dot{x}-a\dot{y}=0$, and proceeding as in § 50 (observing that $\dot{x}$ is constant) we find $\dot{x}^2-a\ddot{y}=0$, if from this equation we now eliminate $a$ by putting instead of it $\frac{x\dot{x}}{\dot{y}}$ (deduced from the equation $x\dot{x}-a\dot{y}=0$) we find after proper reduction

Inverse Method.

$$\ddot{y}x-\dot{x}\dot{y}=0,$$

a fluxional equation of the second order, in which both $a$ and $b$ are wanting, and having $x^2-2ay+b^2$ for its absolute primitive equation.

Let us now take the other fluxional equation of the first order which involves $b$, viz. $(x^2+b^2)\dot{y}-2xy\dot{x}=0$; by proceeding with this as with the former we find $(x^2+b^2)\ddot{y}-2y\dot{x}^2=0$; from the first of these equations we find $x^2+b^2=\frac{2xy\dot{x}}{\dot{y}}$, and from the second $x^2+b^2=\frac{2y\dot{x}^2}{\ddot{y}}$; therefore, $\frac{2xy\dot{x}}{\dot{y}}=\frac{2y\dot{x}^2}{\ddot{y}}$, and hence we have

$$\ddot{y}x-\dot{x}\dot{y}=0,$$

the same equation as before; and as we have arrived at the very same conclusion by considering each of these equations

$$x\dot{x}-a\dot{y}=0,\ (x^2+b^2)\dot{y}-2xy\dot{x}=0$$

as a primitive, it follows that both these are to be considered as primitive equations of the first order of the fluxional equation $\ddot{y}x-\dot{x}\dot{y}=0$.

178. In general, every fluxional equation of the second order has two primitive equations of the first order, and all three may be considered as originating from one and the same absolute primitive equation; and as a fluxional equation of the second order may contain two constant quantities less than its absolute primitive equation, and one less than either of its primitive equations of the first order; so, on the contrary, a primitive equation of the first order may contain one constant quantity more than the fluxional equation of the second order derived from it, and the absolute primitive may contain two constant quantities which are not found in the fluxional equation of the second order derived from it; and similar conclusions may be drawn relating to fluxional equations of the third or any higher order.

### *Of Fluxional Equations of the first order.*

179. When it is required to find the primitive equation corresponding to a proposed fluxional equation of the first order, we may endeavour to separate the variable quantities, that is, to bring the equation to such a form, that it may be composed of two parts, one of which consists of $\dot{x}$ multiplied or divided by a function of $x$ only, and the other of $\dot{y}$ multiplied or divided by a function of $y$ only. When this separation of the variable quantities can be effected, we have only to take the fluents according to the methods explained in SECT. I. and put their sum $=0$, and we immediately have the primitive equation required.

*Ex.* Suppose the fluxional equation to be

$$my\dot{x}+nx\dot{y}=0;$$

divide the terms of the equation by $xy$, and it becomes

$$\frac{m\dot{x}}{x}+\frac{n\dot{y}}{y}=0.$$

Inverse Method.

Now the fluent of $\frac{m\dot{x}}{x}$ is $m$ l. $x+c'$ (§ 103.), and in like manner the fluent of $\frac{n\dot{y}}{y}$ is $n$ l. $y+c''$, therefore

$$m\,\text{l.}\,x+n\,\text{l.}\,y+c'+c''=0,$$

or, transposing $c+c''$, and putting a single constant quantity for their sum, which, to be homogeneous with the logarithmic quantities, may be — log. $c$, or — l. $c$,

$$m\,\text{l.}\,x+n\,\text{l.}\,y=\text{l.}\,c,\ \text{or l.}\,(x^m)+\text{l.}\,(y^n)=\text{l.}\,c,$$
$$\text{or l.}\,(x^my^n)=\text{l.}\,c,\ \text{and hence } x^my^n=c,$$

which last is the primitive equation required.

180. When a primitive equation is *homogeneous*, that is, when the sum of the exponents of the variable quantities $x$ and $y$ is the same in each term, as in this example,

$$ax\dot{x}+by\dot{x}+dx\dot{y}+ey\dot{y}=0,$$
$$\text{or } (ax+by)\dot{x}+(dx+ey)\dot{y}=0,$$

in which the variable part of each term is of the first degree, as also in this equation

$$\left.\begin{array}{l}(ax^2+bxy+dy^2)\dot{x}\\+(ex^2+fxy+gy^2)\dot{y}\end{array}\right\}=0,$$

in which the variable part of each term is of the second degree, such an equation may be always transformed into another which will admit of the variable quantities being separated. To take a particular example, let us suppose the equation to be $x\dot{x}+y\dot{y}=ny\dot{x}$, or $(x-ny)\dot{x}+y\dot{y}=0$. We assume $y=xz$ (and the same assumption is to be made for any other homogeneous equation), then $\dot{y}=z\dot{x}+x\dot{z}$, thus the equation becomes transformed to

$$(x-nxz)\dot{x}+xz(z\dot{x}+x\dot{z})=0,$$

but as the terms of this equation have a common factor $x$, by leaving out that factor, it becomes

$$(1-nz)\dot{x}+z(z\dot{x}+x\dot{z})=0,$$

which also admits of being expressed thus

$$(1-nz+z^2)\dot{x}+xz\dot{z}=0,$$

and, by division,

$$\frac{\dot{x}}{x}+\frac{\dot{z}z}{1-nz+z^2}=0,$$

and taking the fluents

$$\int\frac{\dot{x}}{x}+\int\frac{z\dot{z}}{1-nz+z^2}=C,$$

where C denotes a constant quantity, or, since $\int\frac{\dot{x}}{x}=\text{l.}\,x$,

$$\text{l.}\,x+\int\frac{z\dot{z}}{1-nz+z^2}=C,$$

now

now the particular form of $\int\frac{z\dot{z}}{1-nz+z^2}$ depends upon the value of the number $n$; for if $\frac{n}{2}>1$, it will be a logarithmic function, and if $\frac{n}{2}<1$, it will be expressible by means of a circle, but if $\frac{n}{2}=1$, then it is an algebraic function, and in each case it may be found by the methods delivered in SECT. I. for finding the fluent of a rational fraction. It may however be simplified in its form, by observing, that since

$$\frac{z\dot{z}}{1-nz+z^2}=\frac{1}{2}\frac{2z\dot{z}-n\dot{z}}{1-nz+z^2}+\frac{1}{2}\frac{n\dot{z}}{1-nz+z^2},$$

therefore (§ 103.) $\int\frac{z\dot{z}}{1-nz+z^2}=$

$$\frac{1}{2}\text{ l. }(1-nz+z^2)+\frac{1}{2}\int\frac{n\dot{z}}{1-nz+z^2}.$$

If we limit our enquiry to the case of $n+2$, we have

$$\int\frac{n\dot{z}}{1-nz+z^2}=\int\frac{2\dot{z}}{(1-z)^2}=\frac{2}{1-z},$$

let the terms be now collected into one expression, then observing that $\frac{1}{2}$ l. $(1-2z+z^2)=\frac{1}{2}$ l. $(1-z)^2=$ l. $(1-z)$, we have

$$\text{l.}x+\text{l.}(1-z)+\frac{1}{1-z}=C;$$

and, substituting $\frac{y}{x}$ instead of $z$,

$$\text{l.}x+\text{l.}\left(\frac{x-y}{x}\right)+\frac{x}{x-y}=C,$$

or, substituting l. $c$ instead of C, and collecting the logarithmic functions into one,

$$\text{l.}\frac{x-y}{c}=\frac{-x}{x-y},$$

therefore, passing from logarithms to numbers, by observing that, as when $a=$ l. $p$, we have by the nature of logarithms $e^a=p$, where $e$ denotes the number of which the Napierean logarithm is 1, so in the present case we have $\frac{x-y}{c}=e^{-\frac{x}{x-y}}$, and hence the primitive equation is found to be

$$x-y-ce^{-\frac{x}{x-y}}=0.$$

As a second example let the fluxional equation be

$$x\dot{y}-y\dot{x}=\dot{x}=\dot{x}\sqrt{(x^2+y^2)}$$

which is also homogeneous. Assume as before $y=xz$, then $\dot{y}=x\dot{z}+z\dot{x}$, and substituting these values of $y$ and $\dot{y}$ in the proposed equation, it becomes

$$\dot{x}\sqrt{(1+z^2)}-x\dot{z}=0,$$

from which we get

$$\frac{\dot{x}}{x}-\frac{\dot{z}}{\sqrt{(1+z^2)}}=0,$$

and taking the fluents of the terms, observing that each being a logarithm function, their sum may be put equal to a constant logarithm,

$$\text{l.}x-\text{l.}\left\{z+\sqrt{(1+z^2)}\right\}=\text{l.}c,$$

which expression, by substituting for $z$ its value $\frac{y}{x}$, becomes

$$\text{l.}x=\text{l.}c+\text{l.}\left\{\frac{y+\sqrt{(x^2+y^2)}}{x}\right\}.$$

If we now consider that

$$(y+\sqrt{x^2+y^2})(y-\sqrt{x^2+y^2})=-x^2,$$

and therefore that

$$\frac{y+\sqrt{(x^2+y^2)}}{x}=\frac{-x}{y-\sqrt{(x^2+y^2)}},$$

it will appear, that the above equation may be otherwise expressed thus:

$$\text{l.}x=\text{l.}c+\text{l.}\left\{\frac{-x}{y-\sqrt{(x^2+y^2)}}\right\},$$

from which, by passing from logarithms to their numbers, we find $y-\sqrt{(x^2+y^2)}=-c$, and hence, by so ordering the equation that the radical may disappear, we get $x^2=c^2+2cy$, which is the primitive equation required.

181. An equation which is not homogeneous, may in some cases, by proper transformations, be rendered homogeneous; this is the case in particular with the equation

$$(a+mx+ny)\dot{x}+(b+px=qy)\dot{y}=0,$$

which is general of its kind; for this purpose we assume $x=t+\alpha$, and $y=u+\beta$, then $\dot{x}=\dot{t}$, and $\dot{y}=\dot{u}$; by substituting these values of $x$, $y$, $\dot{x}$, $\dot{y}$, in the proposed equation it becomes

$$\left.\begin{array}{l}(a+m\alpha+n\beta+mt+nu)\dot{t}\\+(b+p\alpha+q\beta+pt+qu)\dot{u}\end{array}\right\}=0,$$

Let us now suppose $\alpha$ and $\beta$ such that

$$a+m\alpha+n\beta=0,$$
$$b+p\alpha+q\beta=0,$$

by these two equations the values of $\alpha$ and $\beta$ are determined, and the transformed equation is reduced to

$$(mt+nu)\dot{t}+(pt+qu)\dot{u}=0,$$

an equation which is homogeneous, and therefore may be treated in the manner explained in last §.

This transformation will not apply, however, when $mq-np=0$, because then the values of $\alpha$ and $\beta$ would be infinite.

infinite. In this case we have $q=\frac{np}{m}$, and therefore $px+qy=\frac{p}{m}(mx+ny)$, hence the original equation may be expressed thus,

$$\left.\begin{array}{r} a\dot{x}+b\dot{y} \\ +(mx+ny)\,(\dot{x}+\frac{p}{m}\dot{y}) \end{array}\right\}=0.$$

Assume now $mx+ny$, then $\dot{y}+\frac{\dot{z}}{n}-\frac{m}{n}\dot{x}$; the values of $mx+ny$ and $\dot{y}$ being now substituted in the equation, and the whole reduced to a proper form, it becomes

$$\dot{x}+\frac{(bm+pz)\dot{z}}{amn-bm^2+(mn-pm)z}=0.$$

The fluent of the second term of this expression will involve logarithms, except that $mn-pm=0$, in which case the primitive equation is

$$x+\frac{2bmz+pz^2}{2(amn-bm^2)}=C.$$

182. When a fluxional equation has this form

$$\dot{y}+Py\dot{x}=Q\dot{x},$$

where P and Q denote any functions of $x$, the variable quantities may be separated in the following manner. Assume $y=Xz$, then, taking the fluxions, we have $\dot{y}=z\dot{X}+X\dot{z}$, and by substitution, the proposed equation becomes

$$z\dot{X}+X\dot{z}+PXz\dot{x}=Q\dot{x};$$

now as in this equation X and $z$ may be supposed to denote indeterminate functions of $x$, we may divide it into two others, such, that the variable quantities in each may be separable; to effect this we assume

$$X\dot{z}+PXz\dot{x}=0,\ z\dot{X}=Q\dot{x};$$

hence, dividing the first equation by X, we have $\dot{z}+Pz\dot{x}=0$, and $\frac{\dot{z}}{z}+P\dot{x}=0$, and taking the fluents, $\mathrm{l}.\,z+\int P\dot{x}=0$, and hence, by passing from logarithms to their numbers,

$$z=e^{-\int P\dot{x}};$$

here no constant quantity is introduced, it being sufficient to add it at the end of the operation; let this value of $z$ be substituted in the second equation, then by deducing from it the value of X, we have

$$\dot{X}=e^{\int P\dot{x}}\,Q\dot{x}$$

$$\text{and } X=\int e^{\int P\dot{x}}\,Q\dot{x}+c;$$

and since $y=Xz$, therefore

$$y=e^{-\int P\dot{x}}\left\{\int e^{\int P\dot{x}}\,Q\dot{x}+c\right\}.$$

Let us take a particular case, and suppose the equation to be $\dot{y}+y\dot{x}=x^n\dot{x}$, then we have $P=1$, $Q=x^n$, and $\int P\dot{x}=x$, hence in this case the general formula becomes

$$y=e^{-x}\left\{\int e^x x^n\dot{x}+c\right\}.$$

The fluent $\int e^x x^n\dot{x}$ may be found by § 143; let us suppose for example that $n=2$, then we have

$$\int e^x x^2\dot{x}=e^x(x^2-2x-2),$$

so that the fluxional equation being

$$\dot{y}+y\dot{x}=x^2\dot{x},$$

the primitive equation is

$$y=x^2-2x+2+ce^{-x}.$$

The general equation $\dot{y}+Py\dot{x}=Q\dot{x}$, which involves the simple power only of the variable quantity $y$, and its fluxion, has been called a *linear equation* of the first order; it has also, with more propriety, been called a fluxional equation of the *first degree*, and of the first order.

183. The equation

$$\dot{y}+Py\dot{x}=Qy^n\dot{x},$$

where P and Q as before denote any functions of $x$, is easily reduced to the form we have been considering; for assume $y^{1-n}=(1-n)z$, then $y^{-n}\dot{y}=\dot{z}$, and $\dot{y}=\dot{z}y^n$, and $y=(1-n)zy^n$; if we now substitute the values of $\dot{y}$ and $y$ in the equation, it becomes

$$y^n\dot{z}+(1-n)Pzy^n\dot{x}=Qy^n\dot{x};$$

let the terms of this equation be divided by $y^n$; then, including the factor $(1-n)$ in the indeterminate function P, the result is

$$\dot{z}+Pz\dot{x}=Q\dot{x},$$

an equation of the very same form as that which has been considered in last §.

184. The most general form that can be given to a fluxional equation of the first order, and consisting of three terms only, is

$$\gamma u^i z^k\dot{z}+\beta u^g z^h\dot{u}=\alpha u^e z^f\dot{u};$$

to give this equation a more simple form, let all its terms be divided by $\gamma u^i z^f$, it then becomes

$$z^{k-f}\dot{z}+\frac{\beta}{\gamma}u^{g-i}z^{h-f}\dot{u}=\frac{\alpha}{\gamma}u^{e-i}\dot{u}.$$

Suppose now

$$z^{k-f}\dot{z}=\frac{\dot{y}}{k-f+1},\ u^{g-i}\dot{u}=\frac{\dot{x}}{g-i+1},$$

$$\text{then } z^{k-f+1}=y,\ u^{g-i+1}=x,$$

and $\dot{y}+\frac{(k-f+1)\beta}{(g-i+1)\gamma}y^{\frac{h-f}{k-f+1}}\dot{x}$;

$$=\frac{(k-f+1)\alpha}{(g-i+1)\gamma}x^{\frac{e-g}{g-i+1}}\dot{x};$$

Let us in order to abridge put

$$\frac{(k-f+1)\beta}{(g-i+1)\gamma}=b,\quad \frac{(k-f+1)\alpha}{(g-i+1)\gamma}=a,$$

$$\frac{h-f}{k-f+1}=n,\quad \frac{e-g}{g-i+1}=m,$$

then the equation becomes

$$\dot{y}+by^n\dot{x}=ax^m\dot{x}.$$

If we suppose $n=1$, the resulting equation $\dot{y}+b\dot{y}x=ax^m\dot{x}$ may have its variable quantities separated by the method explained in § 183; but if we go only one step farther, and suppose $n=2$, so that the equation is

$$\dot{y}+by^2\dot{x}=ax^m\dot{x},$$

the difficulty of separating the variable quantities *generally* is so great as to have hitherto baffled the utmost efforts of the most expert analysts. This equation is commonly called RICCATI's *equation*, on account of its having been first treated of by an Italian mathematician of that name, who succeeded in separating the variable quantities in some particular cases, namely, when $m$ is equal to $\frac{-4p}{2p\pm1}$, where $p$ denotes any whole positive number.

185. If the separating of the variable quantities generally be a problem of insurmountable difficulty when the equation consists of only three terms, its solution can much less be expected, when the equation consists of four, or any greater number. There are, however, particular cases in which some of the most skilful analysts have, by employing happy and peculiar artifices, succeeded in resolving the problem, but the methods of proceeding are, generally speaking, not reducible to any determinate rules.

186. When the expression which constitutes a fluxional equation is such as would be produced by taking the fluxion of some function of $x$ and $y$, in which case it may be said to be a complete fluxion, then, without attempting to separate the variable quantities, we have only to add a constant quantity to that function, and the result put $=0$, will evidently be the primitive equation required.

If, for example, the equation be $x\dot{y}+y\dot{x}=0$, it is obvious that the expression $x\dot{y}+y\dot{x}$ is immediately produced by taking the fluxion of the function $xy$ ($y$ being also considered as a function of $x$), therefore the primitive equation is $xy+c=0$.

From the view which has been given in § 174. of the origin of fluxional equations it appears, that in passing from a primitive equation to its fluxional equation, the terms of the latter in many cases will not constitute a complete fluxion, by reason of some multiplier, or divisor, which was common to them all, having disappeared. In such cases, however, if we can by any means discover that factor, by restoring it we shall immediately have a complete fluxion, the fluent of which, with the addition of a constant quantity, when put $=0$, will be the primitive equation.

For example, if the equation be $x\dot{y}-y\dot{x}=0$, here $x\dot{y}-y\dot{x}$ cannot be immediately produced by taking the fluxion of a function of $x$ and $y$; but, if we divide the equation by $x^2$ so as to give it this form $\frac{x\dot{y}-y\dot{x}}{x^2}=0$, we obtain the expression $\frac{x\dot{y}-y\dot{x}}{x^2}$ which is a complete fluxion, viz. that of the fraction $\frac{y}{x}$, therefore $\frac{y}{x}+c=0$, or $y+cx=0$, is the primitive equation.

In like manner, the equation $mx\dot{y}+ny\dot{x}=0$, which does not in its present form express a complete fluxion, yet becomes so when multiplied by $x^{n-1}y^{m-1}$, for then it is

$$mx^ny^{m-1}\dot{y}+nx^{n-1}y^m\dot{x}=0,$$

from which it appears that the primitive equation in this case must be $x^ny^m+c=0$.

187. That we may be able to discover whether the terms of any proposed fluxional equation constitute a complete fluxion, and also from what expression such a fluxion has been derived, we must attend to the process, by which we find the fluxion of an expression composed of two variable quantities, one of which is a function of the other.

To avoid very general reasoning, we shall take for granted what is evidently possible, that any function of $x$ and $y$ may be generally expressed by a formula of this nature,

$$Ax^my^n=Bx^py^q+Cx^ry^s+\&c.$$

where A, B, C, &c. denote constant quantities, and the exponents $m$, $n$, &c. given numbers, the number of terms being supposed either finite or infinite. Now the fluxion of the whole expression is the sum of the fluxion of its terms, but in taking the fluxion of each term, beginning with the first $Ax^my^n$, the fluxion of which is

$$mAx^{m-1}y^n\dot{x}+nAx^my^{n-1}\dot{y},$$

it is evident that the result is composed of two parts, one of which is the expression we would find for its fluxion, if $x$ only were considered as variable, and $y$ as constant, and the other is the expression for its fluxion, if $y$ only were considered as variable and $x$ as constant; hence it follows, that the sum of the fluxions of all the terms will have the very same property; so that, if $u$ be put for the whole expression, we shall in every case have

$$\dot{u}=M\dot{x}+N\dot{y},$$

where $M\dot{x}$ denotes the result that will be found if the fluxion of $u$ be taken upon the hypothesis that $x$ alone is is variable, and $N\dot{y}$ is the fluxion of $u$, supposing $y$ alone to be variable.

