THOUGHTS ON BOTANY*—*continued.*

BY H. B. BAILDON, B.A. CANTAB.

The Gramineæ—the Coniferæ—the Ascending Axis—Twining Stems.

It would be alike tiresome to you and laborious and unprofitable for me in continuing our meditative review of the Plant-world, if we were to attempt to notice every class of plants with even the same amount of detail and deliberation which we bestowed on ferns and mosses. Nevertheless it will assist us in giving form to this treatment of the subject if we maintain the direction if not the velocity of our progress. If we consider that this planet must at one time—and this seems highly probable, if not absolutely certain—have been in a molten condition, it follows that, upon its first solidifying, the rock would be all of a voltaic character and perfectly naked of soil. We have already observed, however, that there are forms of vegetation which can, under conditions of moisture and heat, attach themselves even to such naked rock and flourish thereon, and while doing so gradually deposit a thin layer of mould. This, as was previously pointed out, is the function of the lichen. And in this first stage of this soilless globe it is evident that no plants save lichens and algæ could exist. We also observed how the moss succeeded the lichen and made provision for the fern. In alliance with these humble and silent agents some mightier, yet not more necessary, natural forces were at work. The adamantine tooth of frost gnawed into crumbs the hardest granite, and slowly the tempest and torrent swept the gathering spoil to swell the hoard of rude soil that was growing in hollow and valley. By such incessant, unresting processes was the earth accumulated and enriched till it became capable of bearing what we call the higher forms of vegetation. But, if we consider the aspect our earth was then assuming and the soil-covered state to which most of its surface has attained, we easily divine that some new agent was now wanted to complete nature's staff of labourers. It was not sufficient that the rocks should be crumbled, powdered and carried down to the lowest ground, but it was evidently requisite that this denudation should be checked so that not only the lower and level tracts but the higher places and slopes should become soil-clad. Had any intelligent human being contemplated the condition of the earth at this stage, he must necessarily have remarked that some agent was now required to give the soil coherence, to bind it together so that it should retain its own position and even arrest the downward progress of the newly forming earth. Accordingly there does appear, when thus demanded, an agent which accomplishes this object in a most complete manner. It seems as though at such an epoch a creative fiat had gone forth, "Let there be grass?" And there was grass. And lo, the shifting restless sand was wonderfully laced and woven and a task more difficult than Michael Scott gave the demon quietly accomplished, and the loose soil at the mercy of the flood was stitched and bound and tied till it became solid immovable turf. And the green irresistible conqueror rose like a gradual wave up the slope and mounted the hill, till the tides met on the summit and the rugged, once uncouth and naked, hulk of rock was clad in a smooth and seamless garment. Grass is not an individual, but an association; not a tribe like the fern, nor a colony like the moss-plot; the grass is a republic, a community, which seems to have recognized, æons since, the modern maxim of liberty, equality, fraternity. Even in cultivated forms this principle is preserved. How scrupulously every ear of wheat seems to respect the rights of his neighbour ears, so long as prosperity and strength enable him to do so, unlike in this respect the forest trees that thrust out rival arms against each other. The two forms to which the flowering heads of grass tend, the limiting forms which are well and clearly represented by our common cereals, the wheat and barley representing one form and the oat the other, are in this reference worthy of notice. In the former the glumes are arranged in close-fitting rows along the axis of the stalk and thus form a clean, firm and compact ear, so free of encumbrance and well contrived that, until it is itself injured or its stalk bruised, not the wildest onsets of the wind can bring it into hurtful collision with its neighbours. It might seem that if this model were departed from a less happy result would be obtained, but on the contrary we find that by a different route the same goal is reached. The head of the oat, representing the second form we specified, is constructed on an opposite principle from the first. The glumes of the oat, instead of being sessile and close laid to the axis, are hung out on fine flexile pedicles at some distance from it, thus forming a spreading and, when ripe, slightly pendent head. But these heads, from the slimness and smoothness of the glumes and the sensitive flexibility of the pedicles, do not tend to abrade or injure one another any more than the compact ears of wheat. If we wished to have single terms for each of these two opposite styles of formation, we might call the one the "serried" and the other the "open" order. And we might divide all grasses into three orders, the serried, the open, and the mixed or intermediate. Now the observations we have made on this subject suggest the reflection, or rather the deduction, which may be supported by hundreds of other natural facts, that nature frequently accomplishes a similar end in diverse ways. This brings to our mind an objection which has been urged against the theory that the forms we meet with in nature are to be entirely accounted for by natural selection and survival of the fittest, or on what we may call a purely competitive system of evolution. We are bound to suppose that grass in its primitive form was intermediate between the serried and the open order. It is difficult to suppose how it could prove to its advantage and contribute to its survival to be both a little closer *and* a little opener. We can conceive its proving advantageous to be either a little closer *or* a little opener, but it is not easy to see how it could be beneficial both ways. Indeed, we are here brought in mind of a great and standing difficulty in the way of accepting the Darwinian theory, viz., that of understanding the use and operation of that slight change which is supposed always to commence that divergence which results in the production of distinct species. The fact is that to a mind divested of the bias of a pet theory, there seems to reside in nature a certain prophetic instinct, urging on development in those directions which produce remote and future advantages rather than near and immediate ones. No one bears in reality, if not verbally, more ample testimony in favour of this belief than Mr. Darwin himself, in his masterly and interesting series of researches on the subject of cross-fertilization. For, proving as he so completely does, that there is a transition, a progress from self-fertilization to cross-fertilization, he at the same time proves, whether he has observed it or no, that such a system could not arise blindly, at haphazard, but was actually aimed at by nature as though conscious of its immense advantages. So positively marvellous are the contrivances by which cross-fertilization is promoted, and such the nicety with which it is accomplished, that one is rather tempted to attribute to plants a faculty of "thinking for themselves" than to deny in such a matter the operation of mind. But we have not yet arrived at that portion of our subject where it will be most convenient to discuss this question in full, and must, therefore, relinquish it for the present, in its general form at least, in order to return for a little to the grasses. Before leaving this subject we cannot avoid the reflection that the presence of grass in any form, such as still exists, implies the possibility, not only of that vast portion of the animal kingdom which we call graminivorous, but also of man. The grasses are, indeed, the foundation, the basis of the present animal economy, the