188. Resuming the consideration of the general expression

$$Ax^m y^n + Bx^p y^q + Cx^r y^s + \&c.$$

let the fluxion of any one of its terms, for example, $Ax^m y^n$, be taken, supposing $x$ alone variable, and the result is $mAx^{m-1}y^n\dot{x}$. Again, let the fluxion of this result be taken, supposing $y$ alone variable, and we find it to be $mnAx^{m-1}y^{n-1}x\dot{y}$. Now, if we first take the fluxion of $Ax^m y^n$, supposing $y$ variable, we get $nAx^m y^{n-1}\dot{y}$, and then, the fluxion of this result, considering $x$ alone as variable, we get $mnAx^{m-1}y^{n-1}\dot{x}\dot{y}$, which is the very same expression as was found by proceeding in a contrary order; and as the same must hold true of all the terms, we may conclude, that if the fluxion of $u$ any function of $x$ and $y$ be taken, considering $x$ only as variable, and then the fluxion of that result, considering $y$ only as variable, the very same final result will be obtained as if we were first to take the fluxion of $u$ supposing $y$ variable, and then the fluxion of that result, supposing $x$ variable; but the fluxion of $u$ being expressed thus, $M\dot{x}+N\dot{y}$, it has been shewn that $M\dot{x}$ is the fluxion of $u$, if $x$ only be supposed variable and $N\dot{y}$ is its fluxion, if $y$ only be variable, therefore, if we take the fluxion of $M\dot{x}$ upon the supposition that $y$ only is variable, also the fluxion of $N\dot{y}$ upon the supposition that $x$ only is variable, the results must be identical. This property affords the following rule, by which we may always determine whether any proposed expression constitutes an exact fluxion or not. *Let the expression be put under this form,* $M\dot{x}+N\dot{y}$; *let* $M'\dot{y}$ *be the fluxion of* M, *supposing* y *alone variable, and* $N'\dot{x}$ *the fluxion of* N, *supposing* x *alone variable, then, if* M' *and* N' *are identical,* $M\dot{x}+N\dot{y}$ *is a complete fluxion; and if they are not,* $M\dot{x}+N\dot{y}$ *is not a complete fluxion.*

189. It is easy to see, how, from a complete fluxion $\dot{u}=M\dot{x}+N\dot{y}$ we may determine $u$ its fluent; for as $M\dot{x}$ has been deduced from $u$ by considering $x$ as variable, and $y$ as constant, on which account all the terms of $u$ that involved $y$ only must have vanished, it follows on the contrary, that if we put Y to denote those terms, we shall have

$$u=\int M\dot{x}+Y,$$

the fluent of $M\dot{x}$ being taken, regarding $x$ only as variable. The function Y may be determined, by comparing the fluxion of the expression thus obtained with the given fluxion $M\dot{x}+N\dot{y}$.

*Ex.* 1. Let the fluxion be $\frac{a\dot{y}+2x\dot{x}+y\dot{x}+x\dot{y}}{2\sqrt{(ay+x^2+xy)}}$, this expression when reduced to the form $\dot{u}=M\dot{x}+N\dot{y}$ is

$$\dot{u}=\frac{(2x+y)\dot{x}}{2\sqrt{(ay+x^2+xy)}}+\frac{(a+x)\dot{y}}{2\sqrt{(ay+x^2+xy)}}$$

hence $M=\frac{2x+y}{2\sqrt{(ay+x^2+xy)}}$, $N=\frac{a+x}{2\sqrt{(ay+x^2+xy)}}$, the fluxion of M, supposing $y$ only variable, gives us

$$\dot{M}=M'\dot{y}=\frac{(ay+xy-2ax)\dot{y}}{4(ay+x^2+xy)^{\frac{3}{2}}},$$

and in like manner the fluxion of N, supposing $x$ only variable, gives

$$\dot{N}=N'\dot{x}=\frac{(ay+xy-2ax)\dot{x}}{4(ay+x^2+xy)^{\frac{3}{2}}},$$

hence it appears that $M'=N'$, and therefore that the proposed expression is an exact fluxion. To determine its fluent, the formula $u=\int M\dot{x}+Y$ gives us

$$u=\sqrt{(ay+x^2+xy)}+Y;$$

the fluxion of this expression taken, upon the supposition that both $x$ and $y$ are variable, is

$$\dot{u}=\frac{a\dot{y}+2x\dot{x}+y\dot{x}+x\dot{y}}{2\sqrt{(ay+x^2+xy)}}+\dot{Y};$$

this result, compared with the original fluxion, shews that $\dot{Y}=0$, and $Y=c$, a constant quantity.

*Ex.* 2. Suppose the fluxion to be

$$\dot{x}\sqrt{(a^2+y^2)}+\dot{y}\frac{(a^2+xy+2y^2)}{\sqrt{(a^2+y^2)}}.$$

Here $M=\sqrt{(a^2+y^2)}$, $\dot{N}=\frac{a^2+xy+2y^2}{\sqrt{(a^2+y^2)}}$, and by proceeding as in last example, we shall find $M'=N'=\frac{y}{\sqrt{(a^2+y^2)}}$, hence it follows that the expression is a complete fluxion, and the formula $\dot{u}=\int M\dot{x}+Y$ shews that $u=\int\dot{x}\sqrt{(a^2+y^2)}+Y$

$$=x\sqrt{(a^2+y^2)}+Y.$$

To determine Y, we take the fluxion of this expression, supposing $x$ and $y$ both variable, and find it to be

$$\dot{u}=\dot{x}\sqrt{(a^2+y^2)}+\frac{xy\dot{y}}{\sqrt{(a^2+y^2)}}+\dot{Y},$$

and this compared with the original fluxion

$$\dot{u}=\dot{x}(\sqrt{a^2+y^2})+\frac{(a^2+xy+2y^2)\dot{y}}{\sqrt{(a^2+y^2)}},$$

shews that $\dot{Y}=\frac{(a^2+2y^2)\dot{y}}{\sqrt{(a^2+y^2)}}$, hence

$$Y=\int\frac{(a^2+2y^2)\dot{y}}{\sqrt{(a^2+y^2)}}=y\sqrt{(a^2+y^2)};$$

therefore the fluent required is

$$x = x\sqrt{(a^2+y^2)}+y\sqrt{(a^2+y^2)}+C$$
$$=(x+y)\sqrt{(a^2+y^2)}+C,$$

where C denotes a constant quantity.

190. It may be demonstrated, that as often as a fluxional equation does not constitute a complete fluxion, there is always an infinite number of factors, such, that if the equation were multiplied by any one of them, the result would be a complete fluxion. A general method of determining some one of these factors, however, seems to be a problem of such difficulty, that its solution, except in some particular cases, is not to be expected.

191. When a fluxional equation involves the second or higher powers of $\dot{x}$ and $\dot{y}$, as in this example,

$$\dot{y}^2-a^2\dot{x}^2=0,$$

which may be put under this form,

$$\frac{\dot{y}^2}{\dot{x}^2}-a^2=0,$$

we may, by the theory of algebraic equations, deduce from it the values of $\frac{\dot{y}}{\dot{x}}$, considering this quantity as a root of the equation; thus, in the present example, by resolving the quadratic equation $\frac{\dot{y}^2}{\dot{x}^2}-a^2=0$, we have $\frac{\dot{y}}{\dot{x}}=\pm a$, so that $\dot{y}-a\dot{x}=0$, and $\dot{y}+a\dot{x}=0$, hence

$$y-ax+c=0,\quad y+ax+c'=0,$$

are two primitive equations, from either of which the fluxional equation $\dot{y}^2-a^2\dot{x}^2=0$ may be derived, and it may also be deduced from their product

$$(y-ax+c)\,(y+ax+c')=0.$$

192. As often as the equation contains only one of the two variable quantities, for example $x$, by the resolution of the equation we may obtain $\frac{\dot{y}}{\dot{x}}=X$ (where X denotes some function of $x$), and hence $y=\int X\dot{x}$, but if it be more easy to resolve the equation with respect to $x$ than to $\frac{\dot{y}}{\dot{x}}$, which we shall denote by $p$, then, instead of seeking the values of $p$ from the equation, we may find that of $x$, thus we shall have $x=P$, some function of $p$, and hence $\dot{x}=\dot{P}$, and since $\dot{y}=p\dot{x}$, therefore, $\dot{y}=p\dot{P}$, and $y=\int p\dot{P}=Pp-\int P\dot{p}$. The relation between $x$ and $y$ is now to be found by eliminating $p$ by means of the two equations

$$x=\dot{P},\quad y=Pp-\int P\dot{p}.$$

As a particular example, let us suppose the equation to be $x\dot{x}+a\dot{y}=b\sqrt{(\dot{x}^2+\dot{y}^2)}$, from which, by putting $\frac{\dot{y}}{\dot{x}}=p$, we find

$$x=b\sqrt{(1+p^2)}-ap=P,$$

$$y=bp\sqrt{(1+p^2)}-\tfrac{1}{2}ap^2-b\int\dot{p}\sqrt{(1+p^2)}$$

the fluent of $\dot{p}\sqrt{(1+p^2)}$ may be found by the formulas given in § 130, and § 131.

193. When we cannot by any means find an expression for the relation between $x$ and $y$ in finite terms, then we must, as a last resource, have recourse to approximation, that is, we must express the value of $y$ in terms of $x$ by means of a series.

When the form of the series is known, we may determine the coefficients of its terms, by substituting the series and its fluxion instead of $y$ and $\dot{y}$ in the proposed equation.

Suppose, for example, that the equation is

$$\dot{y}+y\dot{x}-mx^n\dot{x}=0,$$

we may assume

$$y=Ax^\alpha+Bx^{\alpha+1}+Cx^{\alpha+2}+\&c.$$

then $\dot{y}=Ax^{\alpha-1}\dot{x}+(\alpha+1)Bx^\alpha\dot{x}$

$$+(\alpha+2)Cx^{\alpha+1}\dot{x}+\&c.$$

Substituting now the values of $y$ and $\dot{y}$ in the equation, and dividing the whole by $\dot{x}$, it becomes

$$\begin{array}{l}\alpha Ax^{\alpha-1}\\-mx^n\end{array}\begin{array}{l}+(\alpha+1)B\\+\qquad\quad A\end{array}\Big\}x^\alpha\begin{array}{l}+(\alpha+2)C\\+\qquad\quad B\end{array}\Big\}x^{\alpha+1}$$
$$\begin{array}{l}+(\alpha+3)D\\+\qquad\quad C\end{array}\Big\}x^{\alpha+2}+\&c.=0.$$

This equation becomes identical, if we assume $\alpha-1=n$, or $\alpha=n+1$, and

$$A=\frac{m}{\alpha},\ B=\frac{-m}{\alpha(\alpha+1)},\ C=\frac{m}{\alpha(\alpha+1)(\alpha+2)},$$

$$D=\frac{-m}{\alpha(\alpha+1)(\alpha+2)(\alpha+3)},\ \&c.$$

Hence we have

$$y=m\left\{\frac{x^{n+1}}{n+1}-\frac{x^{n+2}}{(n+1)(n+2)}\right.$$
$$\left.+\frac{x^{n+3}}{(n+1)(n+2)(n+3)}-\&c.\right\}$$

In order that a primitive equation may be general, it ought to contain an indeterminate constant quantity more than is found in the fluxional equation, therefore, this series which contains no such quantity, must be considered as incomplete, or as exhibiting the value of $y$, upon the supposition, that, when $x=0$, then $y=0$. However, we may obtain a value of $y$ that shall be general,

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eral, by proceeding as follows. Let us suppose we now that when $x=a$, then $y=b$; assume $x=a+t$, and $=b+u$, then it is manifest, that if the value of $u$ be ound by a series involving $t$, all the terms of the series ught to vanish when $t=0$. From the assumed values f $x$ and $y$ the equation

$$\dot{y}+y\dot{x}-mx^n\dot{x}=0$$

ecomes

$$\dot{u}+(b+u)\dot{t}-m(a+t)^n\dot{t}=0.$$

Assume now

$$u=At^{\alpha}+Bt^{\alpha+1}+Ct^{\alpha+2}+\&c.$$

hen, proceeding as before, we find

$$\left.\begin{array}{l} \alpha A t^{\alpha-1}+(\alpha+1)Bt^{\alpha}+(\alpha+2)Ct^{\alpha+1}+\&c. \\ \quad\quad + \quad\quad At^{\alpha}+ \quad\quad Bt^{\alpha+1}+\&c. \\ +b \\ -ma^n-m\frac{n}{1}a^{n-1}t-m\frac{n(n-1)}{1\,.\,2}a^{n-2}t^2-\&c. \end{array}\right\}=0.$$

It is necessary, in this equation, to assume $\alpha-1=0$, r $\alpha=1$, and hence we find

$$A=ma^n-b,\quad B=\frac{mna^{n-1}-ma^n+b}{2},$$

$$C=\frac{mn(n-1)a^{n-2}-mna^{n-1}+ma^n-b}{2\,.\,3},$$

&c.

If we now substitute $x-a$, and $y-b$ for $t$ and $u$ respectively, the result will have all the generality that elongs to a primitive equation, expressing the relation etween $x$ and $y$.

### f Fluxional Equations of the second or higher orders.

194. Whatever difficulties occur in finding the primitive equation of a fluxional equation of the first order, it will easily be conceived, that these difficulties nust be greater and more numerous when we have to onsider fluxional equations of the second and higher rders.

One of the most simple cases of an equation of the econd order is this,

$$\ddot{y}-X\dot{x}^2=0,\ \text{or}\ \frac{\ddot{y}}{\dot{x}^2}=X,$$

here X denotes a function of $x$, the variable quantity hose fluxion is supposed to be constant; in this case, ecause $\frac{\ddot{y}}{\dot{x}}=X\dot{x}$, we have $\frac{\dot{y}}{\dot{x}}=\int X\dot{x}$. Let P denote hat function of which $X\dot{x}$ is the fluxion, and $c$, as usual, n indeterminate constant quantity, then $\frac{\dot{y}}{\dot{x}}=P+c$, nd $\dot{y}=P\dot{x}+c\dot{x}$, and taking the fluents a second time

$$y=\int P\dot{x}+cx+c'$$

where $c'$ denotes a second indeterminate constant quantity.

$$\text{As}\int P\dot{x}=Px-\int\dot{P}x=x\int X\dot{x}-\int Xx\dot{x},$$

we have also

$$y=x\int X\dot{x}-\int Xx\dot{x}+cx+c'.$$

Suppose, for example, that the equation is $\ddot{y}-ax\dot{x}^2=0$, so that $\frac{\ddot{y}}{\dot{x}^2}=ax$; here $X=ax$, and therefore

$$\begin{aligned} y&=x\int ax\dot{x}-\int ax^2\dot{x}+cx+c' \\ &=\tfrac{1}{2}ax^3-\tfrac{1}{3}ax^3+cx+c' \\ &=\tfrac{1}{6}ax^3+cx+c'. \end{aligned}$$

In the very same manner we may deduce from the equation of the third order

$$\dddot{y}-X\dot{x}^3=0,\ \text{or,}\ \frac{\dddot{y}}{\dot{x}^3}=X$$

its primitive equation; thus we have

$$\frac{\dddot{y}}{\dot{x}^2}=X\dot{x},\ \frac{\ddot{y}}{\dot{x}^2}=\int X\dot{x}=P+c,$$

where P denotes such a function of $x$, that its fluxion is $X\dot{x}$, and $c$ represents a constant quantity. Again

$$\frac{\ddot{y}}{\dot{x}}=P\dot{x}+c\dot{x},$$

$$\frac{\dot{y}}{\dot{x}}=\int P\dot{x}+cx+c'=Q+cx+c';$$

here Q is put for $\int P\dot{x}$, and $c'$ for a second constant quantity. In like manner we have

$$\dot{y}=Q\dot{x}+cx\dot{x}+c'\dot{x},$$

$$\text{and}\ y=\int Q\dot{x}+\tfrac{1}{2}cx^2+c'x+c'';$$

and as P and Q are functions of $x$, the fluents of $P\dot{x}$ and $Q\dot{x}$ may be found by the methods formerly explained.

195. Let us next consider such equations as involve only $\frac{\ddot{y}}{\dot{x}^2}$, $\frac{\dot{y}}{\dot{x}}$ and constant quantities. In order to abridge let us put $\frac{\dot{y}}{\dot{x}}=p$, then such an equation may be generally expressed thus $\frac{\ddot{y}}{\dot{x}^2}=P$, where P denotes some

known

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known function of $p$; now as $\frac{\dot{y}}{\dot{x}}=p$, by taking the fluxions, and observing that $\dot{x}$ is constant, we have $\frac{\ddot{y}}{\dot{x}}=\frac{\dot{p}}{\dot{x}}$, hence $\frac{\dot{p}}{\dot{x}}=\text{P}$, and $\dot{x}=\frac{\dot{p}}{\text{P}}$, and $x=\int\frac{\dot{p}}{\text{P}}$; let the value of $\dot{x}$ be substituted instead of it in the equation $\dot{y}=p\dot{x}$, and it becomes $\dot{y}=\frac{p\dot{p}}{\text{P}}$, and hence $y=\int\frac{p\dot{p}}{\text{P}}$; thus it appears that if we can find the fluents $\int\frac{\dot{p}}{\text{P}}$ and $\int\frac{p\dot{p}}{\text{P}}$, we shall have the primitive equation when we eliminate $p$ by means of these two equations

$$x=c+\int\frac{\dot{p}}{\text{P}}, \qquad y=c'+\int\frac{p\dot{p}}{\text{P}},$$

where $c$ and $c'$ denote the two indeterminate constant quantities that ought to enter into the primitive equation.

Suppose for example that the equation is

$$\frac{(\dot{x}+\dot{y}^2)^{\frac{3}{2}}}{-\dot{x}\ddot{y}}=a;$$

which, by putting $p$ for $\frac{\dot{y}}{\dot{x}}$, and $\frac{\dot{p}}{\dot{x}}$ for $\frac{\ddot{y}}{\dot{x}^2}$ becomes transformed to

$$-\frac{(1+p^2)^{\frac{3}{2}}\dot{x}}{\dot{p}}=a;$$

hence we have

$$\dot{x}=\frac{-a\dot{p}}{(1+p^2)^{\frac{3}{2}}} \qquad \dot{y}=p\dot{x}=\frac{-ap\dot{p}}{(1+p^2)^{\frac{3}{2}}},$$

$$x=c-\frac{ap}{\sqrt{(1+p^2)}}, \quad y=c'+\frac{a}{\sqrt{(1+p^2)}};$$

when by means of these equations we eliminate $p$, we obtain $(x-c)^2+(y-c')^2=a^2$.

The fluxional equation is evidently formed by putting the general expression for the radius of curvature (given in § 97.) equal to a constant quantity, and the primitive equation is accordingly an equation to a circle having that constant quantity for its radius, as it ought to be.

196. Suppose now that the equation has this form

$$\frac{\ddot{y}}{\dot{x}^2}=\text{Y},$$

where Y denotes a function of $y$, then putting as before $\frac{\dot{y}}{\dot{x}}=p$, we have $\frac{\ddot{y}}{\dot{x}^2}=\frac{\dot{p}}{\dot{x}}=\frac{p\dot{p}}{\dot{y}}$, hence the equation $\frac{\ddot{y}}{\dot{x}^2}=\text{Y}$ becomes $\frac{p\dot{p}}{\dot{y}}=\text{Y}$, and $p\dot{p}=\text{Y}\dot{y}$, and $p^2=$ $2\int\text{Y}\dot{y}+c$, hence $p=\frac{\dot{y}}{\dot{x}}=\sqrt{(c+2\int\text{Y}\dot{y})}$ an

$$x=\int\frac{\dot{y}}{\sqrt{(c+2\int\text{Y}\dot{y})}}+c',$$

where $c$ and $c'$ denote two constant quantities.

To take a particular example, let us suppose the tion to be $\ddot{y}-y\dot{x}^2=a\dot{x}^2$, or $\frac{\ddot{y}}{\dot{x}^2}=a+y$, here Y= and $2\int\text{Y}\dot{y}=2ay+y^2$, hence (and by § 17

$$x=\int\frac{\dot{y}}{\sqrt{(c+2ay+y^2)}}+c'$$

$$=\text{l.}\left\{a+y+\sqrt{(a+2ay+y^2)}\right\}+$$

197. When the equation contains $\frac{\dot{y}}{\dot{x}}$, $\frac{\ddot{y}}{\dot{x}^2}$ a may be transformed to a fluxional equation of order, by substituting in it $p\dot{x}$ and $\dot{p}\dot{x}$, inste and $\ddot{y}$; if we can find the primitive of that equation, and thence the value of $p$ in terms shall have the value of $y$ from the formula $y=\int$ if we have the value of $x$ in terms of $p$, then, $\int p\dot{x}=px-\int x\dot{p}$, we shall have

$$y=px-\int x\dot{p}.$$

Suppose the equation to be

$$\frac{(\dot{x}^2+\dot{y}^2)^{\frac{3}{2}}}{-\dot{x}\ddot{y}}=\text{X}, \text{ or } -\frac{(1+p^2)^{\frac{3}{2}}\dot{x}}{\dot{p}}=\text{X},$$

where X denotes any function of $x$, then,

$$\frac{\dot{x}}{\text{X}}=\frac{-\dot{p}}{(1+p^2)^{\frac{3}{2}}}, \text{ and} \int\frac{\dot{x}}{\text{X}}=\frac{-p}{\sqrt{(1+p^2)}};$$

Let us represent $\int\frac{\dot{x}}{\text{X}}$ by V, then $p=\frac{\text{V}}{\sqrt{(1-}}$ and

$$y=\int p\dot{x}=\int\frac{\text{V}\dot{x}}{\sqrt{(1-\text{V}^2)}}.$$

This equation evidently expresses the natu curve such, that $\frac{(\dot{x}^2+\dot{y}^2)^{\frac{3}{2}}}{-\dot{x}\ddot{y}}$, its radius of cu (§ 97.), is equal to X a function of $x$ one of its dinates.

198. If the proposed fluxional equation of the order contains $\frac{\dot{y}}{\dot{x}}$, $\frac{\ddot{y}}{\dot{x}^2}$ and $y$, to transform it w exterminate $\dot{x}$ by means of its value $\frac{\dot{y}}{p}$ deduced the equation $\dot{y}=p\dot{x}$, thus we shall have

$$\frac{\ddot{y}}{\dot{x}^2}=\frac{\dot{p}}{\dot{x}}=\frac{p\,\dot{p}}{\dot{y}},$$

d the result will be an equation of the first order conning only $p$, $\dot{p}$ and $y$; when its primitive equation n be found, and thence the value of $p$, in terms of $y$, : may find $x$ by the formula $x=\int\frac{\dot{y}}{p}$, and by the :mula $x=\frac{y}{p}=\int\frac{y\dot{p}}{p^2}$ when $y$ is expressed by means $p$.

199. As an example of the manner in which fluxionequations of the second order are to be resolved by proximation, we shall take the particular equation

$$\ddot{y}+a\,x^n y\,\dot{x}^2=0.$$

If the value of $y$ which satisfies the equation be sup-sed to have this form

$$A\,x^\alpha+Bx^{\alpha+\delta}+Cx^{\alpha+2\delta}+\&c.$$

l that the series of exponents goes on increasing, or it $\delta$ is positive, we may, by supposing $x$ to be a very all quantity, conceive that the expression for $y$ is re-:ed to its first term, because in that case each of the owing terms will be inconsiderable in respect of that n. According to this hypothesis we shall have

$$y=A\,x^\alpha,\ \ddot{y}=\alpha\,(\alpha-1)\,A\,x^{\alpha-2}\,\dot{x}^2,$$

thus the proposed equation becomes

$$\alpha(\alpha-1)\,A\,x^{\alpha-2}+a\,A\,x^{\alpha+n}=0.$$

t will not be possible to give to $\alpha$ such a value that two exponents $\alpha-2$ and $\alpha+n$ shall become equal, ept in the particular case of $c=-2$; but if we sup-e $x$ very small, the equation may be satisfied in two rs, namely, by taking $\alpha=0$, and $\alpha=1$, because upon ier supposition the term $\alpha\,(\alpha-1)\,A\,x^{\alpha-2}$, which is greatest, vanishes, and therefore A is left indeter-ate; thus we have two series, one beginning with and the other with A $x$.

Assuming therefore successively

$$y=A+Bx^\delta+Cx^{2\delta}+\&c.$$
$$y=A\,x+B\,x^{1+\delta}+Cx^{1+2\delta}+\&c.$$

substituting these values as well as their corresponding values of $\ddot{y}$ in the proposed equation, we shall find rranging the terms, that $\delta$ ought to be $=2$; after-ls by determining the coefficients A, B, C, &c. in usual manner (ALGEBRA, § 261.) we obtain two :s, one of these is

$$\frac{a\,Ax^{n+2}}{(n+1)\,(n+2)}+\frac{a^2\,A\,x^{2n+4}}{(n+1)\,(n+2)\,(2n+3)\,(2n+4)}$$
$$\frac{a^3\,A\,x^{3n+6}}{n+1)(n+2)(2n+3)(2n+4)(3n+5)(3n+6)}+\&c.$$

and the other

$$A\,x-\frac{a\,A\,x^{n+3}}{(n+2)(n+3)}+\frac{a^2\,A\,x^{2n+5}}{(n+2)(n+3)(2n+4)(2n+5)}$$
$$-\frac{a^3\,A\,x^{3n+7}}{(n+2)(n+3)(2n+4)(2n+5)(3n+6)(3n+7)}+\&c.$$

As a primitive equation in its general form ought to contain two constant quantities which do not appear in the fluxional equation of the second order derived from it (§ 177.), the value of $y$ to be complete ought to contain two arbitrary constant quantities, but as each of these series contains only one such quantity, namely A, it must be considered as expressing only a particular value of $y$. The fluxional equation $\ddot{y}+a\,x^n\,y\,\dot{x}^2=0$ is however of such a nature that from two particular values of $y$ we may deduce its general value; for let us denote these values by z and Z, then, as each of them must satisfy the fluxional equation, we have

$$\ddot{z}+a\,x^n\,z\,\dot{x}^2=0,\ \ddot{Z}+a\,x\ \dot{Z}\dot{x}^2=0;$$

let $c$ and C denote two arbitrary constant quantities, then we have also

$$c\ddot{z}+c\,a\,x^n\,z\,\dot{x}^2=0,\ C\ddot{Z}+Ca\,x^n Z\dot{x}^2=0,$$

and as each of these equations is identical, their sum must also be identical, that is

$$c\ddot{z}+C\ddot{Z}+a\,x^n(cz+CZ)\dot{x}^2=0;$$

but the very same result will be obtained if we substitute $cz+CZ$ instead of $y$ in the proposed fluxional equation, therefore $cz+CZ$ is also a value of $y$, and as it involves two arbitrary constant quantities, $c$ and C, it possesses all the generality of which the value of $y$ is susceptible. Hence it follows that if $c$ be put instead of A in one of the two series which we have found for the value of $y$, and C instead of A in the other series, the sum of the two results will be a general expression for the value of $y$.

200. Having now explained the theory of fluxional equations at as great length as we conceive to be compatible with the nature of this work, we shall conclude this treatise by resolving a few problems which produce fluxional equations.

*Prob.* 1. Having given any *hyperbolic*, or, as it may more properly be called, *Napiereun* logarithm, it is required to find a general expression for its corresponding natural number.

Let the number be denoted by $1+x$, and its logarithm by $y$, then $\dot{y}=\frac{\dot{x}}{1+x}$ (§ 57.), or

$$\dot{y}+x\dot{y}-\dot{x}=0,$$

and the problem requires that from this equation we deduce an expression for $x$.

As when $y=0$, then $x=0$, we may assume

$$x=A\,y+B\,y^2+C\,y^3+\ \&c.$$
$$\text{then}\ \dot{x}=A\,\dot{y}=2\,B\,y\,\dot{y}+3\,C\,y^2\dot{y}+\&c.$$

and our equation becomes

$$\left.\begin{array}{l}\dot{y}+Ay\dot{y}+By^2\dot{y}+Cy^3\dot{y}+\&c.\\ -A\dot{y}-2By\dot{y}-3Cy^2\dot{y}-4Dy^3\dot{y}-\&c.\end{array}\right\}=0.$$

Hence, by comparing the coefficients of the like terms, it appears that $A=1$, $2B=A$, $3C=B$, $4D=C$, &c. so that $A=1$, $B=\frac{1}{2}$, $C=\frac{1}{2.3}$, $D=\frac{1}{2.3.4}$, &c.

therefore $x=y+\frac{y^2}{2}+\frac{y^3}{2.3}+\frac{y^4}{2.3.4}+\&c.$ and

$$1+x=1+y+\frac{y^2}{2}+\frac{y^3}{2.3}+\frac{y^4}{2.3.4}+\&c.$$

Fig. 38.

*Prob.* 2. Let AB, AC, be two straight lines given by position meeting each other at right angles in A, let C be a given point in AC one of the lines, and let a straight line PQ meet them in P and Q, and cut off from them equal segments AP, CQ adjacent to the given points A, C, it is required to find the nature of the curve to which PQ is a tangent.

Let D be the point in which the tangent PQ meets the curve, draw DE perpendicular to AC, and DF to AP, put $CA=a$, $CE=x$, $ED=y$, then AE or DF $=a-x$, and since $EQ=\frac{y\dot{x}}{\dot{y}}$ (§ 73.) and EQ : ED :: DF : FP, therefore $FP=\frac{(a-x)\dot{y}}{\dot{x}}$; hence PA $=$ (PF+FA$=$) $\frac{(a-x)\dot{y}}{\dot{x}}+y$, and CQ$=$(CE$-$EQ$=$) $x-\frac{y\dot{x}}{\dot{y}}$, and as by hypothesis AP$=$CQ, therefore

$$y+\frac{(a-x)\dot{y}}{\dot{x}}=x-\frac{y\dot{x}}{\dot{y}}.$$

This expression belongs to a class of fluxional equations which have the singular property of being more easily resolved by first taking their fluxion, considering the fluxion of one of the variable quantities as constant; thus, in the present case, making $\dot{x}$ constant, we find

$$\dot{y}\,\frac{\dot{x}\dot{y}-(a-x)\ddot{y}}{\dot{x}}=\dot{x}-\frac{\dot{x}\dot{y}^2-y\dot{x}\ddot{y}}{\dot{y}^2}$$

$$\text{or }\frac{(a-x)\ddot{y}}{\dot{x}}=\frac{y\dot{x}\ddot{y}}{\dot{y}^2};$$

hence dividing by $\ddot{y}$, the equation is easily reduced to

$$\frac{\dot{y}}{\sqrt{y}}=\frac{\dot{x}}{\sqrt{(a-x)}},$$

and taking the fluents

$$\sqrt{y}=c-\sqrt{(a-x)}$$

but when $x=0$, then $y=0$, therefore $c=\sqrt{a}$, and

$$\sqrt{y}=\sqrt{a}-\sqrt{(a-x)},\text{ or }x=2\sqrt{ay}-y,$$

which equation belongs to the common parabola.

Fig. 39.

*Prob.* 3. Let APQ be one of any number of curves of the parabolic kind, having the same vertex A, and axis AE, and the nature of which is defined by the equation $px^m=y^n$, where $x$ denotes the abscis and $y$ the ordinate PB, and $p$ an indeterminate qua tity which is the same for the whole of any one of parabolas, but different for different parabolas; it is re quired to find the nature of a curve that shall inter them all in a given angle.

Let the curve whose nature is required meet any of the parabolas in P, let PT, P$t$ tangents to the curves meet the axis in T and $t$; then, from the na of the problem, the lines PT, P$t$ must contain a angle, let $a$ denote its numerical tangent.

Because PT touches the parabola, the tangent of angle PTB will be equal to $\frac{\dot{y}}{\dot{x}}$ (§ 75.) the rat this expression being supposed deduced from the equa tion $px^m=y^n$; but taking the fluxion of this equa and eliminating the indeterminate quantity $p$ by m of the two equations, we find $\frac{\dot{y}}{\dot{x}}=\frac{my}{nx}$, therefore T$=\frac{my}{nx}$.

Again, by considering $x$ and $y$ as the absc ordinate of the curve whose equation is sought, which P$t$ is a tangent, we have the tangent angle $t$ equal to $\frac{\dot{y}}{\dot{x}}$ (§ 75.). Now the angle T ing the difference of the two angles PTB, P follows from the formula for finding the tangent difference of two angles, (ALGEBRA, § 368.) th

$$a=\frac{\frac{\dot{y}}{\dot{x}}-\frac{my}{nx}}{1+\frac{my\dot{y}}{nx\dot{x}}}$$

hence we have

$$a(nx\dot{x}+my\dot{y})+my\dot{x}-nx\dot{y}=0,$$

a fluxional equation expressing the nature of the which being homogeneous may be treated acc the method explained in § 180.

If the curves be supposed to cut each other angles, then, $a$ being infinite, the part of the which is not multiplied by $a$ vanishes in respect other, which is multiplied by it; hence we hav

$$nx\dot{x}+my\dot{y}=0.$$

and taking the fluents

$$nx^2+my^2=c,$$

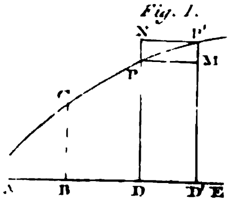
where $c$ is put for a constant quantity. This shews that the curve is an ellipse, the centre of at A the common vertex of all the parabolas.

The problem which we have here resolved particular case of one more general, and which its object *To determine the nature of the curv intersects all other curves of a given kind is angle.* The problem thus generalised is know name of the *Problem of Trajectories*; it was proposed by *Leibnitz* as a challenge to the mathematicians, and resolved by *Newton*, on th received it. See FLUENTS, SUPPLEMENT.

# FLUXIONS.

# PLATE CCXIX.

Fig. 1.



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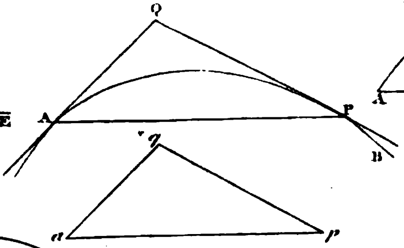

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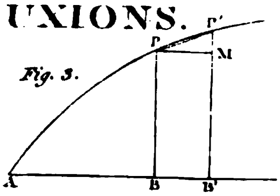

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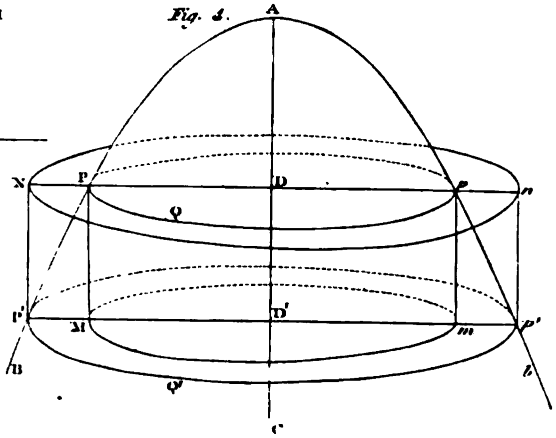

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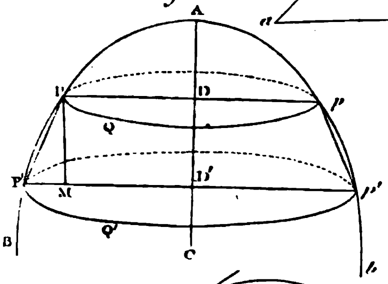

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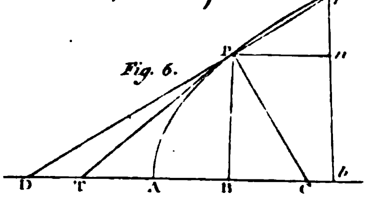

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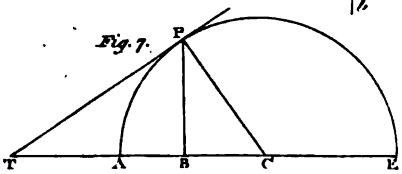

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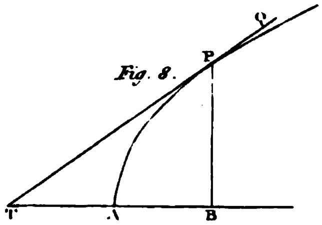

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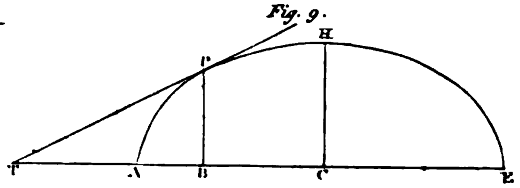

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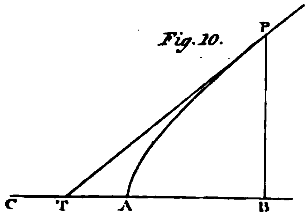

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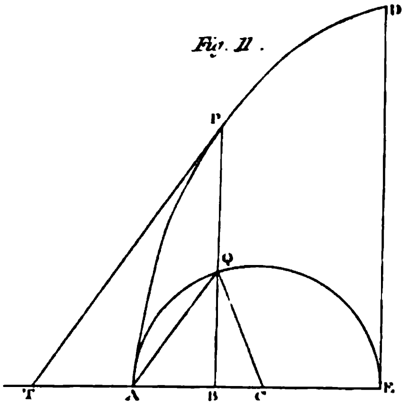

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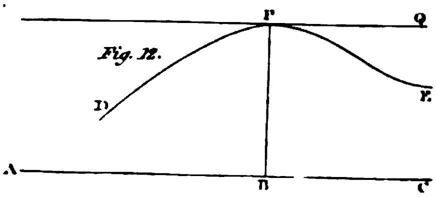

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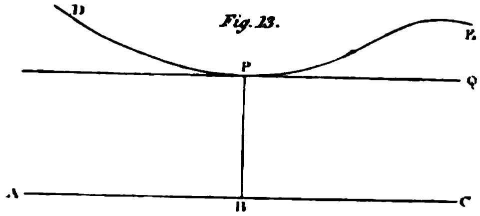

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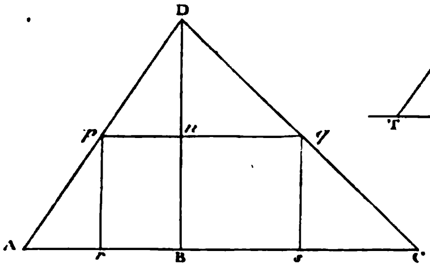

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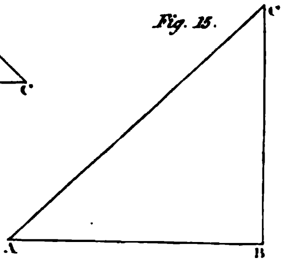

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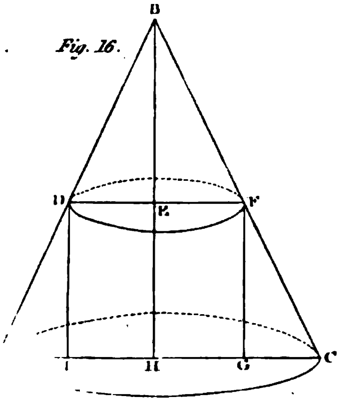

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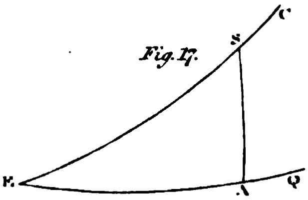

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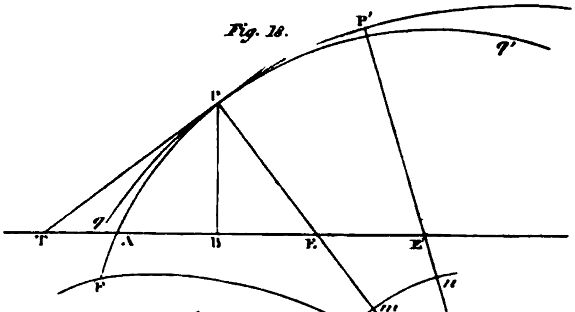

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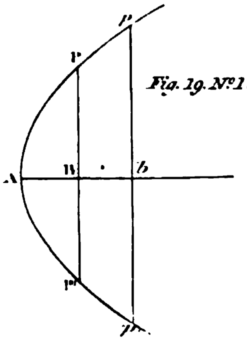

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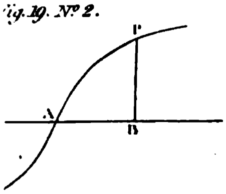

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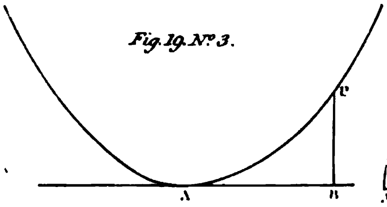

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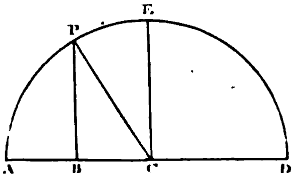

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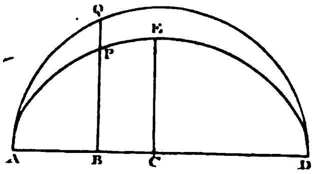

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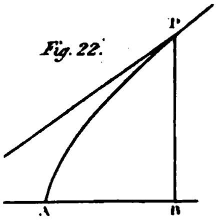

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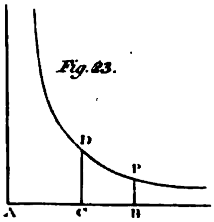

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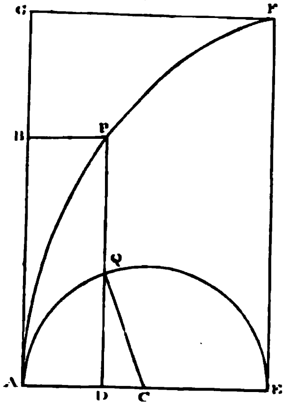

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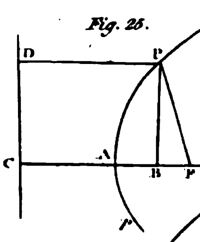

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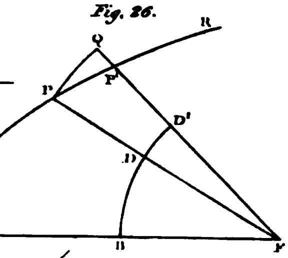

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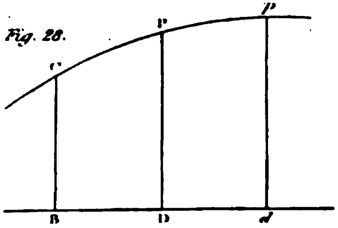

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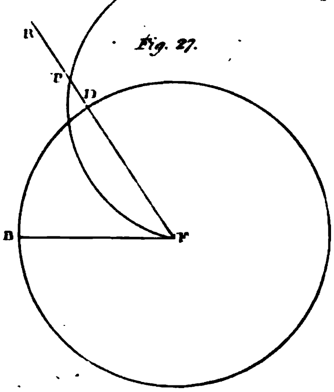

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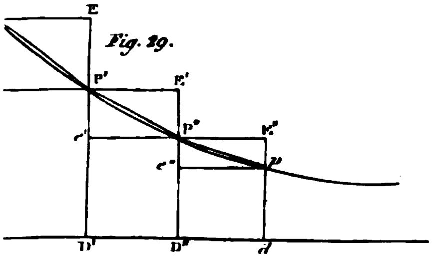

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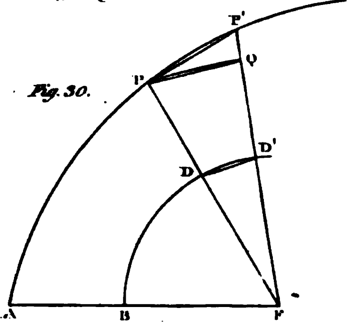

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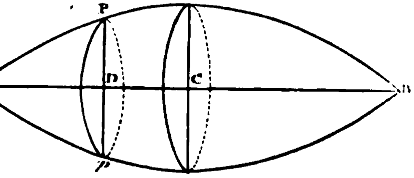

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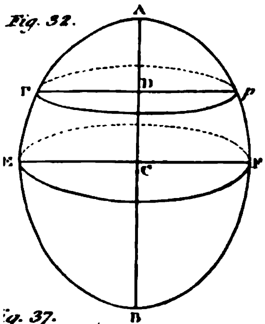

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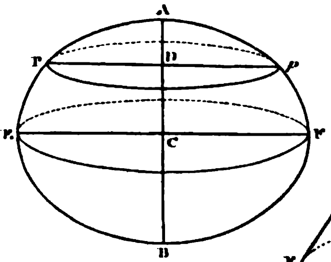

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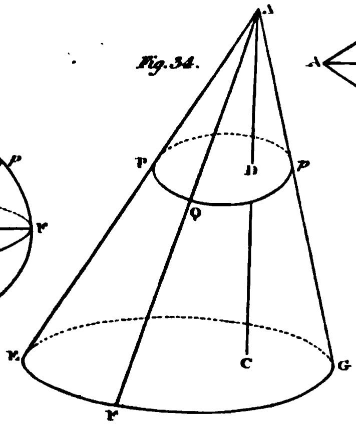

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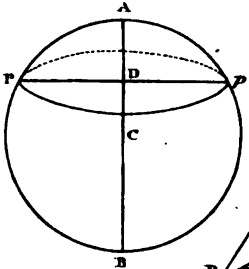