* Read at an Evening Meeting of the North British Branch of the Pharmaceutical Society, January 31, 1879. The preceding paper was read February 22, 1878.

sea upon which the ship of life is upborne. Without grass civilization, yea, humanity itself, were impossible. As it may be said to have civilized the savage primeval world in a physical sense, so it teaches civilization, and even, as we have seen, politics to man. All those animals which aid the food-raising operations of man are graminivorous; the horse, the ass, the ox, etc. Until he has subjugated and utilized these, he cannot be said to have reached the first plateau of civilized existence. When he has, he obtains some breathing space; his purely physical labour is done for him, and hence arises leisure, thought, culture. It would be easy to expatiate at length upon the economic importance of this order of plants, but as our present aim is rather to condense than to elaborate, we must refrain from so doing. But there remains yet another aspect under which we may consider it, viz., the æsthetic or decorative.

Whether we regard the grass collectively, as forming that lovely natural carpet, so elastic and grateful to the foot of man or animal, or in the beauty of its individual forms, we find a fertile source of delight and admiration. There are in nature few fairer sights than a meadow on a bright day of June or July, when the grasses are in flower. No web from Lyons loom ever wore a more sweet and silken lustre than those acres of rippling grasses, over which the breezes seem to pass a-tip-toe, and fleet beyond our furthest view, ever returning, so it would seem, to renew their joyous race, calling on the staid, slow-sailing cloud-shadows to join them in their unwearying play, while before them the broad grass-billows flee, glancing and shimmering in the sunlight, as though they were happy mates and playfellows of old. Or again, what more pleasant than to lean one's head back in the deep grasses and indulge in the phantasy of dreaming one's-self to be one of those minute creatures that haunt that miniature jungle, or an invisible daylight fairy exploring those steep greenlit glades, or surveying that tiny forest from the top-gallants of one of its mimic masts. Here, though we may in some sort allow fancy to become the exponent of fact, it is nevertheless true that it is the inherent beauty in the aspect of these things that touches the heart with delight, and wakes pleasant fancies in the brain; or, if we look upon the various forms that grasses take, whether in the leaves themselves or in the flowering stems, we cannot fail to be struck by the exquisite beauty by which the majority are characterized. They, like the ferns, appear to employ form rather than colour as a decorative agent; they are the delicate draughtsmen and designers of natural chasing and fine tracery, the elvin armourers that prepare swords and lances and bayonets, standards, pennons and plumes. It is, indeed, impossible to decide whether they exceed in beauty or in utility. Man thus served is like the hungry Geraint waited on by Enid, when he must have doubted for which he was the more grateful, the good fare or the lovely face.

I am quite aware that much that has been said applies more to the grasses of temperate than to those of tropical countries, but the difference is rather in detail than in principle, and there is no doubt that while the latter may be coarser in appearance, they are likewise often more conspicuous and splendid in their attractions. It is not here contended that the whole of this immense order is equally perfect in design and entirely beneficial to man. There are some less sightly than others, and some either poisonous, as the darnel is suspected to be, or dangerous and annoying, as the New Zealand spear-grass certainly is. But such exceptions can hardly weigh, so exceedingly rare are they. So much, too briefly, and yet, considering the range of our subject, also too lengthily, of the grasses.

There is another order of great beauty and likewise of immense usefulness to man, which, before passing on it behoves us to notice—I mean the Coniferæ, the pine order. They appear historically to have even preceded the grasses, and, following our plan of taking into account the gradual process of soil formation, it is easy to see that they would naturally be contemporaries of the ferns, etc., because we find it characteristic of them to be able to subsist on the merest modicum of soil, on the all-but-bare rock. All they really seem to require is a safe anchorage, and this is best secured on mountain side, precipice, or cliff, where the roots can grapple themselves with more than iron grip about huge boulders, or to the cracks and friendly seams, fissures and angles of the living rock, herein performing a mechanical feat which would defy the appliances of man. It would be as impossible to secure a pine, once felled, to its former position, on the same principle that nature does of merely tying it by the root, so as to resist the enormous leverage it affords to the wind, as it would to put together the Humpty-Dumpty of the nursery rhyme. The strength of those living clamps and cordage seems little short of miraculous. The pine cannot therefore draw its chief nutriment from the soil; dew, mist, rain and snow are its seeming ethereal food, and it is extremely interesting to note how admirably adapted for arresting and absorbing these forms of sustenance it is. The fine innumerable spines catch and secure all these as in a close, almost impermeable, web or net. In nearly all instances the most important agent in its nutriment is the snow, for as a race the coniferæ affect great altitudes, at which the snow lies through a great part of the year. Now when the earth is iron-bound with frost, it seems obvious that the tree must feed on the snow. Only this winter, during the severe weather, I was struck by the admirable adaptation it exhibits for this purpose. At first one notices how heavily laden all the trees of this order become with snow, and it appears a disadvantage, as though they would be more injured than other plants. On looking closer and reflecting more deeply it becomes evident that this fact is of great service. Let us take four species of quite different habits, and see how they adapt themselves. Take first the common Scotch fir that we sometimes see riding the tempest under almost bare poles. In this case it is evident the snow does tend to remove the lower branches, but mark how the summit spreads itself into broad palms, which will receive and retain the greatest amount of snow, almost as much as if it were feathered to the ground. Consider, secondly, the cedar of Lebanon, which sends out its lusty limbs at a slight upward incline, and expands into broad trays and terraces, which only become horizontal under a considerable weight of snow. We may take as a third example the deodore, and we find that in a quite different way it carries out the same purpose. Its branches leave the stem at right angles, or even with a slight downward incline, and they are, especially at the point, supple and pendent. The snow thus tends to slip off the upper and lither boughs and descend upon the lower branches, which are already resting on the ground or their lower fellows, and which thus become thickly "happed" about with mounded snow. A fourth and equally distinctive case may be found in the araucaria, upon whose long bristling arms I have seen a deep ruff-like ridge of snow fully two inches and a half high, which did not seem calculated to injure or inconvenience the plant, so easily was it sustained. These facts taken together with that, that when the ground is hard frozen a tree which so far maintains its vigour as to remain ever green, as all of them do, can draw little or no nutriment from the earth, absolutely convince me that the pine feeds upon the snow through its leaves. The method in which it does so, as I believe, I will endeavour to explain. Firstly, it is ascertained by careful and repeated experiment that plants in general develop a certain small amount of heat, the result of which is that in summer the temperature of the plant is below, in winter above that of the surrounding atmosphere. Secondly, this temperature, besides depending on a chemical process in the plant, varies also according to that of the ground where the roots are. Thus, for example, the heaping of the snow round the deodore will tend to the increase of the temperature of the whole plant. My belief is that the temperature of the pine is from such causes sufficiently high to melt, as it were, but a film of the snow next its leaves, and thus absorb it. A confirmation of this theory will be found in the way that snow, which has lain on a pine for a short time, will thrust itself home along the lengthy spines till it rests against the branch itself. From all this we gather that these four species of coniferæ, at least, are most excellently adapted, though in quite different ways, for receiving and retaining a share of fit winter provision. We imagine that a human being who had never seen a cedar or a deodore, and yet had conceived them and their special modes of adaptation to snow-catching and bearing, would be thought a person of exceptional intelligence; and yet we are seriously asked to believe that these things have come into existence without thought, guidance or design. Call the process of the production, evolution, growth, creation, what you will, but do not try to persuade sane men that the element of evolution, the conditions of growth, do not as surely imply intelligence and foresight as would the fiats of a Creator.

To attempt duly to extol this noble race of trees would be indeed like trying

"To add a perfume to the violet."