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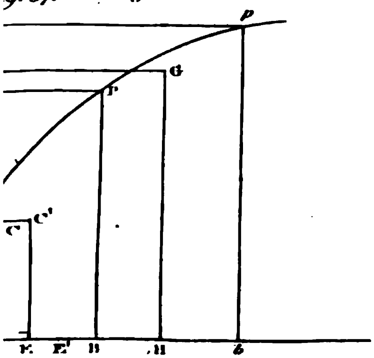

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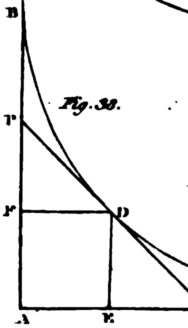

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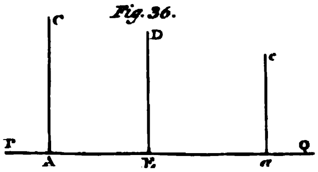

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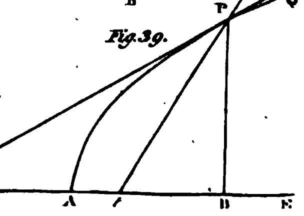

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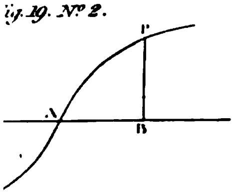

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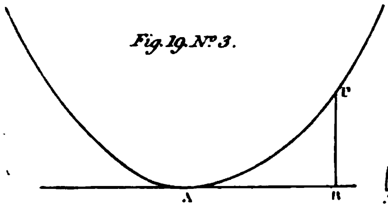

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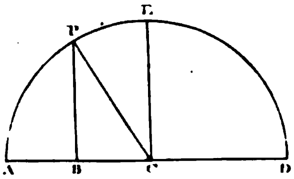

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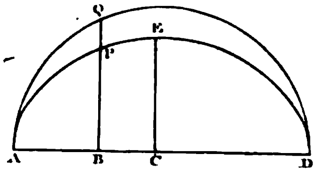

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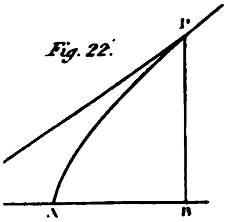

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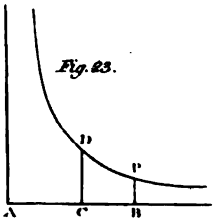

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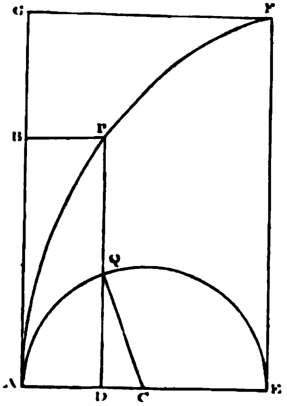

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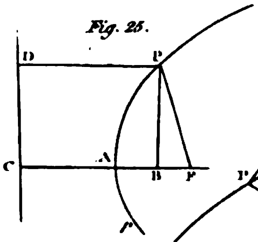

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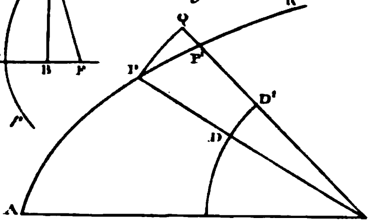

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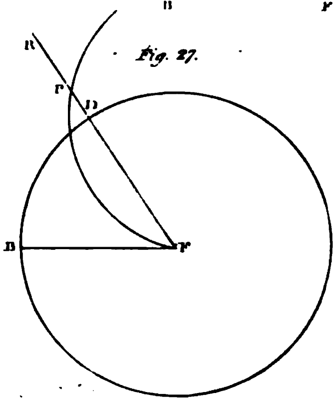


Fig. 28.

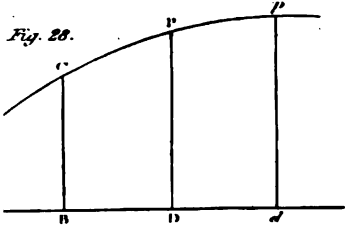


Fig. 29.

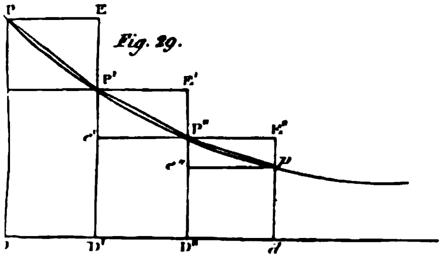


Fig. 30.

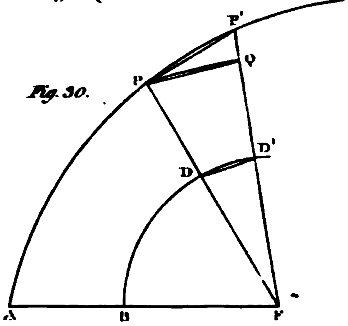


Fig. 31.

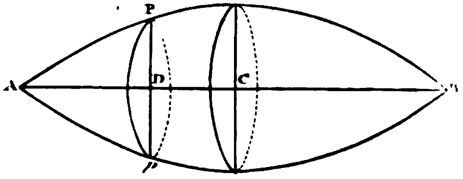


Fig. 32.

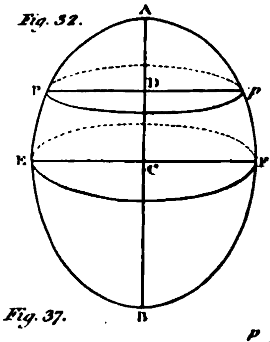


Fig. 33.

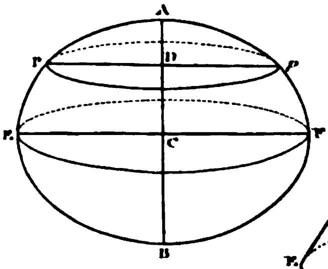


Fig. 34.

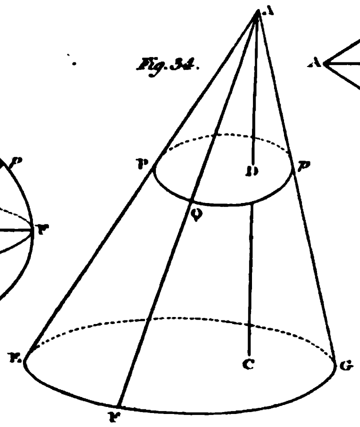


Fig. 35.

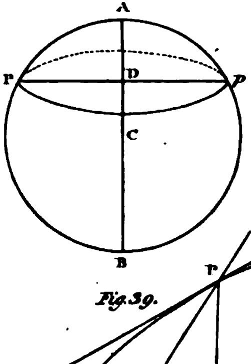


Fig. 36.

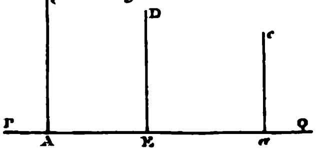


Fig. 37.

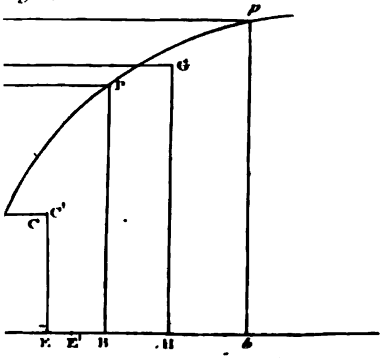


Fig. 38.

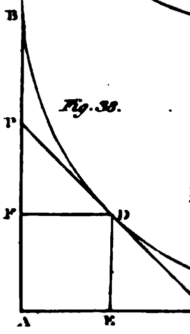
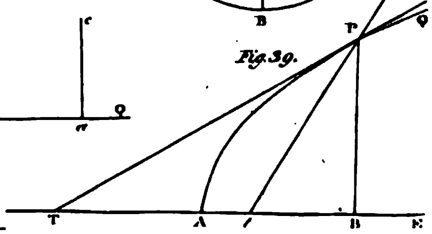


Fig. 39.



W. Archibald sculp.

Fly-tree.
Flyers.

**FLY**, in *Zoology*, a large order of insects, the distinguishing characteristic of which is that their wings re transparent. By this they are distinguished from eetles, butterflies, grashoppers, &c. Flies are subdiided into those which have four, and those which have wo wings. Of those with four wings there are several enera or kinds; as the ant, the bee, the ichneumon, &c. Of those with two wings, there are likewise seeral kinds, as the gad-fly, gnat, house-fly, &c. For heir classification and natural history, see Entomoogy.

*House* Fly. See Musca.

*Pestilential* Fly. See Abyssinia.

Fly, in mechanics, a cross with leaden weights at ts ends; or rather, a heavy wheel at right angles to he axis of a windlass, jack, or the like; by means of which, the force of the power, whatever it is, is not nly preserved, but equally distributed in all parts of he revolution of the machine. See Mechanics.

*Flies for Fishing*. See *Fishing Fly*.

*Vegetable* Fly, a curious natural production chiefly found in the West Indies. "Excepting that it has no wings, it resembles the drone both in size and colour more than any other British insect. In the month of May it buries itself in the earth, and begins to vegetate. By the latter end of July, the tree is arrived at its full growth, and resembles a coral branch; and is about hree inches high, and bears several little pods, which dropping off become worms, and from thence flies, like he British caterpillar."

Such was the account originally given of this extraordinary production. But several boxes of these flies having been sent to Dr Hill for examination, his report was this: "There is in Martinique a fungus of he clavaria kind, different in species from those hitherto known. It produces soboles from its sides; I call it herefore *clavaria sobolifera*. It grows on putrid animal bodies, as our *fungus ex pede equino* from the dead horse's hoof. The cicada is common in Martinique; and in its nympha state, in which the old authors call it *tettigometra*, it buries itself under dead leaves to wait ts change; and when the season is unfavourable, many perish. The seeds of the clavaria find a proper bed on his dead insect, and grow. The tettigometra is among he cicadæ in the British museum; the clavaria is just now known. This is the fact, and all the fact; though he untaught inhabitants suppose a fly to vegetate, and though there is a Spanish drawing of the plant's growing into a trifoliate tree, and it has been figured with the creature flying with this tree upon its back." See Edwards's Gleanings of Natural History.

*Fly-Boat*, or *Flight*, a large flat-bottomed Dutch vessel, whose burden is generally from 600 to 1200 tons. It is distinguished by a very high stern, resembling a Gothic turret, and by very broad buttocks below.

*Fly-Catcher*, in *Zoology*. See Muscicapa.

*Venus's Fly-Trap*, a kind of sensitive plant. See *Dionæa Muscipula*, Botany *Index*.

*Fly-Tree*, in *Natural History*, a name given by the common people of America to a tree, whose leaves, hey say, at a certain time of the year produce *flies*. On examining these leaves about the middle of summer, the time at which the flies use to be produced, here are found on them a sort of bags of a tough matter, of about the size of a filbert, and of a dusky greenish colour. On opening one of these bags with a knife, there is usually found a single full-grown fly, of the gnat kind, and a number of small worms, which in a day or two more have wings, and fly away in the form of their parent. The tree is of the mulberry kind, and its leaves are usually very largely stocked with these insect bags; and the generality of them are found to contain the insects in their worm state; when they become winged, they soon make their way out. The bags begin to appear when the leaves are young, and afterwards grow with them; but they never rumple the leaf or injure its shape. They are of the kind of leaf-galls, and partake in all respects, except size, of a species we have frequent on the large maple, or, as it is called, the *sycamore*.

**FLYERS**, in architecture, such stairs as go straight, and do not wind round, or have the steps made tapering; but the fore and back part of each stair and the ends respectively parallel to one another: So that if one flight do not carry you to your designed height, there is a broad half space; and then you fly again, with steps everywhere of the same breath and length as before.

Flyers, the performers in a celebrated exhibition among the Mexicans, which was made on certain great festivals, and is thus described by Clavigero in his History of that people. "They sought in the woods for an extremely lofty tree, which, after stripping it of its branches and bark, they brought to the city, and fixed in the centre of some large square. They cased the point of the tree in a wooden cylinder, which, on account of some resemblance in its shape, the Spaniards called a *mortar*. From this cylinder hung four strong ropes, which served to support a square frame. In the space between the cylinder and the frame, they fixed four other thick ropes, which they twisted as many times round the tree as there were revolutions to be made by the flyers. These ropes were drawn through four holes, made in the middle of the four planks of which the frame consisted. The four principal flyers, disguised like eagles, herons, and other birds, mounted the tree with great agility, by means of a rope which was laced about it from the ground up to the frame; from the frame they mounted one at a time successively upon the cylinder, and after having danced there a little, they tied themselves round with the ends of the ropes, which were drawn through the holes of the frame, and launching with a spring from it, began their flight with their wings expanded. The action of their bodies put the frame and the cylinder in motion; the frame by its revolutions gradually untwisted the cords by which the flyers swung; so that as the ropes lengthened, they made so much the greater circles in their flight. Whilst these four were flying, a fifth danced upon the cylinder, beating a little drum, or waving a flag, without the smallest apprehension of the danger he was in of being precipitated from such a height. The others who were upon the frame (10 or 12 persons generally mounted), as soon as they saw the flyers in their last revolution, precipitated themselves by the same ropes, in order to reach the ground at the same time amidst the acclamations of the populace. Those who precipitated themselves in this manner by the ropes, that they might make a still greater display of their agility, frequently passed from one rope to another, at that part where, on account of the little distance between them, it was possible for them to do so. The most essential point of this performance consisted in proportioning so justly the height of the tree with the length of the ropes, that the flyers should reach the ground with 13 revolutions, to represent by such number their century of 52 years, composed in the manner we have already mentioned. This celebrated diversion is still in use in that kingdom; but no particular attention is paid to the number of the revolutions of the flyers; as the frame is commonly hexagonal or octagonal, and the flyers six or eight in number. In some places they put a rail round the frame, to prevent accidents, which were frequent after the conquest; as the Indians became much given to drinking, and used to mount the tree when intoxicated with wine or brandy, and were unable to keep their station on so great a height, which was usually 60 feet.

FLYING, the progressive motion of a bird, or other winged animal, in the air.

The parts of birds chiefly concerned in flying are the wings and tail; by the first, the bird sustains and wafts himself along; and by the second, he is assisted, in ascending and descending, to keep his body poised and upright, and to obviate the vacillations thereof.

It is by the size and strength of the pectoral muscles, that birds are so well disposed for quick, strong, and continued flying. These muscles, which in men are scarcely a 70th part of the muscles of the body, in birds exceed and outweigh all the other muscles taken together; upon which Mr Willoughby makes this reflection, that if it be possible for a man to fly, his wings must be so contrived and adapted, that he may make use of his legs, and not his arms, in managing them.

The tail, Messrs Willoughby, Ray, and many others, imagine to be principally employed in steering and turning the body in the air, as a rudder; but Borelli has put it beyond all doubt, that this is the least use of it, which is chiefly to assist the bird in its ascent and descent in the air, and to obviate the vacillations of the body and wings; for as to turning to this or that side, it is performed by the wings and inclination of the body, and but very little by the help of the tail. The flying of a bird, in effect, is quite a different thing from the rowing of a vessel. Birds do not vibrate their wings towards the tail, as oars are struck towards the stern, but waft them downwards; nor does the tail of the bird cut the air at right angles as the rudder does the water; but is disposed horizontally, and preserves the same situation what way soever the bird turns. In effect, as a vessel is turned about on a centre of gravity to the right, by a brisk application of the oars to the left; so a bird, in beating the air with its right wing alone towards the tail, will turn its fore part to the left. Thus pigeons changing their course to the left, would labour it with their right wing, keeping the other almost at rest. Birds of a long neck alter their course by the inclination of their head and neck; which altering the course of gravity, the bird will proceed in a new direction.

*The manner of* FLYING is thus. The bird first bends his legs, and springs with a violent leap from the ground; then opens and expands the joints of his wings, so as to make a right line perpendicular to the sides of his body: thus the wings, with all the feathers therein, constitute one continued lamina. Being now raised a little above the horizon, and vibrating the wings with great force and velocity perpendicularly against the subject air, that fluid resists those succussions, both from its natural inactivity and elasticity, by means of which the whole body of the bird is protruded. The resistance the air makes to the withdrawing of the wings, and consequently the progress of the bird, will be so much the greater, as the waft or stroke of the fan of the wing is longer: but as the force of the wing is continually diminished by this resistance, when the two forces continue to be *in equilibrio*, the bird will remain suspended in the same place; for the bird only ascends so long as the arch of air the wing describes makes a resistance equal to the excess of the specific gravity of the bird above the air. If the air, therefore, be so rare as to give way with the same velocity as it is struck withal, there will be no resistance, and consequently the bird can never mount. Birds never fly upwards in a perpendicular line, but always in a parabola. In a direct ascent, the natural and artificial tendency would oppose and destroy each other, so that the progress would be very slow. In a direct ascent they would aid one another, so that the fall would be too precipitate.

*Artificial* FLYING, that attempted by men, by the assistance of mechanics.

The art of flying has been attempted by several persons in all ages. The Leucadians, out of superstition, are reported to have had a custom of precipitating a man from a high cliff into the sea, first fixing feathers, variously expanded, round his body, in order to break the fall.

Friar Bacon, who lived near 500 years ago, not only affirms the art of flying possible, but assures us that he himself knew how to make an engine wherein a man sitting might be able to convey himself through the air like a bird; and further adds, that there was then one who had tried it with success. The secret consisted in a couple of large thin hollow copper globes, exhausted of air; which being much lighter than air, would sustain a chair whereon a person might sit. Father Francisco Lana, in his *Prodromo*, proposes the same thing as his own thoughts. He computes, that a round vessel of plate brass, 14 feet in diameter, weighing three ounces the square foot, will only weigh 1848 ounces; whereas a quantity of air of the same bulk will weigh $2155\frac{2}{3}$ ounces; so that the globe will not only be sustained in the air, but will carry with it a weight of $373\frac{2}{3}$d ounces; and by increasing the bulk of the globe, without increasing the thickness of the metal, he adds, a vessel might be made to carry a much greater weight.—But the fallacy is obvious: a globe of the dimensions he describes, Dr Hook shews, would not sustain the pressure of the air, but be crushed inwards. Besides, in whatever ratio the bulk of the globe were increased, in the same must the thickness of the metal, and consequently the weight be increased: so that there would be no advantage in such augmentation. See AEROSTATION.

The same author describes an engine for flying, invented by the Sieur Besnier, a smith of Sable, in the county of Maine. *Vid. Philosoph. Collect.*

The

The philosophers of King Charles the second's reign were mightily busied about this art. The famous Bishop Wilkins was so confident of success in it, that he says, he does not question but in future ages it will be as usual to hear a man call for his wings, when he is going a journey, as it is now to call for his boots.

*Flying Bridge*. See Bridge.

*Flying Fish*, a name given to several species of fish, which, by means of long fins, can keep themselves out of the water for some time. See Exocoetus, Ichthyology *Index*.

*Flying Pinion*, is part of a clock, having a fly or fan whereby to gather air, and so bridle the rapidity of the clock's motion, when the weight descends in the striking part.

FO, or Foe; an idol of the Chinese. He was originally worshipped in the Indies, and transported from thence into China, together with the fables with which the Indian books were filled. He is said to have performed most wonderful things, which the Chinese have described in several volumes, and represented by cuts.

*Sect of Fo*. See China, N° 104.

*Fo-Kien*. See Fokien.

FOAL, or *Colt and Filly*; the young of the horse kind. The word *colt*, among dealers, is understood of the male, as *filly* is of the female. See Colt.

FOCUS, in *Geometry* and *Conic Sections*, is applied to certain points in the parabola, ellipsis, and hyperbola, where the rays reflected from all parts of these curves concur and meet. See *Conic Sections*.

Focus, in *Optics*, a point in which any number of rays, after being reflected or refracted, meet.

FODDER, any kind of meat for horses or other cattle. In some places, hay and straw, mingled together, is peculiarly denominated *fodder*.

Fodder, in the civil law, is used for a prerogative that the prince has, to be provided with corn and other meats for his horses, by the subjects, in his warlike expeditions.

Fodder, among miners, a measure containing 22 hundred and a half weight; in London the fodder is only 20 hundred weight.

FODDERING a ship. See Fothering.

FOENUGREEK. See Trigonella, Botany *Index*.

FOENUS nauticum. Where money was lent to a merchant to be employed in a beneficial trade, with condition to be repaid with extraordinary interest, in case such voyage was safely performed, the agreement was sometimes called *fœnus nauticum*, sometimes *usura maritima*. But as this gave an opening for usurious and gaming contracts, 19 Geo. II. c. 37. enacts, that all money lent on bottomry, or at *respondentia*, on vessels bound to or from the East Indies, shall be expressly lent upon the ship or merchandise; the lender to have the benefit of salvage, &c. *Blackst. Com.* ii. 459. *Mol. de Jour. Mar.* 361.

FOETOR, in *Medicine*, fetid effluvia arising from the body or any part thereof.

FOETUS, the young of all viviparous animals whilst in the womb, and of oviparous animals before being hatched: the name is transferred by botanists to the *embryos of vegetables*.

Strictly, the name is applied to the young after it is perfectly formed; previous to which it is usually called Embryo. See Anatomy *Index*.

Foetus, Fog.

In the human fœtus are several peculiarities not to be found in the adult; some of them are as follow. 1. The arteries of the navel string, which are continuations of the hypogastrics, are, after the birth, shrivelled up, and form the ligamenta umbilic. infer. 2. The veins of the navel string are formed by the union of all the venous branches in the placenta, and passing into the abdomen become the falciform ligament of the liver. 3. The lungs, before being inflated with air, are compact and heavy, but after one inspiration they become light, and as it were spongy; and it may be noted here, that the notion of the lungs sinking in water before the child breathes, and of their swimming after the reception of air, are no certain proofs that the child had or had not breathed, much less that it was murdered: for the uninflated lungs become specifically lighter than water as soon as any degree of putrefaction takes place in them; and this soon happens after the death of the child; besides, where the utmost care hath been taken to preserve the child, it hath breathed once or twice and then died. 4. The thymus gland is very large in the fœtus, but dwindles away in proportion as years advance. 5. The foramen ovale in the heart of a fœtus, is generally closed in an adult.

FOG, or Mist, a meteor, consisting of gross vapours, floating near the surface of the earth.