Their beauty is varied, and exceeding, from the less attractive but solemn and impressive yews and cypresses, and the picturesque ever-interesting Scotch fir, to the more clothed and reverend pine, the patriarchal cedar, the haughty affluent wellingtonia, and the refined and lovely deodore. But the spirit of the order is that of aspiration. All its higher members send their shafts straight heavenward without division or divergence. I doubt not the human notions of spire and pagoda came from the pine and the larch respectively. The pine is truly nature's priest, worshipping literally in the high places, gathering its solemn choirs about her mighty hill-altars, and chanting an eternal psalm. (Though I am no philologist, I should be hard to persuade that the very word psalm did not arise from an attempt to reproduce the grave and meditative murmur of wind in a pine forest.) The motto of the tree is "Excelsior," and its forests sweep up the mountain flanks in huge green waves, in serried hosts, as of a gallant army flinging itself indomitably up the steep glacis and against the mighty outworks and bastions that defend the fortresses of the frost and the shining citadels of snow. Like a sane, yet aspiring soul, the pine anchors itself to the solid fundamental rock, and straining upward, with constant purpose, is nourished by the pure skies to which it ever tends, fed with food from the heaven to which it points.

(*To be continued.*)

THE PREPARATION OF SINGLE REGULAR CRYSTALS OF ANY DESIRED SIZE.*

Mr. Ferdinand Meyer, who has for thirty years studied the conditions necessary for obtaining large, single, and regular crystals of chemical salts, has published his method in the *Archiv der Pharmacie*, Oct., 1878, from which we take the following:—

Prepare a solution of any salt in water of such a strength that, after standing twenty-four hours, a portion of the salt will separate in crystals. Pour off the mother-water, select a few of the best-formed crystals, and place them on a plate of glass, which lies in a rather tall vessel. Then re-dissolve a little of the dry salt in a small quantity of the mother water, add this supersaturated solution to the main bulk of the mother water, pour this upon the crystals on the plate of the glass, and place the vessel into a room where the temperature remains as uniform as possible, best in the cellar. The temperature of the room should be ascertained by a thermometer, and in case of any changes of temperature, a further quantity of the salt is to be dissolved in the mother water. This must be repeated every twelve or fourteen hours, until the crystals have reached the desired size. If the solution is too strong, single regular crystals are seldom obtained at once, but this is generally of no consequence, for, as long as one side at least is perfectly formed, it is only necessary to turn them two or three times, to cause the other sides likewise to become perfect. As the crystals increase in size, care must be taken to give them a correct position on the plate of glass; and, if the solution is at all concentrated, the crystals must be carefully freed from adhering irregularities, and then replaced in the solution.

In a solution of alum, a very oblique octoëder is usually obtained first. This may be allowed to reach a considerable size, after which it is to be laid successively on the narrow sides, when it will gradually become a regular octoëder. If it is always kept lying on the broadest sides, it will continue to grow obliquely.

It is well known that several isomorphous salts may be crystallized, one over the other, in layers, without a change of crystalline form. Chrome-alum crystals may thus be covered with crystals of ordinary alum. The largest crystal of this kind obtained by the author weighed over three pounds.

The author also observed that, when employing the same mother water for a considerable time, the crystals began to show blunt or flattened points. This happened with regular as well as with oblique crystals, so that in place of eight surfaces, the regular crystals gradually assumed sixteen equal sides, and the irregular ones, fourteen smaller and two larger sides. If, however, the mother water be acidulated with a little sulphuric acid, this flattening of the points occurs but rarely.

As a general rule, by changing the position of the single crystals of any salt, but particularly of sulphate of zinc, copper, nickel, or magnesium, and of Rochelle salts, different forms of the same system are obtained. If crystals of Rochelle salt, which may easily be obtained of large size, are always placed upon one and the same side, one half of the crystal will become perfectly developed; but if they are laid, alternately, upon the two opposite long surfaces, the development is less regular. On placing large crystals of the same salt, even if only half developed, lengthwise into the liquid, alternately upon either end, development of the lateral surfaces proceeds very regularly.

It is not advisable to introduce crystals into a solution if the latter is at all warm, or to pour a warm solution into a cold one containing crystals, as the latter are thereby generally torn or broken. If a portion of a crystal has been by accident broken off, it may be repaired by subjecting it to the above-detailed process. In a crystal of chrome alum, from which a piece weighing ten grams had been broken off, the gap was completely restored, by subjecting it to the feeding process for a fortnight.

As soon as the crystals have attained the desired size, it is best to place them into less concentrated solutions, in a slightly cooler place; this after-treatment causes the surfaces to become smooth and levelled, and the edges to become sharp.

* From *New Remedies*, January, 1879.

COMPOSITION OF THE MILK OF THE COW TREE.*

(*Brosimum galactodendron.*)

BY M. BOUSSINGAULT.

At a recent meeting of the French Academy of Sciences the author gave some information respecting this remarkable tree and the liquid which it yields. He first made his acquaintance with the "milk" some years since whilst

* *Comptes Rendus*, vol, lxxxvii. p. 277.

tar, soft soap and methylated spirit, but the preparation being Austrian, one from where methylated spirit is unknown, rectified spirit is most probably intended.

"Senex," in No. 240, states that a prescription came under his notice where saccharum ʒiij was one of the ingredients, and asks, was he justified in using ʒivss fluid of syr. simp. But he does not state whether the prescription was a powder or a mixture. If a powder, of course sugar in powder should have been used. In a mixture syrup may generally be used where sugar is ordered, and ʒiij of sugar would as nearly as possible be represented by ʒiiiss fl. of syr. simp., B.P., not ʒivss as he seems in his inquiry to imagine.

The prescription No. 241 is very likely to be a hospital or private formula, and can only be answered by some correspondent who may have a knowledge of its existence and composition.

In answer to J. G., No. 242, one of the best excipients for croton chloral is conf. rosæ can. In this instance the excipient of tragacanth and glycerine of the usual consistence is too soft. At the same time a very stiff excipient of glycerine and tragacanth, made for this purpose, would answer equally well; but the conf. rosæ can. being ready to hand will generally be used for the purpose.

The ointment, No. 243, will turn yellow after being made some time; there is no known method of obviating this change of colour. The theory of the change which takes place will be found in the remarks of one of the preceeding "Months."

No. 244 is one of those indefinite queries which now and then find their way into the "Dispensing Memoranda." "Juvenis" does not say what information he wants—whether how many doses should be sent, if separately, or in one bottle, or is it how tr. guaiac. ammon. may be best emulsified? It would usually be sent out six or eight doses in one bottle, and if ʒij of mucilage be mixed with the water previously to the tincture being added a perfect emulsion will result, which will retain its character for any resonable length of time.

In reply to No. 245, sulphur præcip. should not be used in an electuary where sulphur is ordered. It is not necessary here to enter into the chemical phase of the question, and it has not been proved that the state of division of the precipitated sulphur has any influence on its aperient and other effects.

In whatever order the ingredients of No. 246 be mixed a bulky precipitate of ferrous carbonate will necessarily result, at first of a light green colour, gradually darkening as oxidation of the iron proceeds.

It is probable that in prescription No. 247 the character of vaseline is not understood by the writer of the prescription. The ointment should be made by rubbing down the ferri sulph. to a very fine powder and then mixing it with the vaseline. A solution of the ferri sulph. would not be miscible with this vehicle.

No. 248 is a prescription where "co." has been omitted. The occasional absence of the "co." in prescriptions has already been alluded too. When tr. chlorof. is prescribed the tr. chlorof. co., not the sp. chlorof. should be used.

In prescription No. 249 there is not sufficient spirit ordered to dissolve the potass. iodid. If ʒss of it be replaced by ʒss of water a satisfactory result will be obtained. But if the water be added to the spirit already in the prescription, the resulting ointment may be inconveniently soft.

The subject in No. 250 is an interesting one, but as the composition of vaseline is a secret, the decomposition which ensues on mixing sulph. hypochlor. with it must remain involved in some obscurity; it seems clear, however, that vaseline is not suited as a diluent for the external use of sulph. hypochlor., and as vasceline is now being extensively used as a substitute for lard, any information relating to decomposition resulting from its use is of value, and should receive careful consideration.

THOUGHTS ON BOTANY*—*continued.*

BY H. B. BAILDON, B.A. CANTAB.

The Gramineæ—the Coniferæ—the Ascending Axis—Twining Stems.

(*Concluded from page* 679).