Mists, according to Lord Bacon, are imperfect condensations of the air, consisting of a large proportion of the air, and a small one of the aqueous vapour; and these happen in the winter, about the change of the weather from frost to thaw, or from thaw to frost; but in the summer, and in the spring, from the expansion of the dew.

If the vapours which are raised plentifully from the earth and waters, either by the solar or subterraneous heat, do at their first entrance into the atmosphere meet with cold enough to condense them to a considerable degree, their specific gravity is by that means increased, and so they will be stopped from ascending; and either return back in form of dew or of drizzling rain, or remain suspended some time in the form of a fog. Vapours may be seen on the high grounds as well as the low, but more especially about marshy places. They are easily dissipated by the wind, as also by the heat of the sun. They continue longest in the lowest grounds, because these places contain most moisture, and are least exposed to the action of the wind.

Hence we may easily conceive, that fogs are only low clouds, or clouds in the lowest region of the air; as clouds are no other than fogs raised on high. See Cloud.

When fogs stink, then the vapours are mixed with sulphureous exhalations, which smell so. Objects viewed through fogs appear larger and more remote than through the common air. Mr Boyle observes, that upon the coast of Coromandel, and most maritime parts of the East Indies, there are, notwithstanding the heat of the climate, annual fogs so thick, as to occasion people of other nations who reside there, and even the more tender sort of the natives, to keep their houses close shut up.

Fogs are commonly strongly electrified, as appears

from

from Mr Cavallo's observations upon them. See ELECTRICITY.

**FOGAGE**, in the forest law, is rank grass not eaten up in summer.

**FOGO**, or FUEGO. See FUEGO.

**FOHI**. See FE; and CHINA, N° 7.

**FOIBLE**, a French term, frequently used also in our language. It literally signifies *weak;* and in that sense is applied to the body of animals and the parts thereof, as *foible* reins, *foible* sight, &c. being derived from the Italian *fievole*, of the Latin *flebilis*, to be "lamented, pitied."

But it is chiefly used with us substantively, to denote a defect or flaw in a person or thing. Thus we say, Every person has his foible; and the great secret consists in hiding it artfully: Princes are gained by flattery, that is their foible. The foible of young people is pleasure; the foible of old men is avarice; the foible of the great and learned is vanity; the foible of women and girls, coquetry, or an affectation of having gallants: You should know the forte and the foible of a man before you employ him: We should not let people perceive that we know their foible.

**FOIL**, in fencing denotes a blunt sword, or one that has a button at the end covered with leather, used in learning the art of fencing.

**FOIL**, among glass-grinders, a sheet of tin, with quicksilver, or the like, laid on the backside of a looking glass, to make it reflect. See FOLIATING.

**FOIL**, among jewellers, a thin leaf of metal placed under a precious stone, in order to make it look transparent, and give it an agreeable different colour, either deep or pale: thus, if you want a stone to be of a pale colour, put a foil of that colour under it; or if you would have it deep, lay a dark one under it.

These foils are made either of copper, gold, or gold and silver together. The copper foils are commonly known by the name of *Nuremberg* or *German foils;* and are prepared as follows: Procure the thinnest copper plates you can get; beat these plates gently upon a well-polished anvil, with a polished hammer, as thin as possible; and placing them between two iron plates as thin as writing paper, heat them in the fire; then boil the foil in a pipkin, with equal quantities of tartar and salt, constantly stirring them till by boiling they become white; after which, taking them out and drying them, give them another hammering, till they are made fit for your purpose: however, care must be taken not to give the foils too much heat, for fear of melting; nor must they be too long boiled, for fear of attracting too much salt.

The manner of polishing these foils is as follows: Take a plate of the best copper, one foot long and about five or six inches wide, polished to the greatest perfection; bend this to a long convex, fasten it upon a half roll, and fix it to a bench or table; then take some chalk washed as clean as possible, and filtered through a fine linen cloth, till it be as fine as you can make it; and having laid some thereof on the roll, and wetted the copper all over, lay your foils on it, and with a polishing stone and the chalk polish your foils till they are as bright as a looking-glass; after which they must be dried, and laid up secure from dust.

**FOKIEN**, a province of China in Asia, commodiously situated for navigation and commerce, part of it bordering on the sea, in which they catch large quantities of fish, which they send salted to other parts of the empire. Its shores are very uneven, by reason of the number and variety of its bays; and there are many forts built thereon to guard the coast. The air is hot, but pure and wholesome.

The mountains are almost everywhere disposed into a kind of amphitheatres, by the labour of the inhabitants, with terraces placed one above another. The fields are watered with rivers and springs, which issue out of the mountains, and which the husbandmen conduct in such a manner as to overflow the fields of rice when they please, because it thrives best in watery ground. They make use of pipes of bamboo for this purpose.

They have all commodities in common with the rest of China; but more particularly musk, precious stones, quicksilver, silk, hempen cloth, callico, iron, and all sorts of utensils wrought to the greatest perfection. From other countries they have cloves, cinnamon, pepper, sandal wood, amber, coral, and many other things. The capital city is Fou-tcheou Fou; or, as others would have it written, Fucherofu. But as for Fokien, which most geographers make the capital, Grosier informs us there is no such place.

**FOLARD**, CHARLES, an eminent Frenchman, famous for his skill and knowledge in the military art, was born at Avignon in 1669, of a noble family, but not a rich one. He discovered an early turn for the sciences, and a strong passion for arms; which last was so inflamed by reading Cæsar's Commentaries, that he enlisted at 16 years of age. His father got him off, and shut him in a monastery: but he made his escape in about two years after, and entered himself a second time in quality of cadet. His inclination for military affairs, and the great pains he took to accomplish himself in that way, recommended him to notice; and he was admitted into the friendship of the first-rate officers. M. de Vendome, who commanded in Italy in 1702, made him his aid-de-camp, having conceived the highest regard for him: and soon after sent him with part of his forces into Lombardy. He was entirely trusted by the commander of that army; and no measures were concerted, or steps taken, without consulting him. By pursuing his plans, many places were taken, and advantages gained; and such, in short, were his services, that he had a pension of 500 livres settled upon him, and was honoured with the cross of St Louis. He distinguished himself greatly, August 15. 1705, at the battle of Cassano; where he received a wound upon his left hand, which deprived him of the use of it ever after. It was at this battle that he conceived the first idea of the system of columns, which he afterwards prefixed to his Commentaries upon Polybius. The duke of Orleans sending De Vendome again into Italy in 1706, Folard had orders to throw himself into Modena to defend it against Eugene: where, though he acquitted himself with his usual skill, he was very near being assassinated. The description which he has given of the conduct and character of the governor of this town, may be found in his Treatise of the Defence of Places, and deserves to be read. He received a dangerous wound on the thigh at the battle of Malplaquet, and was some time after made prisoner by Prince Eugene. Being exchanged in 1711, he was made governor of Bourbourg. In 1714, he went to Malta, to assist in defending that island against the Turks. Upon his return to France, he embarked for Sweden, having a passionate desire to see Charles XII. He acquired the esteem and confidence of that famous general, who sent him to France to negotiate the re-establishment of James II. upon the throne of England; but that project being dropped, he returned to Sweden, followed Charles XII. in his expedition to Norway, and served under him at the siege of Frederickshall, where that prince was killed, Dec. 11. 1718. Folard then returned to France; and made his last campaign in 1719, under the duke of Berwick, in quality of colonel. From that time he applied himself intensely to the study of the military art as far as it could be studied at home; and built his theories upon the foundation of his experience and observations on facts. He contracted an intimacy with Count Saxe, who, as he then declared, would one day prove a very great general. He was chosen a fellow of the Royal Society of London in 1749; and, in 1751, made a journey to Avignon, where he died in 1752, aged 83 years. He was the author of several works, the principal of which are; 1. Commentaries upon Polybius, in six volumes, 4to. 2. A Book of New Discoveries in War. 3. A Treatise concerning the Defence of Places, &c. in French. Those who would know more of this eminent soldier, may consult a French piece, entitled, *Memoires pour servir à l'Histoire de M. le Chevalier de Folard. Ratisbone*, 1753, 12mo.

FOLC-LANDS, (Sax.) copyhold lands so called in the time of the Saxons, as charter-lands were called *boc-lands*, Kitch. 174. *Folkland* was *terra vulgi* or *popularis;* the land of the vulgar people, who had no certain estate therein, but held the same, under the rents and services accustomed or agreed, at the will only of their lord the thane; and it was therefore not put in writing, but accounted *prædium rusticum et ignobile*. Spelm. of Feuds, c. 5.

FOLCMOTE, or FOLKMOTE, (Sax. *Folcgemote*, i. e. *conventus populi*), is compounded of *folk*, *populus*, and *mote*, or *gemote*, *convenire;* and signified originally, as Somner in his Saxon Dictionary informs us, a general assembly of the people, to consider of and order matters of the commonwealth. And Sir Henry Spelman says, the *folcmote* was a sort of annual parliament or convention of the bishops, thanes, aldermen, and freemen, upon every May-day yearly; where the laymen were sworn to defend one another and the king, and to preserve the laws of the kingdom; and then consulted of the common safety. But Dr Brady infers from the laws of the Saxon kings of England, that it was an inferior court, held before the king's *reeve* or steward, every month, to do *folk* right, or compose smaller differences, from whence there lay appeal to the superior courts; *Gloss.* p. 48. Squire seems to think the *folcmote* not distinct from the *shiremote*, or common general meeting of the county. See his *Angl. Sax. Gov.* 155. *n.*

Manwood mentions *folcmote* as a court holden in London, wherein all the *folk* and people of the city did complain of the mayor and aldermen, for misgovernment within the said city; and this word is still in use among the Londoners, and denotes *celebrem ex tota civitate conventum*. *Stow's Survey*. According to Kennet, the *folcmote* was a common council of all the inhabitants of a city, town, or borough, convened often by sound of bell, to the *Mote Hall* or *House;* or it was applied to a larger congress of all the freemen within a county, called the *shiremote*, where formerly all knights and military tenants did fealty to the king, and elected the annual sheriff on the 1st of October; till this popular election, to avoid tumults and riots, devolved to the king's nomination, anno 1315, 3 Edw. 1. After which the city *folkmote* was swallowed up in a select committee or common council, and the county *folkmote* in the sheriff's tourn and assizes.

The word *folkmote* was also used for any kind of popular or public meetings; as of all the tenants at the *court leet*, or *court baron*, in which signification it was of a less extent. *Paroch. Antiq.* 120.

FOLENGIO, THEOPHILUS, an Italian poet, was a native of Mantua. He was known also by the title of *Merlin Coccaye*, a name which he gave to a poem, and which has been adopted ever since for all trifling performances of the same species, consisting of buffoonery, puns, anagrams, wit without wisdom, and humour without good sense. His poem was called The Macaroni, from an Italian cake of the same name, which is sweet to the taste, but has not the least alimentary virtue, on the contrary palls the appetite and cloys the stomach. These idle poems, however, became the reigning taste in Italy and in France; they give birth to macaroni academies, and reaching England, to macaroni clubs; till, in the end, every thing insipid, contemptible, and ridiculous, in the character, dress, or behaviour, of both men and women, is now summed up in the despicable appellation of *a macaroni*. Folengio died in 1544.

FOLIA, among botanists, particularly signify the leaves of plants; those of flowers being expressed by the word *petals*. See BOTANY.

FOLIAGE, a cluster or assemblage of flowers, leaves, branches, &c.

FOLIAGE, is particularly used for the representations of such flowers, leaves, branches, rinds, &c. whether natural or artificial, as are used for enrichments on capitals, friezes, pediments, &c.

FOLIATING *of* LOOKING-GLASSES, the spreading the plates over, after they are polished, with quicksilver, &c. in order to reflect the image. It is performed thus: A thin blotting paper is spread on the table and sprinkled with fine chalk; and then a fine lamina or leaf of tin, called *foil*, is laid over the paper; upon this is poured mercury, which is to be distributed equally over the leaf with a hare's foot or cotton; over this is laid a clean paper, and over that the glass plate, which is pressed down with the right hand, and the paper gently drawn out with the left; this being done, the plate is covered with a thicker paper, and loaded with a greater weight, that the superfluous mercury may be driven out and the tin adhere more closely to the glass. When it is dried, the weight is removed, and the looking-glass is complete.

Some add an ounce of marcasite, melted by the fire; and, lest the mercury should evaporate in smoke, they pour it into cold water; and when cooled, squeeze through a cloth, or through leather.

Some add a quarter of an ounce of tin and lead to the marcasite, that the glass may dry the sooner.

FOLIATING *of Globe looking-glasses*, is done as follows:

lows: Take five ounces of quicksilver, and one ounce of bismuth; of lead and tin, half an ounce each: first put the lead and tin into fusion, then put in the bismuth; and when you perceive that in fusion too, let it stand till it is almost cold, and pour the quicksilver into it: after this, take the glass globe, which must be very clean, and the inside free from dust: make a paper funnel, which put into the hole of the globe, as near the glass as you can, so that the amalgam, when you pour it in, may not splash and cause the glass to be full of spots; pour it in gently, and move it about, so that the amalgam may touch everywhere: if you find the amalgam begin to be curdly and fixed, then hold it over a gentle fire, and it will easily flow again; and if you find the amalgam too thin, add a little more lead, tin, and bismuth to it. The finer and clearer your globe is, the better will the looking-glass be.

Dr Shaw observes, that this operation has considerable advantages, as being performed in the cold; and that it is not attended with the danger of poisonous fumes from arsenic, or other unwholesome matters usually employed for this purpose: besides, how far it is applicable to the more commodious foliating of the common looking-glasses and other speculums, he thinks, may deserve to be considered.

FOLIO, in merchants books, denotes a page, or rather both the right and left hand pages, these being expressed by the same figure, and corresponding to each other. See Book-keeping.

Folio, among printers and booksellers, the largest form of books, when each sheet is so printed that it may be bound up in two leaves only.

FOLIS. See Follis.

FOLIUM, or Leaf, in *Botany*. See Leaf.

FOLKES, Martin, a philosopher and antiquarian of considerable eminence, was born in Westminster in the year 1690. A Mr Cappel, once professor of Hebrew at Saumur, was his private tutor. When 17 years of age, he was sent to Clare-hall, Cambridge, where he successfully applied himself to the study of philosophy and the mathematics; and when only twenty-three years of age he was chosen a fellow of the Royal Society. His ingenious communications acquired him so much applause, that he was frequently chosen into its council. He was in habits of friendship with the illustrious Newton, at that time president, and by his influence was elected one of the vice-presidents in the year 1723. Mr Folkes became a candidate for the chair on the death of Sir Isaac Newton; but the superior interest of Sir Hans Sloane rendered his application ineffectual. In 1733 and the two subsequent years, his residence was for the most part in Italy, with the view of improving himself in the knowledge of classical antiquities. To ascertain the weight and value of ancient coins, he carefully consulted the cabinets of the curious; and on his return home he presented to the Antiquarian Society, of which he was a member, a dissertation on this subject. He read before the same learned body, a dissertation on the measurement of Trajan's and Antonine's pillar, together with other remains of antiquity. The fruits of his observations he presented to the Royal Society; and, in particular, "Remarks on the standard measure preserved in the Capitol of Rome," and the model of an ancient globe in the Farnesian palace. He visited Paris in 1739, where he was received with great respect, and honoured with the company of the most eminent literary characters in that metropolis. This respect indeed he was entitled to by his unwearied application to many branches of knowledge which were both curious and useful. His valuable work, entitled "A table of English silver coins, from the Norman Conquest to the present time, with their weights, intrinsic values, and some remarks upon the several pieces," was printed in the year 1745. Among the many honours conferred upon Mr Folkes, he was created doctor of laws by both universities, and chosen president of the Antiquarian Society. He continued to furnish the Philosophical Transactions with many learned papers, till his career was stopped by a paralytic stroke, which terminated his useful life in the year 1654. He was a man of very extensive knowledge and great accuracy; but the chief benefit to science which resulted from his labours, was his treatise on the intricate subject of coins, weights, and measures. His cabinet and library were large and valuable, and exposed to public sale after his death. His private character was distinguished for politeness, generosity, and friendship.

FOLKESTONE, a town of Kent, between Dover and Hythe, 72 miles from London, appears to have been a very ancient place, from the Roman coins and British bricks often found in it. Stillingfleet and Tanner take it for the *Lapis Titali* of Nennius. It was burnt by Earl Godwin, and by the French in the reign of Edward III. It had five churches, now reduced to one. It is a member of the town and port of Dover; and has a weekly market and an annual fair. It is chiefly noted for the multitude of fishing boats that belong to its harbour, which are employed in the season in catching mackerel for London; to which they are carried by the mackerel boats of London and Barking. About Michaelmas, the Folkestone barks, with others for Sussex, go away to the Suffolk and Norfolk coasts to catch herrings for the merchants of Yarmouth and Leostoff.—Folkestone gives the title of *Viscount* to William Henry Bouverie, whose grandfather, Jacob, was so created in 1747. It has been observed of some hills in this neighbourhood, that they have visibly sunk and grown lower within memory.

FOLKLAND, and Folkmote. See Folcland.

FOLLICULUS, (from *follis*, "a bag,") a species of seed-vessel first mentioned by Linnæus in his *Delineatio Plantæ*, generally consisting of one valve, which opens from bottom to top on one side, and has no suture for fastening or attaching the seeds within it.

FOLLICULI are likewise defined by the same author to be small glandular vessels distended with air, which appear on the surface of some plants; as at the foot of water-milfoil, and on the leaves of aldrovanda. In the former the leaves in question are roundish, and furnished with an appearance like two horns; in the latter, pot-shaped, and semicircular.

FOLLIS, or Folis, anciently signified a little bag or purse; whence it came to be used for a sum of money, and very different sums were called by that name: thus the scholiast on the Basilics mentions a follis of copper which was worth but the 24th part of the miliarensis; the glossæ nomicæ, quoted by Gronovius and others, one of 125 miliarenses, and another of 250 denarii, which was the ancient sestertium; and three different sums of eight, four, and two pounds of gold, were each called *follis*. According to the account of the scholiast, the ounce of silver, which contained five miliarenses of 60 in the pound, was worth 120 folles of copper. The glossographer, describing a follis of 250 denarii, says it was equal to 312 pounds 6 ounces of copper; and as the denarius of that age was the 8th part of an ounce, an ounce of silver must have been worth 120 ounces of copper; and therefore the scholiast's follis was an ounce of copper, and equal to the glossographer's nummus. But as Constantine's copper money weighed a quarter of a Roman ounce, the scholiast's follis and the glossographer's nummus contained four of them, as the ancient nummus contained four asses.

FOLLY, according to Mr Locke, consists in the drawing of false conclusions from just principles; by which it is distinguished from madness, which draws just conclusions from false principles.

But this seems too confined a definition; *folly*, in its most general acceptation, denoting a weakness of intellect or apprehension, or some partial absurdity in sentiment or conduct.

FOMAHAUT, in *Astronomy*, a star of the first magnitude in the constellation AQUARIUS.

FOMENTATION, in *Medicine*, is a fluid externally applied, usually as warm as the patient can bear it, and in the following manner. Two flannel cloths are dipped into the heated liquor, one of which is wrung as dry as the necessary speed will admit, then immediately applied to the part affected: it lies on until the heat begins to go off, and the other is in readiness to apply at the instant in which the first is removed: thus these flannels are alternately applied, so as to keep the affected part constantly supplied with them warm. This is continued 15 minutes or half an hour, and repeated as occasion may require.

Every intention of relaxing and soothing by fomentations may be answered as well by warm water alone as when the whole tribe of emollients are boiled in it; but when discutients or antiseptics are required, such ingredients must be called in as are adapted to that end.

The degree of heat should never exceed that of producing a pleasant sensation; great heat produces effects very opposite to that intended by the use of fomentation.

FONG-YANG, a city of China, in the province of *KIANG-Nang*. It is situated on a mountain, which hangs over the Yellow river, and encloses with its walls several fertile little hills. Its jurisdiction is very extensive: for it comprehends 18 cities; five of which are of the second, and 13 of the third class. As this was the birth-place of the emperor Hong-vou, chief of the preceding dynasty, this prince formed a design of rendering it a famous and magnificent city, in order to make it the seat of empire. After having expelled the Western Tartars, who had taken possession of China, he transferred his court hither, and named the city *Fong-yang;* that is to say, "The Place of the Eagle's Splendour." His intention, as we have said, was to beautify and enlarge it; but the inequality of the ground, the scarcity of fresh water, and above all the vicinity of his father's tomb, made him change his design. By the unanimous advice of his principal officers, this prince established his court at NAN-KING, a more beautiful and commodious place. When he had formed this resolution, a stop was put to the intended works: the imperial palace which was to have been enclosed by a triple wall, the walls of the city to which a circumference of nine leagues were assigned, and the canals that were begun, all were abandoned; and nothing was finished, but three monuments that still remain. The extent and magnificence of these sufficiently show what the beauty of this city would have been, had the emperor pursued his original design. The first is the tomb of the father of Hong-vou, to decorate which no expence was spared; it is called *Hoan-lin*, or the *Royal Tomb*. The second is a tower built in the middle of the city, which is of an oblong form, and 100 feet high. The third is a magnificent temple erected to the god Fo. At first it was only a pagod, to which Hong-vou retired after having lost his parents, and where he was admitted as an inferior domestic; but having soon become weary of this kind of life, he enlisted with the chief of a band of banditti, who had revolted from the Tartars. As he was bold and enterprising, the general made choice of him for his son-in-law: soon after he was declared his successor by the unanimous voice of the troops. The new chief seeing himself at the head of a large party, had the presumption to carry his views to the throne. The Tartars, informed of the progress of his arms, sent a numerous army into the field; but he surprised and attacked them with so much impetuosity, that they were obliged to fly; and, though they several times returned to the charge, they were still defeated, and at length driven entirely out of China. As soon as he mounted the throne, he caused the superb temple which we have mentioned to be raised out of gratitude to the Bonzes, who had received him in his distress, and assigned them a revenue sufficient for the maintenance of 300 persons, under a chief of their own sect, whom he constituted a mandarin, with power of governing them, independent of the officers of the city. This pagod was supported as long as the preceding dynasty lasted; but that of the Eastern Tartars, which succeeded, suffered it to fall to ruin.