It is a true saying that truth is stranger than fiction, but it is no less true that nature is more wonderful than what we call miracle and magic. You may search all mythologies and legends, you may ransack all fairy stories and magic tales, but you will not find anything more truly marvellous than a pine tree. Consider the elements of which it is built up, the conditions of its growth. There is first of all the bare or nearly naked rock and a dry, apparently dead, chiplet, we call the seed. Add to these water, with a small amount of other chemical substances in solution, in the various forms of dew, mist, rain and snow, and these under the influence of solar heat become a large and lofty, a strong, tough, firmly founded and solid, a green-clad, shapely, increasing, complex, organiezd, a spined and plumed, aspiring, wisely-planned, utile, solemn-sounding, soul-suggesting thing, we call a pine tree. Everything in legerdemain, magic legend or mythology, however astonishing and supernatural it may seem, is but a poor and shabby wonder beside this one and a thousand others which nature daily and continually accomplishes. Yet because these are gradual and common we pass them by unwondering, if not unadmiring. It is not that science rightly considered either has explained or ever can explain away that wonderfulness which man in the youth of the race found everywhere in nature, and which gave zest and poetry to existence. Rather, on the other hand, has man, bearing the lamp of science in his hand, like the hero of some Eastern tale exploring a magic cavern paved with emeralds and roofed with rubies and diamonds, found in exploring the arcana of natural phenomena, ever new galleries and halls, ever fresh and alluring vistas of research and discovery. Perhaps the present and growing tendency of science to arrange her spoils in graduated series has some effect in detracting from the sense of marvel we would otherwise feel. It is natural that it should be so; yet we must see on reflection that it does not really detract from the power exhibited that the process should be gradual, any more than we ought to admire a picture or a statue less when we know it is the product of a multitude of individual touches or strokes. Nature will not, indeed, condescend to sudden effects and surprises, will not stoop to any *coups de theatre* to startle us into admiration; she presents us with things wonderful, complete, beautiful. If we are blind and say "They are nought," she seems to reply in silent scorn "Indeed they are, *to the blind*, as the diamond to the earth-worm, as the light of noonday to the mole and the bat; they are for the eyes and the hearts that can see." One cannot fail to suspect, on noting the cold and sometimes even disgustful tone in which nature is sometimes spoken of, that certain scientific pursuits, like certain mechanical arts, which by too close and continuous

* Read at an Evening Meeting of the North British Branch of the Pharmaceutical Society, January 31, 1879. The preceding paper was read February 22, 1878.

application injure the sight of the operative, superinduce, in the case of too exclusive a devotion to them, a species of mental, if not of moral, ophthalmia, so that one is inclined to adopt in the case of science the famous replies of Schiller when asked what religion he was of. "Of none," he said. "And wherefore of none?" "For religion's sake!" He feared by adopting the tenets and promoting the objects of a particular sect to lose the larger and loftier emotions and ideas which he felt constituted the truly spiritual and essential part of religion. So we may say, "We will not be, in spirit at least, geologists, botanists, biologists or any of the 'ists' at all, not because we do not respect and credit science, but just because we fear to narrow our conceptions and lose our sense of that wider and higher science, that true knowledge of things in which are embraced and sublated all these partial studies and subaltern pursuits."

It will not be any longer possible for us to follow out what we may call the historic order of Plant-life, according to the hypothesis we had adapted that the various stages of soil-formation would give us a clue to this order; for when we find that the soil has arrived at the point at which it can support the grasses and pines we must see that it is or shortly will be in a condition to support also a great variety of plants of quite distinct orders. We shall, therefore, so far change our method of progress as to consider those various parts of the plant, such at least as have not been already touched upon, in something like a natural and convenient order. Having already devoted some attention to the descending axis or root, we may now proceed to the, formerly deferred, consideration of the ascending axis or stem.

The more one reflects upon the phenomena of life, especially of vegetable life, the more is one convinced that they can only be caused and directed either by a consciousness existing in the organism itself and controlling its conduct, or some pervasive consciousness without the organism which ordains for it its actions, either of which hypotheses seems to imply some pre-existing intelligence; for nature must be a power even more miraculous than we esteem her, if she be either herself wise without thought and prudent without knowledge, or capable of endowing her productions with a consciousness, wisdom, and foresight, of which she herself is innocent. Thus, with regard to a seed, there resides in that organism a faculty of discerning between up and down, and that even when in darkness,—for I have not yet heard of a seed, although many must alight or get down the wrong way up, sending its radicle upwards or its plumule downwards. By a certain and infallible instinct the true direction is always taken, the future root seeking the darkness, and the future stem the air and light. No doubt the sun may be regarded as supplying the physical energy for this action of the plant, as for all, but it cannot be said to have given direction to the movement, the direction being determined by certain qualities in the seed itself, even as in a humanly contrived machine the motive power, heat, supplies the energy, but the intellect of the inventor, as realized in the machine, conducts this energy in the desired course. This is a highly important principle, by losing sight of which men have fallen into the error of reckoning this universe to be the necessary outcome of the undirected action of the various forms of energy. Perhaps no more ludicrously insufficient reason for a fact was ever rendered than that which is seriously assigned as the cause of the upward direction taken by the plumule, viz., that it takes this direction in opposition to the force of gravitation. This is surely the first time that the movement of any body in one direction has been ascribed to a force pulling it in another. There is surely in the plumule no natural, one is tempted to say piggish, obstinacy which causes it to go one way because it is pulled another. All we know, and I believe can know on such a point, is that the plumule is so constituted as to seek the air and light, indeed to take and, if strong enough, maintain that vertical direction through assuming which the plant may best avail itself of the action of air and light; for the natural aim taken by the young growing point is not toward the quarter from which the maximum of light comes, although the tendency of a plant when it loses rigidity is to lean toward the light. The advantage of this fact for that plant which may be said to have a perfect stem, that is, a permanent one, rigid enough to resist the downward attraction of the earth, is obvious, as it is thus enabled to balance itself and maintain its upward course in a way it could not do if starting with a sunward slant. In this, as in all instances, the plant seems to proceed as though possessed of a perfect consciousness of its future, and with a matured scheme of living and complete strategy for the campaign of existence ready to unfold itself. There are thus plants which seem aware from the first that they will not be able to reach the light, to exalt themselves above the surface of the earth. They come, therefore, provided with properties and implements for attaching themselves to bodies more rigid, and thus climbing to the light and upper air. Upon this point I should like to dwell a short time and to quote to you from Mr. Darwin's fascinating and instructive monograph on 'Movements and Habits of Climbing Plants,' sufficiently to show what truly astonishing powers and provisions exist in this class of plants. There are several ways in which these supple-stemmed creatures attach themselves to their stronger fellows or other means of support. They may either twine their stems round some object they meet with and thus rest a part at least of their weight on it, or they may attach themselves at various points by means of hooks and tendrils, or, like ivy, they may clasp with crampions. It is obvious, then, that the first aim of the plant must be to find something suitable to which to attach itself. With this view it executes a circular or elliptic revolution, so that it feels over a considerable circuit and continues this process till it meets with the object of its search. Then either the stem itself twists about the support or the various grappling apparatus lay hold of it. In the former case the whole plant above the first point of contact continues to revolve and wind itself round the stick or stem it has found. In the other the unattached tendrils or hooks remain voluble and sensitive, and proceed to seek and clasp at fresh points. Especially remarkably is it that this sensibility remains just so long as there is hope of its being of use or need for its employment. The following from page 79 of Mr. Darwin's work, referring to the *Gloriosa Plantii*, a plant climbing by its leaf-tendrils, will fully bear out this statement.