*FONG-Choui*, the name of a ridiculous superstition among the Chinese. See CHINA, N° 105.

FONT, among ecclesiastical writers, a large bason in which water is kept for the baptizing of infants or other persons.

FONT, in the art of printing, denotes a complete assortment of letters, accents, &c. used in printing. See FOUNT.

FONTAINE, JOHN, a celebrated French poet, and one of the first-rate geniuses of his age, was born at Chateau-Thierri in Champagne, the 8th of July 1621, of a good family. At the age of 19 he entered amongst the Oratorians, but quitted that order 18 months after. He was 22 years of age before he knew his own talents for poetry; but hearing an ode of Malherbe read, upon the assassination of Henry IV. he was so taken with admiration of it, that the poetical fire, which had before lain dormant within him, seemed to be enkindled from that of the other great poet. He applied himself to read, to meditate, to repeat, in fine to imitate, the works of Malherbe. The first essays of his pen he confined to one of his relations who made him read the best Latin authors, Horace, Virgil, Terence, Quintilian, &c. and then the best

best composition in French and Italian. He applied himself likewise to the study of the Greek authors, particularly Plato and Plutarch. Some time afterwards his parents made him marry a daughter of a lieutenant-general, a relation of the great Racine. This young lady, besides her very great beauty, was remarkable for the delicacy of her wit, and Fontaine never composed any work without consulting her. But as her temper was none of the best, to avoid dissension, he separated himself from her company as often as he well could. The famous duchess of Bouillon, niece to Cardinal Mazarine, being exiled to Chateau-Thierri, took particular notice of Fontaine. Upon her recal, he followed her to Paris; where by the interest of one of his relations, he got a pension settled upon him. He met with great friends and protectors amongst the most distinguished persons of the court, but Madame de la Sabliere was the most particular. She took him to live at her house, and it was then that Fontaine, divested of domestic concerns, led a life conformable to his disposition, and cultivated an acquaintance with all the great men of the age. It was his custom, after he was fixed at Paris, to go every year, during the month of September, to his native place of Chateau-Thierri, and pay a visit to his wife, carrying with him Racine, Despreaux, Chapelle, or some other celebrated writers. When he has sometimes gone thither alone by himself, he has come away without remembering even to call upon her; but seldom omitted selling some part of his lands, by which means he squandered away a considerable fortune. After the death of Madame de la Sabliere, he was invited into England, particularly by Madame Mazarine, and by St Evremond, who promised him all the sweets and comforts of life; but the difficulty of learning the English language, and the liberality of the duke of Burgundy, prevented his voyage.

About the end of the year 1692 he fell dangerously ill: and, as is customary upon these occasions in the Romish church, he made a general confession of his whole life to P. Poguet, an Oratorian; and, before he received the sacrament, he sent for the gentlemen of the French Academy, and in their presence declared his sincere compunction for having composed his Tales; a work he could not reflect upon without the greatest repentance and detestation; promising that if it should please God to restore his health, he would employ his talents only in writing upon matters of morality or piety. He survived this illness two years, living in the most exemplary and edifying manner, and died the 13th of March 1695, being 74 years of age. When they stripped his body, they found next his skin a hair shirt; which gave room for the following expression of the younger Racine:

*Et l'Auteur de Jaconde est orné d'un Cilice.*

Fontaine's character is remarkable for a simplicity, candour, and probity seldom to be met with. He was of an obliging disposition; cultivating a real friendship with his brother poets and authors; and what is very rare, beloved and esteemed by them all. His conversation was neither gay nor brilliant, especially when he was not amongst his intimate friends. One day being invited to a dinner at a farmer general's, he ate a great deal, but did not speak. Rising up from table very early, under pretext of going to the academy, the company represented to him that it was not a proper time: "Well (says he), if it is not, I will a little longer." He had one son by his wife in the year 1660. At the age of 14, he put him into the hands of M. de Harley, the first president, recommending to him his education and fortune. It is said, that having been a long time without seeing him, he happened to meet him one day visiting, without recollecting him again, and mentioned to the company that he thought that young man had a good deal of wit and understanding. When they told him it was his own son, he answered in the most tranquil manner, "Ha! I am glad on't." An indifference, or rather an absence of mind, influenced his whole conduct, and rendered him often insensible to the inclemency of the weather. Madame de Bouillon going one morning to Versailles, saw him, abstracted in thought, sitting in an arbour; returning at night, she found him in the same place, and in the same attitude, although it was very cold, and had rained almost the whole day. He carried this simplicity so far, that he was scarcely sensible of the bad effects some of his writings might occasion, particularly his Tales. In a great sickness, his confessor exhorting him to prayer and alms deeds: "As to alms deeds (replied Fontaine), I am not able, having nothing to give; but they are about publishing a new edition of my Tales, and the bookseller owes me a hundred copies; you shall have them to sell, and distribute their amount amongst the poor." Another time P. Poguet exhorting him to repent of his faults, "If he has committed any (cried the nurse), I am sure it is more from ignorance than malice, for he has as much simplicity as an infant." One time having composed a tale, wherein he made a profane application of those words of the Gospel, "Lord, five talents thou didst deliver me," he dedicated it, by a most ingenious prologue, to the celebrated Arnauld, telling him, it was to shew posterity the great esteem he had for the learned doctor. He was not sensible of the indecency of the dedication, and the profane application of the text, till Boileau and Racine represented it to him. He addressed another by a dedication in the same manner, to the archbishop of Paris. His Fables are an immortal work, exceeding every thing in that kind, both ancient and modern, in the opinion of the learned. People of taste, the oftener they read them, will find continually new beauties and charms, not to be met with elsewhere. The descendants of this great poet were long exempted in France from all taxes and impositions; a privilege which the intendants of Soisson thought it an honour to continue to them.

**FONTAINBLEAU**, a town in the Isle of France, and in the Gatinois, remarkable for its fine palace, which has been the place where the kings of France used to lodge when they went a hunting. It was embellished by Francis I. and every successive king has added something to it; so that it may now be called the finest pleasure house in the world. It stands in the midst of a forest, consisting of 26,424 arpents of land, each containing 100 square perches, and each perch feet. E. Long. 2. 23. N. Lat. 40. 22.

**FONTAINES**, Peter Francis, a French critic, was born of a good family at Rouen in 1685. At he entered into the society of the Jesuits; and at quitted it, for the sake of returning to the world. He was a priest, and had a cure in Normandy: but left it, and was, as a man of wit and letters, some time with the cardinal d'Auvergne. Having excited some attention at Paris by certain critical productions, the Abbé Bignon in 1724 committed to him the *Journal des Sçavans*. He acquitted himself well in this department, and was peaceably enjoying the applauses of the public, when his enemies, whom by critical strictures in his Journal he had made such, formed an accusation against him of a most abominable crime, and procured him to be imprisoned. By the credit of powerful friends, he was set at liberty in 15 days; the magistrate of the police took upon himself the trouble of justifying him in a letter to the Abbé Bignon; and this letter having been read amidst his fellow labourers in the Journal, he was unanimously re-established in his former credit. This happened in 1725. But with whatever repute he might acquit himself in this Journal, frequent disgusts made him frequently abandon it. He laboured meanwhile in some new periodical works, from which he derived his greatest fame. In 1731, he began one under the title of *Nouvelliste du Parnasse, ou Reflections sur les Ouvrages nouveaux*: but only proceeded to two volumes; the work having been suppressed by authority, from the incessant complaints of authors ridiculed therein. About three years after, in 1735, he obtained a new privilege for a periodical production, entitled, *Observations sur les Ecrits Modernes*; which, after continuing to 33 volumes, was suppressed again in 1743. Yet the year following, 1744, he published another weekly paper, called, *Jugemens sur les Ouvrages nouveaux*, and proceeded to 11 volumes: the two last being done by other hands. In 1745, he was attacked with a disorder in the breast, which ended in a dropsy that proved fatal in five weeks. "He was (says M. Freron) born a sentimental person; a philosopher in conduct as well as in principle; exempt from ambition; and of a noble firm spirit, which would not submit to sue for preferments or titles. In common conversation he appeared only a common man: but when subjects of literature, or any thing out of the ordinary way, were agitated, he discovered great force of imagination and wit." Besides the periodical works mentioned above, he was the author of many others: his biographer gives us no less than 17 articles; many of them critical, some historical, and some translations from English writers, chiefly from Pope, Swift, Fielding, &c. The Abbé de la Porte, published, in 1757, *L'Esprit de l'Abbé des Fontaines*, in 4 vols. 12mo.

**FONTANA, Felix**, a celebrated Italian physiologist. See Supplement.

**Fontana**, *Gregory*, an eminent Italian mathematician. See Supplement.

**FONTANELLA**, in *Anatomy*, imports the quadrangular aperture found betwixt the os frontis and ossa sincipitis, in children just born; which is also called *fons pulsatilis*.

**FONTARABIA**, a sea port town of Spain, in Biscay, and in the territory of Guipuscoa, seated on a peninsula on the sea shore, and on the river Bidassoa. It is small, but well fortified both by nature and art; and has a good harbour, though dry at low water. It is built in the form of an amphitheatre, on the declivity of a hill, and surrounded on the land side by the lofty Pyrenean mountains. It is a very important place, being accounted the key of Spain on that side. W. Long. 1. 43. N. Lat. 43.

**FONTENELLE, Bernard le Bovier de**, was a man of letters, born at Rouen in 1657, the most universal genius of the age of Louis XIV. in the estimation of Voltaire. He received his education in the college of Jesuits at Rouen, where the quickness of his parts became conspicuous at a very early period. He was capable of writing Latin verses when only 13, which were deemed worthy of being published. He studied the law at the desire of his father; but as he lost the very first cause in which he was employed as an advocate, he became disgusted with his profession, and devoted himsely entirely to literature and philosophy. He composed a considerable part of the operas of Psyche and Bellerophon, which were printed under the name of his uncle Thomas Corneille. He wrote a tragedy called *Aspar*; but as it did not succeed, he consigned the manuscript to the flames, and never afterwards attempted that species of composition. His Dialogues of the dead were published in the year 1683, which were well received, as a specimen of elegant composition, combining morality with the charms of literature. His "Lettres du Chevalier d'Her," published in 1685 without his name, discovered much wit and ingenuity, but at the same time no small share of affectation. His "Entretiens sur la Pluralité des Mondes," has been regarded as one of his ablest performances, combining science and philosophy with vivacity and humour, a talent which may be said to belong almost exclusively to the French. It was perused by all, and translated into several foreign languages.

In his "History of Oracles," he supported the opinion that oracles were forgeries, in opposition to those who contended that they were supernatural operations of evil spirits, put to silence by the appearing of Christ, and of consequence he exposed himself to clerical animadversion. His "Pastoral Poems" appeared in the year 1688, with a discourse on the nature of the eclogue, which were very much admired for their delicacy of sentiment, as was also his opera of "Thetis and Peleus;" but his "Æneas and Lavinia" was not so successful. In the year 1699, Fontenelle was chosen secretary of the Academy of Sciences, which office he held during the long period of 42 years. He published a volume annually of the history of that learned body, filled with analyses of memoirs, and eulogiums on deceased members.

As a poet, he did not rise above elegance and ingenuity; as a man of science, he rather excelled in throwing light on the inventions of others, than in discovering any new truth himself, and as a general writer, he united solid sense with the delicacy and refinement of a man of wit. He studied his own happiness as much as most men, but he never sacrificed to the promotion of it, the duties of a man of honour and virtue. He had many friends, and towards the close of life, scarcely a single enemy. He was never married, and for a man of letters he acquired considerable affluence. Although of a delicate constitution, he reached the great age of 90 without any complaint but dulness of hearing. He died on the 9th of January 1757, being almost a hundred years of age. When asked by a certain person how he could pass so easily through the world, he replied, "by virtue of these two axioms; All is possible, and every one is in the right."

FONTENOY, a town or village of the Netherlands, in the province of Hainault, and on the borders of Flanders; remarkable for a battle fought between the allies and the French on the first of May 1745. The French were commanded by Mareschal Saxe, and the allies by the duke of Cumberland. On account of the superior numbers of the French army, and the superior generalship of their commander, the allies were defeated with great slaughter. The British troops behaved with great intrepidity, as their enemies themselves acknowledged. It has been said, that the battle was lost through the cowardice of the Dutch, who failed in their attack on the village of Fontenoy, on which the event of the day depended. E. Long. 2. 20. N. Lat. 50. 35.

FONTENOY, a village of France, in the duchy of Burgundy, remarkable for a bloody battle fought there in 841, between the Germans and the French, in which were killed above 100,000 men; and the Germans were defeated. E. Long. 3. 48. N. Lat. 47. 28.

FONTEVRAUD, or FRONTEVAUX, Order of, in ecclesiastical history, a religious order instituted about the latter end of the 11th century, and taken under the protection of the holy see by Pope Pascal II. in 1106, confirmed by a bull in 1113, and invested by his successors with very extraordinary privileges. The chief of this order is a female, who is appointed to inspect both the monks and nuns. The order was divided into four provinces, which were those of France, Aquitaine, Auvergne, and Bretagne, in each of which they had formerly several priories.

FONTICULUS, or FONTANELLA, in *Surgery*, an issue, seton, or small ulcer, made in several parts of the body, in order to excite irritation, or to produce the discharge of matter.

FONTINALIA, or FONTANALIA, in antiquity, a religious feast held among the Romans in honour of the deities who presided over fountains or springs. Varro observes, that it was the custom to visit the wells on those days, and to cast crowns into fountains. Scaliger, in his conjectures on Varro, takes this not to be a feast of fountains in general, as Festus insinuates, but of the fountain which had a temple at Rome, near the Porta Capena, called also *Porta Fontinalis*: he adds, that it is of this fountain Cicero speaks in his second book *De Legibus*. The Fontinalia were held on the 13th of October.

FONTINALIS, WATER-MOSS, a genus of plants belonging to the cryptogamia class, and to the order of musci. See BOTANY *Index*.

FOOD, in the most extensive signification of the word implies whatever aliments are taken into the body, whether solid or fluid; but in common language, it is generally used to signify only the solid part of our aliment.

We are told, that in the first ages men lived upon acorns, berries, and such fruits as the earth spontaneously produces; then they proceeded to eat the flesh of wild animals taken in hunting: But their numbers decreasing and mankind multiplying, necessity taught them the art of cultivating the ground, to sow corn, &c. By and by they began to assign to each other, by general consent, portions of land to produce them their supply of vegetables; after this, reason suggested the expedient of domesticating certain animals, both to assist them in their labours and supply them with food. Hogs were the first animals of the domestic kind that appeared upon their tables; they held it to be ungrateful to devour the beasts that assisted them in their labours.—When they began to make a free use of domestic animals, they roasted them only: boiling was a refinement in cookery which for ages they were strangers to; and fish living in an element men were unused to, were not eaten, till they grew somewhat civilized. Menelaus complains, in the Odyssey, that they had been constrained to feed upon them.

The most remarkable distinction of foods, in a medical view, is into those which are already assimilated into the animal nature, and such as are not. Of the first kind are animal substances in general; which if not entirely similar, are nearly so, to our nature. The second comprehends vegetables, which are much more difficultly assimilated. But as the nourishment of all animals, even those which live on other animals, can be traced originally to the vegetable kingdom, it is plain, that the principle of all nourishment is in vegetables.

*Cullen on the Mat. Med.* 1st edit.

Though there is perhaps no vegetable which does not afford nourishment to some species of animals or other; yet, with regard to mankind, a very considerable distinction is to be made. Those vegetables which are of a mild, bland, agreeable taste, are proper nourishment; while those of an acrid, bitter, and nauseous nature, are improper. We use, indeed, several acrid substances as food; but the mild, the bland, and agreeable, are in the largest proportion in almost every vegetable. Such as are very acrid, and at the same time of an aromatic nature, are not used as food, but as spices or condiments, which answer the purposes of medicines rather than any thing else. Sometimes, indeed, acrid and bitter vegetables seem to be admitted as food. Thus celeri and endive are used in common food, though both are substances of considerable acrimony; but it must be observed, that when we use them, they are previously blanched, which almost totally destroys their acrimony. Or if we employ other acrid substances, we generally, in a great measure, deprive them of their acrimony by boiling. In different countries, the same plants grow with different degrees of acrimony. Thus garlic here seldom enters our food; but in the southern countries, where the plants grow more mild, they are frequently used for that purpose. The plant which furnishes cassada, being very acrimonious, and even poisonous, in its recent state, affords an instance of the necessity of preparing acrid substances even in the hot countries: and there are other plants, such as arum root, which are so exceedingly acrimonious in their natural state, that they cannot be swallowed with safety; yet, when deprived of that acrimony, will afford good nourishment.

The most remarkable properties of different vegetable substances as food, are taken notice of under their different names: here we shall only compare vegetable foods in general with those of the animal kind.

I. *In the Stomach*, they differ remarkably, in that the vegetables always have a tendency to acidity, while animal

animal food of all kinds rather tends to alkalescency and putrefaction. Some animal foods, indeed, turn manifestly acid before they putrify; and it has been asserted, that some degree of acescency takes place in every kind of animal food before digestion. This acescency of animal food, however, never comes to any morbid degree, but the disease is always on the side of putrescency. The acescency of vegetables is more frequent, and ought to be more attended to, than the alkalescency of animal food; which last, even in weak stomachs, is seldom felt; while acescency greatly affects both the stomach and system.

With regard to their difference of *solution*:—Heaviness, as it is called, is seldom felt from vegetables, except from tough farinaceous paste, or the most viscid substances; while the heaviness of animal food is more frequently noticed, especially when in any great quantity. Difficulty of solution does not depend so much on firmness of texture (as a man, from fish of all kinds, is more oppressed than from firmer substances), as on viscidity; and hence it is more frequent in animal food, especially in the younger animals.

With regard to *mixture*:—There is no instance of difficult mixture in vegetables, except in vegetable oils; while animal foods, from both viscidity and oiliness, especially the fatter meats, are refractory in this respect. Perhaps the difference of animal and vegetable foods might be referred to this head of mixture. For vegetable food continues long in the stomach, giving little stimulus: Now the system is affected in proportion to the extent of this stimulus, which is incomparably greater from the animal viscid oily food, than from the vegetable, firmer, and more aqueous. However, there are certain applications to the stomach, which have a tendency to bring on the cold fit of fever, independent of stimulus, merely by their refrigeration: and this oftener arises from vegetables; as we see, in those hot countries where intermittents prevail, they are oftener induced from a surfeit of vegetable than of animal food. A proof of this is, that when one is recovering of an intermittent, there is nothing more apt to cause a relapse than cold food, especially if taken on those days when the fit should return, and particularly acescent, fermentable vegetables, as salads, melons, cucumbers, &c. *acido-dulces*, &c. which, according to Dr Cullen, are the most frequent causes of epidemics; therefore, when an intermittent is to be avoided, we shun vegetable diet, and give animal foods, although their stimulus be greater.

II. *In the Intestines.* When the putrescency of animal food has gone too far, it produces an active stimulus, causing diarrhœa, dysentery, &c. But these effects are but rare; whereas from vegetable food and its acid, which, united with the bile, proves a pretty strong stimulus, they more frequently occur; but luckily are of less consequence, if the refrigeration is not very great. In the autumnal season, when there is a tendency to dysentery, if it is observed that eating of fruits brings it on, it is rather to be ascribed to their cooling than stimulating the intestines.

As to *stool*:—Wherever neither putrefaction nor acidity has gone a great length, animal food keeps the belly more regular. Vegetable food gives a greater proportion of succulent matter; and, when exsiccated by the stomach and intestines, is more apt to stagnate, and produce slow belly and costiveness, than animal stimulating food; which, before it comes to the great guts, where stoppage is made, has obtained a putrefactive tendency, and gives a proper stimulus: and thus those who are costive from the use of vegetables; when they have recourse to animal food are in this respect better.

III. *In the blood-vessels.* They both give a blood of the same kind, but of different quality. Animal food gives it in great quantity, being in great part, as the expression is, convertible *in succum et sanguinem*, and of easy digestion; whereas vegetable is more watery, and contains a portion of unconquerable saline matter, which causes it to be thrown out of the body by some excretion. Animal food affords a more dense stimulating elastic blood than vegetable; stretching and causing a great resistance in the solids, and again exciting their stronger action. It has been supposed that acescency of vegetable food is carried into the blood-vessels, and there exerts its effects; but the tendency of animal fluids is so strong to alkalescency, that the existence of an acid acrimony in the blood seems very improbable. Animal food alone will soon produce an alkalescent acrimony; and if a person who lives entirely on vegetables were to take no food for a few days, his acrimony would be alkalescent.

IV. We are next to take notice of the *quantity of nutriment* these different foods afford. Nutriment is of two kinds: the first repairs the waste of the solid fibres; the other supplies certain fluids, the chief of which is oil. Now, as animal food is easier converted, and also retained longer in the system, and as it contains a greater proportion of oil, it will afford both kinds of nutriment more copiously than vegetables.

V. Lastly, *As to the different degrees of perspirability of these foods.* This is not yet properly determined. Sanctorius constantly speaks of mutton as the most perspirable of all food, and of vegetables as checking perspiration. This is a consequence of the different stimulus those foods give to the stomach, so that persons who live on vegetables have not their perspiration so suddenly excited. In time of digestion, perspiration is stopped from whatever food, much more so from cooling vegetables. Another reason why vegetables are less perspirable is, because their aqueo-saline juices determine them to go off by urine, while the more perfectly mixed animal food is more equally diffused over the system, and so goes off by perspiration. Hence Sanctorius's accounts may be understood; for vegetable aliment is not longer retained in the body, but mostly takes the course of the kidneys. Both are equally perspirable in this respect, viz. that a person living on either returns once a day to his usual weight; and if we consider the little nourishment of vegetables, and the great tendency of animal food to corpulency, we must allow that vegetable is more quickly perspired than animal food.

As to the question, Whether man was originally designed for animal or vegetable food, see the article CARNIVOROUS.

With regard to the effects of these foods on men, it must be observed, that there are no persons who live entirely on vegetables. The Pythagoreans themselves ate milk; and those who do so mostly, as these Pythagoreans, are weakly, sickly, and meagre, labouring under a constant diarrhœa and several other diseases. None of the hardy, robust, live on these; but chiefly such as gain a livelihood by the exertion of their mental faculties, as (in the East Indies) factors and brokers; and this method of life is now confined to the hot climates, where vegetable diet, without inconvenience, may be carried to great excess. Though it be granted, therefore, that man is intended to live on these different foods promiscuously, yet the vegetable should be in very great proportion. Thus the Laplanders are said to live entirely on animal food: but this is contradicted by the best accounts; for Linnæus says, that besides milk, which they take sour, to obviate the bad effects of animal food, they use also calamenyanthes, and many other plants, copiously. So there is no instance of any nation living entirely either on vegetable or animal food, though there are indeed some who live particularly on one or other in the greatest proportion. In the cold countries, *e. g.* the inhabitants live chiefly on animal food, on account of the rigour of the season, their smaller perspiration, and little tendency to putrefaction.

Of more importance, however, is the following than the former question, viz. *In what proportion animal and vegetable food ought to be mixed?*

1. *Animal* food certainly gives most strength to the system. It is a known aphorism of Sanctorius, that *pondus addit robur;* which may be explained from the impletion of the blood-vessels, and giving a proper degree of tension for the performance of strong oscillations. Now animal food not only goes a greater way in supplying fluid, but also gives the fluid more dense and elastic. The art of giving the utmost strength to the system is best understood by those who breed fighting cocks. These people raise the cocks to a certain weight, which must bear a certain proportion to the other parts of the system, and which at the same time is so nicely proportioned, as that, on losing a few ounces of it, their strength is very considerably impaired. Dr Robinson of Dublin has observed, that the force and weight of the system ought to be determined by the largeness of the heart, and its proportion to the system: for a large heart will give large blood-vessels, while at the same time the viscera are less, particularly the liver; which last being increased in size, a greater quantity of fluid is determined into the cellular texture, and less into the sanguineous system. Hence we see how animal food gives strength, by filling the sanguiferous vessels. What pains we now bestow on cocks, the ancients did on the athletæ, by proper nourishment bringing them to a great degree of strength and agility. It is said that men were at first fed on figs, a proof of which we have from their nutritious quality: however, in this respect they were soon found to fall short of animal food; and thus we see, that men, in some measure, will work in proportion to the quality of their food. The English labour more than the Scots; and wherever men are exposed to hard labour, their food should be animal.—Animal food, although it gives strength, yet loads the body; and Hippocrates long ago observed, that the athletic habit, by a small increase, was exposed to the greatest hazards. Hence it is only proper for bodily labours, and entirely improper for mental exercises; for whoever would keep his mind acute and penetrating, will exceed rather on the side of vegetable food. Even the body is oppressed with animal food; a full meal always produces dullness, laziness, and yawning; and hence the feeding of gamesters, whose mind must be ready to take advantage, is always performed by avoiding a large quantity of animal food. Farther, With regard to the strength of the body, animal food, in the first stage of life, is hardly necessary to give strength: in manhood, when we are exposed to active scenes, it is more allowable; and even in the decline of life, some proportion of it is necessary to keep the body in vigour. There are some diseases which come on in the decay of life, at least are aggravated by it; among these the most remarkable is the gout. This, when it is in the system, and does not appear with inflammation in the extremities, has pernicious effects there, attacking the lungs, stomach, head, &c. Now, to determine this to the extremities, a large proportion of animal food is necessary, especially as the person is commonly incapable of much exercise.

Animal food, although it gives strength, is yet of many hazards to the system, as it produces plethora and all its consequences. As a stimulus to the stomach and to the whole system, it excites fever, urges the circulation, and promotes the perspiration. The system, however, by the repetition of these stimuli, is soon worn out; and a man who has early used the athletic diet, is either early carried off by inflammatory diseases, or, if he takes exercise sufficient to render that diet salutary, such an accumulation is made of putrescent fluids, as in his after life lays a foundation for the most inveterate chronic distempers. Therefore it is to be questioned, whether we should desire this high degree of bodily strength, with all the inconveniences and dangers attending it. Those who are chiefly employed in mental researches, and not exposed to too much bodily labour, should always avoid an excess of animal food. There is a disease which seems to require animal food, viz. the hysteric or hypochondriac; and which appears to be very much a-kin to the gout, affecting the alimentary canal. All people affected with this disease are much disposed to acescency: which sometimes goes so far, that no other vegetable but bread can be taken in, without occasioning the worst consequences. Here then we are obliged to prescribe an animal diet, even to those of very weak organs; for it generally obviates the symptoms. However, several instances of scurvy in excess have been produced by a long-continued use of this diet, which it is always unlucky to be obliged to prescribe; and when it is absolutely necessary to prescribe, it should be joined with as much of the vegetable as possible, and when a cure is performed we should gradually recur to that again.

2. Next, let us consider the *vegetable* diet. The chief inconveniency of this is difficulty of assimilation; which, however, in the vigorous and exercised, will not be liable to occur. In warm climates, the assimilation of vegetable aliment is more easy, so that *there* it may be more used, and when joined to exercise gives a pretty tolerable degree of strength and vigour; and though the general rule be in favour of *animal* diet, for giving strength, yet there are many instances of its being remarkably produced from vegetable. Vegetable diet has this advantage, that it whets the appetite, and that we can hardly suffer from a full meal of it. Besides

the disorders it is liable to produce in the *primæ viæ*, and its falling short to give strength, there seem to be no bad consequences it can produce to the blood vessels; for there is no instance where its peculiar acrimony was ever carried there, and it is certainly less putrefiable than animal food; nor, without the utmost indolence, and a sharp appetite, does it give plethora, or any of its consequences: so that we cannot here but conclude, that a large proportion of vegetable food is useful for the generality of mankind.

There is no error in this country more dangerous, or more common, than the neglect of bread: for it is the safest of vegetable aliments, and the best corrector of animal food; and, by a large proportion of this alone, its bad consequences, when used in a hypochondriac state, have been obviated. The French apparently have as much animal food on their tables as the British; and yet, by a greater use of bread, and the dried acid fruits, its bad effects are prevented; and therefore bread should be particularly used by the English, as they are so voracious of animal food. Vegetable food is not only necessary to secure health, but long life: and, as we have said, in infancy and youth we should be confined to it mostly: in manhood, and decay of life, use animal food; and near the end, vegetable again.

There is another question much agitated, viz. *What are the effects of variety in food?* Is it necessary and allowable, or universally hurtful? Variety of a certain kind seems necessary; as vegetable and animal foods have their mutual advantages, tending to correct each other. Another variety, which is very proper, is that of liquid and solid food, which should be so managed as to temper each other; and liquid food, especially of the vegetable kind, is too ready to pass off before it is properly assimilated, while solid food makes a long stay. But this does not properly belong to the question, whether variety of the same kind is necessary or proper, as in animal foods, beef, fish, fowl, &c. It doth not appear that there is any inconvenience arising from this mixture, or difficulty of assimilation, provided a moderate quantity be taken. When any inconvenience does arise, it probably proceeds from this, that one of the particular substances in the mixture, when taken by itself, would produce the *same effects;* and indeed it would appear that this effect is not *heightened* by the mixture, but properly *obviated* by it. There are few exceptions to this, if any, e. g. taking a large proportion of acescent substances with milk. The coldness, &c. acidity, flatulency, &c. may appear; and it is possible that the coagulum, from the acescency of the vegetables, being somewhat stronger induced, may give occasion to too long retention in the stomach, and to acidity in too great degree. Again, the mixture of fish and milk often occasions inconveniences. The theory of this is difficult, though, from universal consent, it must certainly be just. Can we suppose that fish gives occasion to such a coagulum as runnet? If it does so, it may produce bad effects. Besides, fishes approach somewhat to vegetables, in giving little stimulus; and are accused of the same bad effects as these, viz. bringing on the cold fit of fever.

Thus much may be said for variety. But it also has its disadvantages, provoking to gluttony; this, and the art of cookery, making men take in more than they properly can digest: and hence, perhaps very justly, physicians have universally almost preferred simplicity of diet; for, in spite of rules, man's eating will only be measured by his appetite, and satiety is sooner produced by *one* than by *many* substances. But this is so far from being an argument against variety, that it is one for it, as the only way of avoiding a full meal of animal food, and its bad effects, is by presenting a quantity of vegetables. Another mean of preventing the bad effects of animal food, is to take a large proportion of liquid; and hence the bad effects of animal food are less felt in Scotland, on account of their drinking much with it, and using broths, which are at once excellent correctors of animal food and preventives of gluttony.

With regard to the difference between ANIMAL FOODS, properly so called, the first regards their solubility, depending on a lax or firm texture of their different kinds.

I. SOLUBILITY of animal food seems to deserve less attention than is commonly imagined; for there are many instances of persons of a weak stomach, incapable of breaking down the texture of vegetables, or even of dissolving a light pudding, to whom hung beef, or a piece of ham, was very grateful and easily digested. None of the theories given for the solution of animal food in the human stomach seem to have explained the process sufficiently. Long ago has been discarded the supposition of an active corrosive menstruum there; and also the doctrine of trituration, for which, indeed there seems no mechanism in the human body; and, till lately, physicians commonly agreed with Boerhaave in supposing nothing more to be necessary than a watery menstruum, moderate heat, and frequent agitation. This will account for solution in some cases, but not entirely. Let us try to imitate it out of the body with the same circumstances, and in ten times the time in which the food is dissolved in the stomach we shall not be able to bring about the same changes. Take the coagulated white of an egg, which almost every body can easily digest, and yet no artifice shall be able to dissolve it. Hence, then, we are led to seek another cause for solution, viz. fermentation; a notion, indeed, formerly embraced, but on the introduction of mechanical philosophy, industriously banished, with every other supposition of that process taking place at all in the animal economy.

Many of the ancients imagined this fermentation to be putrefactive. But this we deny, as an acid is produced; though hence the fermentation might be reckoned the vinous; which, however, seems always to be morbid. Neither indeed is the fermentation purely acetous, but modified by putrescence; for Pringle has observed, that animal matters raise and even expede the acetous process. The fermentation, then, in the stomach is of a mixed nature, between the acetous and the putrefactive, mutually modifying each other; though, indeed, in the intestines, somewhat of the putrefactive seems to take place, as may be observed from the state of the feces broke down, and from the little disposition of such substances to be so, which are not liable to the putrefactive process, as the firmer parts of vegetables, &c. Upon this view solution seems to be extremely easy, and those substances to be most easily broke down

Food.

which are most subject to putrefaction. See ANATOMY, and GASTRIC *Juice*.

But solution also depends on other circumstances, and hence requires a more particular regard.

1. There is a difference of solubility with respect to the manducation of animal food, for which bread is extremely necessary, in order to keep the more slippery parts in the mouth till they be properly comminuted. From want of proper manducation persons are subject to eructations; and this more frequently from the firm vegetable foods, as apples, almonds, &c. than from the animal, though, indeed, even from animal food, very tendinous, or swallowed in unbroken masses, such sometimes occur. Manducation is so much connected with solution, that some, from imperfectly performing that, are obliged to belch up their food, remanducate it, and swallow it again before the stomach can dissolve it, or proper nourishment be extracted. Another proof of our regard to solubility, is our rejecting the firmer parts of animal food, as bull beef, and generally carnivorous animals.

2. Its effects with regard to solubility seem also to be the foundation of our choice between *fat* and *lean*, *young* and *old meats*. In the *lean* although perhaps a single fibre might be sufficiently tender, yet these, when collected in *fasciculi*, are very firm and compact, and of difficult solution; whereas in the *fat* there is a greater number of vessels, a greater quantity of juice, more interposition of cellular substance, and consequently more solubility. Again, in young animals, there is probably the same number of fibres as in the older, but these more connected: whereas, in the older, the growth depending on the separation of these, and the increase of vessels and cellular substance, the texture is less firm and more soluble; which qualities, with regard to the stomach, are at that time too increased, by the increased alkalescency of the animal. To this also may be referred our choice of castrated animals, viz. on account of their disposition to fatten after the operation.

3. It is with a view to the solubility, that we make a choice between meats recently killed, and those which have been kept for some time. As soon as meat is killed, the putrefactive process begins; which commonly we allow to proceed for a little, as that process is the most effectual breaker down of animal matters, and a great assistance to solution. The length of time during which meat ought to be kept, is proportioned to the meat's tendency to undergo the putrid fermentation, and the degree of those circumstances which favour it: Thus, in the torrid zone, where meat cannot be kept above four or five hours, it is used much more recent than in these northern climates.

4. *Boiled* or *roasted* meats create a difference of solution. By boiling we extract the juices interposed between the fibres, approximate them more to each other, and render them of more difficult solubility; which is increased too by the extraction of the juices, which are much more alkalescent than the fibres: but when we want to avoid the stimulus of alkalescent food, and the quick solution, as in some cases of disease, the roasted is not to be chosen. Of roasted meats it may be asked, which are more proper, those which are most or least roasted? That which is least done is certainly the most soluble: even raw mea
soluble than dressed, as Dr Cullen was inform
person who from necessity was obliged, for
to eat such. But at the same time that
done are very soluble, they are very alkale
that, wherever we want to avoid alkalescenc
*primæ viæ*, the most roasted meats should
Those who throw away the broths of boiled
very improperly; for, besides their supplying
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white of eggs, it seems very insoluble, yet,
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when it was used in great quantity, the sc
more frequent: but to a moderate use of it,
climates, no such objection takes place.

5. Solubility is varied from another source,
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but also their greater viscidity of juice. And
is more common, than to be longer oppress
full meal of veal, than from the same quantity
&c. Upon account, too, of their greater vi
juice, are the tendinous and ligamentous par
mals longer retained than the purely muscula
as on account of their firmness of texture. Ev
whose muscular parts are exceedingly tender,
account of their gluey viscosity, longer in
the stomach. And eggs, too, which are ex
nourishing, have the same effect, and cannot
in great quantity: For the stomach is pecul
sible to gelatinous substances; and by this
nature perhaps taught us, as it were by a
stinct, to limit ourselves in the quantity of
tive substances.

6. With regard to solution, we must take
of animal food; which, when tolerably pure,
least putrescent part of it, and, by diminishing
hesion of the fibres, render them more solu
this last account is the lean of fat meat more
solved than other lean. But when the meat
sed to much heat, this oil is separated, leaving
lid parts less easily soluble, and becoming itse
reumatic, rancescent, and of difficult mixture
mach. Fried meats, from the reasons now
baked meats, for the same, as well as for the
of the paste, are preparations which diminis
bility of the food. From what has been said,
paration of food by fattening it, and keeping
some time after being killed, although it may
to gluttony, will yet, it must be confessed,
solution of the food.

II. The second difference of animal food is
gard to ALKALESCENCY.

Of this we have taken a little notice alread
the head of *Solubility*.

1. From their too great alkalescency we
avoid the carnivorous animals, and the
choose rather the granivorous. Some birds,
which live on insects, are admitted into our

no man, without *nausea*, can live upon these alone for any length of time. Fishes, too, are an exception to this rule, living almost universally on each other. But in these the alkalescency does not proceed so far; whether from the viscidity of their juice, their want of heat, or some peculiarity in their economy, is not easy to determine.

2. Alkalescency is determined by difference of age. The older animals are always more alkalescent than the young, from their continual progress to putrefaction. Homberg always found in his endeavours to extract an acid from human blood, that more was obtained from the young than from the old animals.

3. A third circumstance which varies the alkalescency of the food, is the wildness or tameness of the animal; and this again seems to depend on its exercise. Dr Cullen knew a gentleman who was fond of cats for food; but he always used to feed them on vegetable food, and kept them from exercise; and in the same manner did the Romans rear up their rats, when intended for food. In the same way the flesh of the partridge and the hen seems to be much the same; only, from its being more on the wing, the one is more alkalescent than the other. Again, tame animals are commonly used without their blood; whereas the wild are commonly killed in their blood, and upon that account, as well as their greater exercise, are more alkalescent.

4. The alkalescency of food may be determined from the quantity of volatile salt it affords. The older the meat is, it is found to give the greater proportion of volatile salt.

5. The alkalescency of aliment may also, in some measure, be determined from its colour, the younger animals being whiter and less alkalescent. We also take a mark from the colour of the gravy poured out, according to the redness of the juices judging of the animal's alkalescency.

6. The relish of food is found to depend much on its alkalescency, as does also the stimulus it gives and the fever it produces in the system. These effects are also complicated with the viscidity of the food, by which means it is longer detained in the stomach, and the want of alkalescency supplied.

Having mentioned animal food as differing in solubility and alkalescency, which often go together in the same subject, we come to the third difference, viz.

III. QUANTITY of Nutriment. Which is either absolute or relative: absolute with respect to the quantity it really contains, sufficient powers being given to extract it; relative, with respect to the assimilatory powers of those who use it. The absolute nutriment is of some consequence: but the relative, in the robust and healthy, and except in cases of extraordinary weakness, may, without much inconvenience, be disregarded. In another case is the quantity of nourishment relative, viz. with regard to its *perspirability;* for if the food is soon carried off by the excretions, it is the same thing as if it contained a less proportion of nourishment. For, giving more fluid, that which is longer retained affords most; and, for the repair of the solids, that retention also is of advantage. Now, gelatinous substances are long retained; and, besides, are themselves animal substances dissolved; so that, both absolutely and relatively, such substances are nutritious. Of this kind are eggs, shell fish, &c. In adults, though it is disputed whether their solids need any repair, yet at any rate, at this period, fluid is more required; for this purpose the alkalescent foods are most proper, being most easily dissolved. They are, at the same time, the most perspirable; on one hand that alkalescency leading to disease, while on the other their perspirability obviates it. Adults, therefore, as writers justly observe, are better nourished on the alkalescent; the young and growing, on gelatinous foods. All this leads to a comparison of young and old meats; the first being more gelatinous, and the last more alkalescent. This, however, by experience, is not yet properly ascertained. Mr Geoffroy is the only person who has been taken up with the analysis of foods. See *Memoires de l'Academie*, l'an. 1731 & 1732. His attempt was certainly laudable, and in some respects usefully performed; but, in general, his experiments were not sufficiently repeated, nor are indeed sufficiently accurate. He has not been on his guard against the various circumstances which affect meats; the cow-kind liking a moist succulent herbage, which is not to be got in warm climates; while the sheep are fond of dry food, and thrive best there. Again, some of his experiments seem contradictory. He says, that veal gives more solution than beef, while lamb gives less than mutton, which is much to be doubted. If both he and Sanctorius had examined English beef, the result probably would have been very different as to its perspirability, &c. Besides, Mr Geoffroy has only analyzed beef and veal when raw; has made no proper circumstantial comparisons between quadrupeds and birds; and has examined these last along with their bones, and not their muscles, &c. by themselves, as he ought to have done, &c. If a set of experiments of this kind were properly and accurately performed, they might be of great use; but at present, for the purpose of determining our present object, we must have recourse to our alkalescency, solubility, &c.

IV. The fourth difference of animal food is, *The NATURE of the FLUIDS they afford.* The whole of this will be understood from what has been said on alkalescency; the fluid produced being more or less dense and stimulating, in proportion as that prevails.

V. The fifth difference of animal foods is with respect to their

PERSPIRABILITY. The sum of what can be said on this matter is this, that such foods as promote an accumulation of fluid in our vessels and dispose to plethora, are the least perspirable, and commonly give most strength; that the more alkalescent foods are the most perspirable, though the viscid and less alkalescent may attain the same property by long retention in the system. The authors on perspirability have determined the perspiration of foods as imperfectly as Mr Geoffroy has done the solubility, and in a few cases only. We must not lay hold on what Sanctorius has said on the perspirability of mutton, because he has not examined in the same way other meats in their perfect state; far less on what Keil says of oysters, as he himself was a valetudinarian, and consequently an unfit subject for such experiments, and probably of a peculiar temperament.

As to the effects of FOOD on the MIND, we have already hinted at them above. It is plain, that delicacy

cacy of feeling, liveliness of imagination, quickness of apprehension, and acuteness of judgment, more frequently accompany a weak state of the body. True it is, indeed, that the same state is liable to timidity, fluctuation and doubt; while the strong have that steadiness of judgment, and firmness of purpose, which are proper for the higher and more active scenes of life. The most valuable state of the mind, however, appears to reside in somewhat less firmness and vigour of body. Vegetable aliment, as never over-distending the vessels or loading the system, never interrupts the stronger motions of the mind; while the heat, fulness, and weight, of animal food, are an enemy to its vigorous efforts. Temperance, then, does not so much consist in the quantity, for that always will be regulated by our appetite, as in the quality, viz. a large proportion of vegetable aliment.

A considerable change has now taken place in the articles made use of as food by the ancients, by substituting, instead of what were then used, particularly of the vegetable kind, a number of more bland, agreeable, and nutritive juices. The acorns and nuts of the primitive times have given way to a variety of sweeter farinaceous seeds and roots. To the malvaceous tribe of plants, so much used by the Greeks and Romans, has succeeded the more grateful spinach, and to the blite, the garden orach. The rough borage is supplanted by the acescent sorrel; and asparagus has banished a number of roots recorded by the Roman writers under the name of *bulbs;* but Linnæus is of opinion, that the parsnip has undeservedly usurped the place of the skirret. The bean of the ancients, improperly so called, being the roots as well as other parts of the *nymphæa nelumbo*, or Indian water-lily, is superseded by the kidney bean. The garden rocket, eaten with and as an antidote against the chilling qualities of the lettuce, is banished by the more agreeable cress and tarragon; the apium by the meliorated celery; the pompion, and others of the cucurbitaceous tribe, by the melon; and the sumach berries, by the fragrant nutmeg. The silphium, or succus Cyrenaicus, which the Romans purchased from Persia and India at a great price, and is thought by some to have been the asafœtida of the present time, is no longer used in preference to the alliaceous tribe.

To turn from the vegetable to some of the animal substitutes, we may mention the carp among fishes as having excluded a great number held in high estimation among the Romans; the change of oil for butter; of honey for sugar; of mulsa, or liquors made of wine, water, and honey, for the wines of modern times; and that of the ancient zythus for the present improved malt liquors; not to mention also the *Callida* of the Roman taverns, analogous to our tea and coffee. See FOOD and DIETETICS, in the SUPPLEMENT.

*Food of Plants.* See AGRICULTURE *Index.*

FOOL, according to Mr Locke, is a person who makes false conclusions from right principles; whereas a madman, on the contrary, draws right conclusions from wrong principles. See FOLLY.