"The hook when first formed, before the leaf has bent downwards, is but little sensitive. If it catches hold of nothing it remains open and sensitive for a long time. Ultimately the extremity spontaneously and slowly curls inwards and makes a button-like, flat, spiral coil at the end of the leaf. As soon as the tip has curled so much inwards that the hook is converted into a ring its sensibility is lost, but as long as it remains open some sensibility is retained.

"While the plant was only about six inches in height, the leaves, four or five in number, were broader than those subsequently produced; their soft and but little attenuated tips were not sensitive and did not form hooks, nor did the stem then revolve. At this early period of growth the plant can support itself; its climbing powers are not required, and consequently not developed; so, again, the leaves on the summit of a full-grown flowering plant, which would not require to climb any higher, were not sensitive and could not clasp a stick. We thus see how perfect is the economy of nature." This last exclamation is not mine, but Mr. Darwin's own, and no wonder; dull must be the mind that is not attracted, charmed and exhilarated by contemplating so exquisite and accurate adjustment of means to end. As illustrating the versatilty of nature's contrivances note the following. Speaking of *Bignonia littoralis* Mr. Darwin says, "The species last described, *Bignonia Venusta*, ascended a vertical stick by twining spirally and seizing it alternately with its opposite tendrils, like a sailor pulling himself up a rope hand over hand. The present species pulls itself up like a sailor seizing with both hands together a rope above his head," page 92. Of *Bignonia speciosa* he says, "The whole terminal portion of the tendril exhibits a singular habit, which in an animal would be called an instinct, for it continually searches for any little crevice or hole into which to insert itself," page 95.

"Tendrils will not clasp each other, and if they have done so, unclasp again" (page 131).

"A nice case of co-adaptation here comes into play; in all the other tendrils observed by me, the several branches become sensitive at the same period. Had this been the case with the *Hanburya Mexicana*, the inwardly-directed, spur-like branch, from being pressed during the revolving movement against the projecting end of the shoot, would infallibly have seized it in a useless and injurious manner. But the main branch of the tendril, after revolving for a time in a vertical position, spontaneously bends downwards, and in doing so raises the spur-like branch, which itself also curves upwards, so that by these combined movements it rises above the projecting end of the shoot, and can now move freely without touching the shoot; and now *it first becomes sensitive*" (page 134).

On page 181 of the same work, Mr. Darwin, frankly and modestly, and with true scientific spirit, confesses, "Why a delicate touch should cause one side of a tendril to contract, we know as little as why, on the view held by Sachs, it should lead to extraordinarily rapid growth of the opposite side."

This sentence shows that Mr. Darwin himself, if not possessing a truly philosophic mind, has at least sufficient philosophic sense to avoid confounding *cause* and *means* in the way some of his so-called followers frequently do. To certain of these it would appear a sufficient explanation of *cause* to say that the tendril clasped the support because the outside part grew faster than the inner; but this is really only an explanation of *means*, for we want to know the cause of this different rate of growth, which evidently is some extraordinary faculty of the plant, not to be explained on either mechanical or chemical principles alone. For if it rested on mechanical ones, how can we explain why one tendril either does not clasp another at all, or, having done so, unclasps again? It is not a little gratifying to me to find Mr. Darwin driven to use the same expression with regard to these tendrils which I ventured to apply to the conduct of rootlets—viz., instinct. There is, indeed, no other term, so scientifically precise, that can be applied; for instinct simply means the faculty of performing necessary and beneficial actions without consciousness or ratiocination. It is, therefore, as correct to say that the conduct of tendrils and rootlets is guided by a vegetable instinct, as to say that action of young animals is guided by animal instinct. Instinct is then a characteristic of both kinds of living matter, and it may be traced very low, if not indeed to be very lowest forms of life; and it is a quality completely absent in dead unvitalized matter. This conclusion gives no little support to our contention that vital action is as distinct from mechano-chemical action as mechanics and chemistry are themselves distinct. We are at any rate in this case shut up to one of two inferences from the facts Mr. Darwin has placed before us, either that these plants have both some consciousness of their surroundings and a capacity of acquiring the properties necessary to their well-being, or that some intelligent agent has constructed them so and endowed them with such faculties that they are specially and wonderfully adapted to the situation in which they are found. Which hypothesis is the more credible one may safely leave to the verdict of any sane mind. As an example how what we look upon as human inventions and contrivances have been anticipated by nature the following may be quoted from the same work:—

"A tendril which has not become attached to any body does not contract spirally, and in the course of a week or two shrinks into the finest thread, withers and drops off. An attached tendril, on the other hand, contracts spirally, and thus becomes highly elastic, so when the main footstalk is pulled the strain is distributed equally between all the attached discs" (page 147).

Whatever mortal first discovered and applied the principle of the spiral spring doubtless considered himself, and was esteemed by others, a very clever person; but nature had been quite as clever long before. And what art is there in nature, what still unrivalled wealth of beauty! How we should miss the solid greenery of the ivy, that adorns alike the wrecks of nature and the ruins of human works. How could we spare the sweet woodbine, that twines innocently about the rude trunk and breathes its honey-luscious fragrance through the evening woods? or could we afford to lose from nature's bounty the purple-blooming clusters of the grape? Yet all these and hundreds of other plants—so dear to the sight, so grateful to other senses—are only enabled to exist by means of those extraordinary and beautiful provisions which we have been considering. Had this world been the result of a mere blind struggle for existence, unguided by purpose or prevision, it seems in the highest degree unlikely that these plants could have developed such powers in time to avail them in so intense a struggle. There may, indeed, be in nature many problems which try the faith and defy the penetration of the acutest intellect, many sorrowful, apparently cruel, facts which sadden the heart, but the more deep and loving our study of nature becomes, the more, I thoroughly believe, will a faith be strengthened in us, that it is neither without intelligence, without foresight, or wisdom, nor yet without at least mercy and benevolence that the universe we contemplate has been constructed and is still controlled.

THE COBALT HYGROMETER.*

Unsized paper, as thin blotting or filtering paper, is to be dipped into a solution of chloride of cobalt, common salt, and a little gum arabic. It is red at first, but while drying becomes more pink, bluish-red, and finally blue when quite dry. As the paper thus prepared is slightly hygroscopic, it will easily attract atmospheric moisture, and be coloured more or less reddish in proportion as it finds more moisture to attract. The *Manufacturer and Builder* suggests that if it is to be used in very dry climates, a very little glycerin or chloride of lime may perhaps be added to the solution, when it will be more capable of indicating the difference in moisture in comparatively dryer kinds of air. A good addition to this arrangement is a disc painted with half a dozen or more shades of red and blue for comparison, as enumerated below, which shades may then be marked thus:

Rose-red.	Pink.	Bluish-pink.	Lavender.	Violet.	Blue.
Rain.	Very moist.	Moist.	Middling.	Dry.	Very dry.

REMOVAL OF ODOUR OF MUSK.*

Mr. Ernst Biltz, in his admirable work, 'Notizen zur Pharmacopœa Germanica,' states that the disagreeable persistence of the odour of musk, on the hands and on utensils, may be readily removed by powdered ergot. About a teaspoonful of the latter is placed into the hollow of the hand, warm water is added to make a thin paste, and both hands are then well rubbed with it. The odour immediately disappears, and does not return. The author made this observation while making some powders containing musk and ergot; he had triturated the musk with sugar previous to the addition of the ergot, otherwise the resulting odourlessness of the mixture might have caused him to doubt whether he had added any musk or not.

* *New Remedies.*