*Fool-Stones.* See ORCHIS, BOTANY *Index.*

FOOSHT, an island in the Red sea; situated, according to the observations of Mr Bruce, in N. Lat. 13° 59′ 43″. It is described by him as about five miles in length from north to south, though only *nine* in circumference. It is low and sandy in the southern part, but the north rises in a black hill of inconsiderable height. It is covered with a kind of bent grass, which never arises at any great length by reason of want of rain and the constant browzing of the goats. There are great appearances of the black hill having once been a volcano; and near the north cape the ground sounds hollow like the Solfaterra in Italy. There are a vast number of beautiful fish met with upon the coasts, but few fit for eating; and our traveller observed, that the most beautiful were the most noxious when eaten; none indeed being salutary food excepting those which resembled the fish of the northern seas. There are many beautiful shell-fish, as the concha veneris, of several colours and sizes; sea urchins, &c. Sponges are likewise found all along the coast. There are also pearls, but neither large nor of a good water; in consequence of which they sell at no great price. They are produced by a species of bivalve shells. Several large shells, from the fish named *bisser*, are met with upon stones of ten or twelve tons weight along the coast. They are turned upon their faces and sunk into the stones, as into a paste, the stone being raised all about them in such a manner as to cover the edge of the shell; "a proof (says Mr Bruce) that this stone must some time lately have been soft or liquefied: for had it been long ago, the sun and air would have worn the surface of the shell; but it seems perfectly entire, and is set in that hard brown rock as the stone of a ring is in a golden chasing."—The water in this island is very good.

The inhabitants of Foosht are poor fishermen of a swarthy colour; going naked, excepting only a rag about their waist. They have no bread but what they procure in exchange for the fish they catch. What they barter in this manner is called *seajan*. But besides this they catch another species, which is flat, with a long tail, and the skin made use of for shagreen, of which the handles of knives and swords are made. There is a small town on the island, consisting of about 30 huts, built with faggots of bent grass or spartum, supported by a few sticks, and thatched with grass of the same kind of which they are built.

FOOT, a part of the body of most animals whereon they stand, walk, &c. See ANATOMY.

FOOT, in the Latin and Greek poetry, a metre or measure, composed of a certain number of long and short syllables.

These feet are commonly reckoned 28: of which some are simple, as consisting of two or three syllables, and therefore called *dissyllabic* or *trisyllabic feet;* others are compound, consisting of four syllables, and are therefore called *tetrasyllabic feet.*

The dissyllabic feet are four in number, viz. the pyrrichius, spondeus, iambus, and trocheus. See PYRRHICHIUS, &c.

The trisyllabic feet are eight in number, viz. the dactylus, anapæstus, tribrachys, molossus, amphibrachys, amphimacer, bacchius, and antibacchius. See DACTYL, &c.

The tetrasyllabic are in number 16, viz. the proceleusmaticus, dispondeus, choriambus, antispastus, diambus, dichoreus, ionicus a majore, ionicus a minore, epitritus primus, epitritus secundus, epitritus tertius, epitritus

epitritus quartus, pæon primus, pæon secundus, pæon tertius, and pæon quartus. See PROCELEUSMATICUS, &c.

FOOT is also a long measure consisting of 12 inches. Geometricians divide the foot into 10 digits, and the digit into 10 lines.

*FOOT-Halt*, the name of a disorder peculiar to sheep. It is occasioned by an insect, which when it comes to a certain maturity, resembles a worm of two, three, or four inches in length. See FARRIERY *Index*.

*FOOT-Square*, is the same measure both in breadth and length, containing 144 square or superficial inches.

*Cubic* or *Solid FOOT*, is the same measure in all the three dimensions, length, breadth, and depth or thickness, containing 1728 cubic inches.

*FOOT of a Horse*, in the manege, the extremity of the leg, from the coronet to the lower part of the hoof.

*FOOT Level*, among artificers, an instrument that serves as a foot rule, a square, and a level. See LEVEL, RULE, and SQUARE.

FOOTE, SAMUEL, Esq. the modern Aristophanes, was born at Truro, in Cornwall; and was descended from a very ancient family. His father was member of parliament for Tiverton, in Devonshire, and enjoyed the post of commissioner of the prize office and fine-contract. His mother was heiress of the Dinely and Goodere families. In consequence of a fatal misunderstanding between her two brothers, Sir John Dinely Goodere, Bart. and Samuel Goodere, Esq. captain of his majesty's ship the Ruby, which ended in the death of both, a considerable part of the Goodere estate, which was better that 5000l. per annum, descended to Mr Foote.

He was educated at Worcester college, Oxford, which owed its foundation to Sir Thomas Cookes Windford, Bart. a second cousin of our author's. On leaving the university, he commenced student of law in the Temple; but as the dryness of this study did not suit the liveliness of his genius, he soon relinquised it. He married a young lady of a good family and some fortune; but their tempers not agreeing, a perfect harmony did not long subsist between them. He now launched into all the fashionable foibles of the age, gaming not excepted, and in a few years spent his whole fortune. His necessities led him to the stage, and he made his first appearance in the character of Othello. He next performed Fondlewife with much more applause; and this, indeed, was ever after one of his capital parts. He attempted Lord Foppington likewise, but prudently gave it up. But as Mr Foote was never a capital actor in the plays of others, his salary was very unequal to his gay and extravagant turn; and he contracted debts which forced him to take refuge within the verge of the court. On this occasion, he relieved his necessities by the following stratagem. Sir Fr—s D—l—l had long been his intimate friend, and had dissipated his fortune by similar extravagance. Lady N-ss-u P—let, who was likewise an intimate acquaintance of Foote's, and who was exceedingly rich, was fortunately at that time bent upon a matrimonial scheme. Foote strongly recommended to her to consult upon this momentous affair the conjurer in the Old Bailey, whom he represented as a man of surprising skill and penetration. He employed an acquaintance of his own to personate the conjurer; who depicted Sir Fr—s D—l—l at full length; described the time when, the place where, and the dress in which she would see him. The lady was so struck with the coincidence of every circumstance, that she married D—l—l in a few days. For this service Sir Francis settled an annuity upon Foote; and this enabled him once more to emerge from obscurity.

In 1747 he opened the little theatre in the Haymarket, taking upon himself the double character of author and performer; and appeared in a dramatic piece of his own composing, called the *Diversions of the Morning*. The piece consisted of nothing more than the exhibition of several characters well known in real life; whose manner of conversation and expression this author very happily hit off in the diction of his drama, and still more happily represented on the stage, by an exact and most amazing imitation, not only of the manner and tone of voice, but even of the very persons, of those whom he intended to take off. In this performance, a certain physician, Dr L—s, well known for the oddity and singularity of his appearance and conversation, and the celebrated Chevalier Taylor, who was at that time in the height of his popularity, were made objects of Foote's ridicule; the latter, indeed very deservedly: and, in the concluding part of his speech, under the character of a theatrical director, Mr Foote took off, with great humour and accuracy, the several styles of acting of every principal performer on the English stage. The performance at first met with some opposition from the civil magistrates of Westminster, under the sanction of the act of parliament for limiting the number of playhouses, as well as from the jealousy of one of the managers of Drury-lane playhouse: but the author being patronized by many of the principal nobility, and other persons of distinction, this opposition was overruled: and having altered the title of his performance, Mr Foote proceeded, without farther molestation, to give *Tea in a Morning* to his friends, and represented it through a run of 40 mornings to crowded and splendid audiences.—The ensuing season he produced another piece of the same kind, which be called *An Auction of Pictures*. In this performance he introduced several new and popular characters; particularly Sir Thomas de Veil, then the acting justice of peace for Westminster, Mr Cock the celebrated auctioneer, and the equally famous Orator Henley. This piece also had a very great run.—His *Knights*, which was the production of the ensuing season, was a performance of somewhat more dramatic regularity: but still, although his plot and characters seemed less immediately personal, it was apparent that he kept some particular real persons strongly in his eye in the performance; and the town took upon themselves to fix them where the resemblance appeared to be the most striking. Thus Mr Foote continued from time to time to select, for the entertainment of the public, such characters, as well general as individual, as seemed most likely to engage their attention. His dramatic pieces, exclusive of the interlude called *Piety in Pattens*, are as follows: Taste, the Knights, The Author, The Englishman in Paris, The Englishman returned from Paris, The Mayor of Garrat, The Liar, The Patron, The Minor, The Orators, The

Foote.

Commissary, The Devil upon two Sticks, The Lame Lover, The Maid of Bath, The Nabob, the Cozeners, The Capuchin, the Bankrupt, and an unfinished comedy called The Slanderer. All these works are only to be ranked among the *petites pieces* of the theatre. In the execution they are somewhat loose, negligent, and unfinished; the plots are often irregular, and the catastrophes not always conclusive; but with all these deficiencies, they contain more strength of character, more strokes of keen satire, and more touches of temporary humour, than are to be found in the writings of any other modern dramatist. Even the language spoken by his characters, incorrect as it may sometimes seem, will on a closer examination be found entirely dramatical; as it abounds with those natural minutiæ of expression which frequently form the very basis of character, and which render it the truest mirror of the conversation of the times in which he wrote.

In the year 1766, being on a party of pleasure with the late duke of York, Lord Mexborough, and Sir Francis Delaval, Mr Foote had the misfortune to break his leg, by a fall from his horse; in consequence of which he was compelled to undergo an amputation. This accident so sensibly affected the duke, that he made a point of obtaining for Mr Foote a patent for life; whereby he was allowed to perform, at the little theatre in the Haymarket, from the 15th of May to the 15th of September every year.

He now became a greater favourite of the town than ever: his very laughable pieces, with his more laughable performance, constantly filled his house; and his receipts were sometimes almost incredible. Parsimony was never a vice to be ascribed to Mr Foote; his hospitality and generosity were ever conspicuous; he was visited by the first nobility, and he was sometimes honoured even by royal guests.

The attack made upon his character by one of his domestics, whom he had dismissed for misbehaviour, is too well known to be particularized here. Suffice it to say, he was honourably acquitted of that charge: but it is believed by some, that the shock which he received from it accelerated his death; others pretend, that his literary altercation with a certain *then* duchess, or rather her agents, much affected him, and that from that time his health declined. It is probable, however, that his natural volatility of spirits could scarcely fail to support him against all impressions from either of these quarters.

Mr Foote, finding his health decline, entered into an agreement with Mr Colman, for his patent of the theatre; according to which, he was to receive from Mr Colman, 1600l. per annum, besides a stipulated sum whenever he chose to perform. Mr Foote made his appearance two or three times in some of the most admired characters; but being suddenly affected with a paralytic stroke one night whilst upon the stage, he was compelled to retire. He was advised to bathe; and accordingly retired to Brighthelmstone, where he apparently recovered his former health and spirits, and was what is called the *fiddle of the company* who resorted to that agreeable place of amusement. A few weeks before his death, he returned to London; but, by the advice of his physicians, set out with an intention to spend the winter at Paris and in the south of France. He had got no farther than Dover, when he was suddenly attacked by another stroke of the palsy, in a few hours terminated his existence. He the 21st of October 1777, in the 56th year of his and was privately interred in the cloisters of We ster abbey.

**FOP**, probably derived from the *voppa* of applied in the first satire of his first book to the and extravagant Nævius, is used among us to person who cultivates a regard to adventitious and beauty to excess.

**FORAMEN**, in *Anatomy*, a name given to apertures or perforations in divers parts of the as, 1. The external and internal foramina of the nium or skull. 2. The foramina in the upper and jaw. 3. Foramen lachrymale. 4. Foramen tympani.

*Foramen Ovale*, an oval aperture or passage the heart of a fœtus, which closes up after arises from the coronal vein, near the right passes directly into the left auricle of the heart, for the circulation of the blood in the fœtus, time as the infant breathes, and the lungs are in this the fœtus differs from the adult; almost all anatomists, Mr Cheselden excepted, us, that the foramen ovale has sometimes been adults. See Foetus.

**FORBES, Duncan**, Esq. of Culloden, lord dent of the court of session in Scotland, was the year 1685. In his early life, he was in a family remarkable for hospitality; which, led him afterwards to a freer indulgence in social sures. His natural disposition inclined him to my: but, as he soon discovered a superior the advice of his friends he applied himself to He directed his studies particularly to the civil which he made a quick progress, and in 1709 mitted an advocate. From 1722 to 1737, he sented in parliament the boroughs of Inverness, Nairn, and Forres. In 1725, he was made vocate; and in 1737 lord president of the court of In the rebellions which broke out in Scotland and 1745 he espoused the royal cause; but with prudence and moderation did he conduct himself delicate conjuncture, that not a whisper was at heard to his prejudice. The glory he acquired vancing the prosperity of his country, and in ting to re-establish peace and order, was the only of his services. He had even impaired, and ed, his private fortune in the cause of the government did not make him the smallest The minister, with a meanness for which it is to account, desired to have a state of his Shocked at the incivility and rudeness of this he left the minister without making any reply. out the whole course of his life he had a lively religion, without the least taint of superstition; charity was extended to every sect and religionists indiscriminately. He was well Hebrew language; and wrote in a flowing and rial style, concerning religion natural and some important discoveries in theology and and concerning the sources of incredulity. He 1747, in the 62d year of his age; and his since been published in two volumes octavo.

**FORCE**, in *Philosophy*, denotes the cause change in the state of a body, when, being at rest, it begins to move, or has a motion which is either not uniform or not direct. While a body remains in the same state, either of rest or of uniform and rectilinear motion, the cause of its remaining in such a state is in the nature of the body, and it cannot be said that any extrinsic force has acted on it. This internal cause or principle is called *inertia*.

Mechanical forces may be reduced to two sorts: one of a body at rest, the other of a body in motion.

The force of a body at rest, is that which we conceive to be in a body lying still on a table, or hanging by a rope, or supported by a spring, &c. and this is called by the names of *pressure*, *tension*, *force*, or *vis mortua*, *solicitatio*, *conatus movendi*, *conamen*, &c. To this class also of forces we must refer centripetal and centrifugal forces, though they reside in a body in motion; because these forces are homogeneous to weights, pressures, or tensions of any kind.

The force of a body in motion is a power residing in that body so long as it continues its motion; by means of which it is able to remove obstacles lying in its way; to lessen, destroy, or overcome the force of any other moving body which meets it in an opposite direction; or to surmount any dead pressure or resistance, as tensity, gravity, friction, &c. for some time; but which will be lessened or destroyed by such resistance as lessens or destroys the motion of the body. This is called *moving force*, *vis motrix*, and by some late writers *vis viva*, to distinguish it from the *vis mortua* spoken of before; and by these appellations, however different, the same thing is understood by all mathematicians; namely, that power of displacing, of withstanding opposite moving forces, or of overcoming any dead resistance, which resides in a moving body, and which, in whole or in part, continues to accompany it, so long as the body moves. See MECHANICS.

We have several curious as well as useful observations in Desaguliers's Experimental Philosophy, concerning the comparative forces of men and horses, and the best way of applying them. A horse draws with the greatest advantage when the line of direction is level with his breast; in such a situation, he is able to draw 200lb. eight hours a-day, walking about two miles and a half an hour. And if the same horse is made to draw 240lb. he can work but six hours a-day, and cannot go quite so fast. On a carriage, indeed, where friction alone is to be overcome, a middling horse will draw 1000lb. But the best way to try a horse's force, is by making him draw up out of a well, over a single pulley or roller; and, in such a case, one horse with another will draw 200lb. as already observed.

Five men are found to be equal in strength to one horse, and can, with as much ease, push round the horizontal beam of a mill, in a walk 40 feet wide; whereas three men will do it in a walk only 19 feet wide.

The worst way of applying the force of a horse, is to make him carry or draw up hill; for if the hill be steep, three men will do more than a horse, each man climbing up faster with a burden of 100lb. weight, than a horse that is loaded with 300lb.; a difference which is owing to the position of the parts of the human body being better adapted to climb than those of a horse.

On the other hand, the best way of applying the force of a horse, is in a horizontal direction, wherein a man can exert least force; thus a man weighing 140lb. and drawing a boat along by means of a rope coming over his shoulders, cannot draw above 27lb. or exert above one-seventh part of the force of a horse employed to the same purpose.

The very best and most effectual posture in a man, is that of rowing, in which he not only acts with more muscles at once for overcoming the resistance, than in any other position; but as he pulls backward, the weight of his body assists by way of lever. See Desaguliers, Exp. Phil. vol. i. p. 241. where we have several other observations relative to force acquired by certain positions of the body, from which that author accounts for most feats of strength and activity. See also a *Memoire* on this subject by M. de la Hire, in Mem. Roy. Acad. Sc. 1629; or in Desaguliers, Exp. &c. 267, &c. who has published a translation of part of it, with remarks.

Citizen Regnier has invented an instrument for ascertaining the relative strength of men and animals, for an account of which, see DYNAMOMETER; and for a fuller description of the apparatus, the reader may consult the original paper on the subject in *Jour. de l'Ecole Polytech.* vol. ii. or the translation in Phil. Mag. vol. i.

FORCE, in *Law*, signifies any unlawful violence offered to things or persons, and is divided into simple and compound. *Simple force* is what is so committed, that it has no other crime attending it; as where a person by force enters on another's possession, without committing any other unlawful act. *Compound force*, is where some other violence is committed, with such an act which of itself alone is criminal; as if one enters by force into another's house, and there kills a person, or ravishes a woman. There is likewise a force implied in law, as in every trespass, rescue, or disseisin, and an actual force with weapons, number of persons, &c.—Any person may lawfully enter a tavern, inn, or victualling-house; so may a landlord his tenant's house to view repairs, &c. But if, in these cases, the person that enters commits any violence or force the law will intend that he entered for that purpose.

FORCEPS, in *Surgery*, &c. a pair of scissars for cutting off, or dividing, the fleshy membranous parts of the body, as occasion requires. See SURGERY.

FORCER, in *Mechanics*, is properly a piston, without a valve. For by drawing up such a piston, the air is drawn up, and the water follows; then pushing the piston down again, the water, being prevented from descending by the lower valve, is forced up to any height above, by means of a side branch between the two.

FORCIBLE ENTRY, is a violent and actual entry into houses or lands; and a forcible detainer, is where one by violence withholds the possession of lands, &c. so that the person who has a right of entry is barred, or hindered, therefrom.

At common law, any person that had a right to enter into lands, &c. might retain possession of it by force. But this liberty being abused, to the breach of the peace, it was therefore found necessary that the same should be restrained: Though, at this day, he who is wrongfully dispossessed of goods may by force retake them. By statute no person shall make an entry on any lands or tenements, except where it is given by law, and in a peaceable manner, even though they have title of entry, on pain of imprisonment; and where a forcible entry is committed, justices of the peace are authorized to view the place, and inquire of the force by a jury, summoned by the sheriff of the county; and they may cause the tenements, &c. to be restored, and imprison the offenders till they pay a fine. Likewise a writ of forcible entry lies, where a person seized of freehold, is by force put out thereof.

*Forcible Marriage*, of a woman of estate, is felony. For by the statute 3 H. VII. c. 2. it is enacted, "That if any persons shall take away any woman having lands or goods, or that is heir-apparent to her ancestor, by force and against her will, and *marry* or *defile* her; the takers, procurers, abettors, and receivers, of the woman taken away against her will, and knowing the same, shall be deemed principal felons; but as to procurers and accessories before the fact, they are to be excluded the benefit of clergy, by 39 Elizabeth, c. 9. The indictment on the statute Hen. VII. is expressly to set forth, that the woman taken away had lands or goods, or was heir apparent; and also that she was married or defiled, because no other case is within the statute; and it ought to allege that the taking was for lucre. It is no excuse that the woman at first was taken away with her consent; for if she afterwards refuse to continue with the offender, and be forced against her will, she may from that time properly be said to be taken against her will; and it is not material whether a woman so taken away be at last married or defiled with her own consent or not, if she was under force at the time; the offenders being in both cases equally within the words of the act.

Those persons who, after the fact, receive the offender, are but accessories after the offence, according to the rules of common law; and those that are only privy to the damage, but not parties to the forcible taking away, are not within the act H. P. C. 119. A man may be indicted for taking away a woman by force in another country; for the continuing of the force in any country, amounts to a forcible taking there. *Ibid.* Taking away any woman child under the age of 16 years and unmarried, out of the custody and without the consent of the father or guardian, &c. the offender shall suffer fine and imprisonment; and if the woman agrees to any contract of matrimony with such person, she shall forfeit her estate during life, to the next of kin, to whom the inheritance should descend, &c. stat. 4 & 5 P. & M. c. 8. This is a force against the parents; and an information will lie for seducing a young man or woman from their parents, against their consents, in order to marry them, &c. See Marriage.

FORCING, in *Gardening*, a method of producing ripe fruits from trees before their natural season. See Gardening *Index*.

Forcing, in the wine trade, a term used by the wine coopers, for the fining down wines, and rendering them fit for immediate draught. The principal inconvenience of the common way of fining down the white wines with isinglass, and the red with whites of eggs, is the slowness of the operation; these ingredients not performing their office in less than a week, or sometimes a fortnight, according as the weather proves favourable, cloudy or clear, windy or calm: this appears to be matter of constant observation. But the wine merchant frequently requires a method that shall, with certainty, make the wines fit for tasting in a few hours. A method of this kind there is; but it is kept in a few hands a valuable secret. Perhaps it depends upon a prudent use of a tartarised spirit of wine, and the common forcing, as occasion is, along with gypsum, as the principal; all which are to be well stirred about in the wine, for half an hour before it is suffered to rest.

FORDOUN, John of, the father of Scottish history, flourished in the reign of Alexander III. towards the end of the 13th century. But of his life there is nothing known with certainty, though there was not a monastery that possessed not copies of his work. The first five books of the history which bears his name were written by him: the rest were fabricated from materials left by him, and from new collections by different persons. There is a manuscript in vellum of Fordoun's History, in the library of the university of Edinburgh.

FORDWICH, a town of Kent, called in Doomsday Book "the little borough of Fordwich," is a member of the port of Sandwich, and was anciently incorporated by the style of the barons of the town of Fordwich, but more lately by the name of the mayor, jurats, and commonalty, who enjoy the same privileges as the cinque ports. This place is famous for excellent trouts in its river Stour.

END OF THE EIGHTH VOLUME.

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