WHY DO ROOTS GROW DOWNWARDS, AND STEMS TOWARDS THE HEAVENS?

Second Article.

Our readers may remember a very simple experiment, but pregnant with important results, which we described in our former article: namely, if an onion plant, exposed to day light, be laid horizontally on the ground, the extremities of the stem and roots will in the course of a few hours turn themselves in their natural directions, the one upwards and the other downwards; if a similar plant be placed in a dark cellar, to which no light has access, the same things will take place; but that which happens in a few hours in the one instance, will require as many days in the other. From this experiment we were led to conclude that in the production of the proper directions of stems and roots, two classes of causes operate, namely, the light; and, secondly, some other principle distinct from light. Our former article was devoted to the explanation of the manner in which light causes stems to ascend, and roots to descend; we shall now endeavour to investigate that other principle, less powerful, but more universal, which shares in the production of the same phenomena.

If the flower stalk of the common dandelion be split vertically into a number of portions, each of these will be seen, spontaneously, to curl outwards; the same tendency must be familiar to every one in celery dressed for the table; if the root of the dandelion be split vertically into two or more parts, these will likewise be found to curve, but in a contrary direction from those of the stem; they will curl inwards. We thus find that all the portions of stem placed round the central axis have a natural tendency to curl outwards; while all the portions of root round the central axis have a tendency to curl inwards. The stem may be therefore considered as consisting of a number of springs placed round a central axis, and all endeavouring to burst away from each other; while the root, in a like manner, may be regarded as composed of a number of springs placed round a central axis, and all pressing against each other. These natural tendencies are overcome, in the living plant, by the mutual cohesion of these parts or springs; but when this cohesion is removed by the knife, their influence becomes acknowledged.

Now, if we imagine a number of springs, all of equal strength, and either dragging away from each other or pressing together, it will be easily understood that in such cases perfect equilibrium should result: for, of two springs pulling in opposite directions, for either to overcome, it is necessary that one should be the more powerful; and the same applies to springs pressing against each other. As long, therefore, as a stem consists of a number of equal springs, all endeavouring to burst away from each other, its direction will be in a straight line; and as long as a root is composed of equal springs pressing towards each other, its direction, likewise, will be straight.

If a stem or root be placed for a certain length of time in a horizontal position, the peculiar tendency to curvation of its parts will become modified. If a stem which has been thus treated be split along its axis, the part which, while it was in a horizontal position, was superior, will have its tendency to curl outwards increased; while that which was under the same circumstances inferior, will have its tendency to curl outwards diminished. If a root be placed, during a certain period, horizontally, and then split along its axis, the superior portion will be found to have its tendency to curl inwards increased, while the inferior portion will have the same tendency diminished. A horizontal position is therefore found to increase the peculiar tendencies to curvation of the superior parts of stems and roots, and to lessen those of the inferior half.

Now, we have already ascertained that while equal springs either pull against or press towards each other, equilibrium is obtained; but if from any cause the springs become unequal, the greater power may be expected to overcome the less. When a stem or root has been kept for some time horizontally, the upper half has its elastic power increased, while the spring of the most depending portion has become diminished; we have therefore now springs of unequal power placed round a central axis, the superior being rendered more energetic, while their antagonists have become weakened; it is reasonable, therefore, to expect that the respective directions of roots and stems under such circumstances should be obedient to the excess of elasticity which the upper half has acquired over the lower; in other words, these stems and roots ought to direct themselves in accordance with the natural tendencies of the superior springs which enter into the structure of these organs. Now, the superior springs of the stems have a natural tendency to curl outwards, or when placed horizontally, upwards; and the superior half of the root has an equally natural tendency to curl inwards, or, when placed horizontally, downwards. Need we be surprised, therefore, if in obedience to these more powerful springs the stems and roots of vegetables shall (as experience shows us they will do) curve, after having been placed for some time in a horizontal position, the former upward and the latter downward?

Let us now endeavour to explain the causes which produce these peculiar and different tendencies to curvation of stems and roots, and for this purpose it will be necessary for us to premise, that the fleshy substance which constitutes the basis of vegetable structure is composed of a multitude of little vesicles or cells, each perfectly distinct in itself, and merely adhering by its external surface with those surrounding it, while it contains a thick syrupy liquid; these cells, although pressed to a certain extent against each other, are not so closely approached as to obliterate completely the spaces existing between them, so that little passages, called intercellular passages, continue to remain, during the life of the plant, between the cells through which the ascending sap rises in its passage to the buds. This ascending sap is not so viscid a liquid as that contained in the cells: thus, the syrupy contents of the latter must, according to the principle of endosmose described in a previous article, absorb into the cells the ascending sap, in a way similar to that whereby syrup placed in a bladder, immersed in a basin of water, will attract the latter liquid through the membrane, until the bladder be filled. While the sap continues to ascend, therefore, the cells must necessarily continue swollen in proportion to their size.

If we examine the relative size of the cells in stems and roots, we will meet with a remarkable phenomenon: in stems the largest cells are situated towards the centre; but on the contrary, in roots, the largest cells are placed near the circumference. Now, we have ascertained in the preceding paragraph that all the cells have a tendency to swell in proportion to their size: it follows that the central cells of stems and the circumferential cells of roots possess the greatest tendency to swell. The centre of a stem has therefore greater elasticity than the circumference, while the circumference of a root has greater elasticity than the centre. When this elasticity in either case is permitted to exert itself by means of a vertical section, it causes each half of the stem to curl outwards, and each half of the root to curl inwards. If the influence of endosmose be acknowledged, the explanation is perfect.

But it may be said, what proof have we that endosmose operates in these cases? An experiment instituted by Dutrochet, and repeated by the writer of this article, sufficiently demonstrates its influence. A plant of dandelion was immersed in syrup, and after a certain time the root and stalk were severally split in a vertical direction: the tendencies to incurvation of these organs were now seen to be completely changed from what they are under ordinary circumstances; the parts of the stalk curled inwards, those of the root outwards: this was exactly what might be expected, if we suppose endosmose to be the cause of these phenomena; placed in syrup, this thick fluid attracted liquid out of the cells, which consequently shrunk in place of expanding; and the larger cells contracting more than the smaller, the former elasticities became reversed.

It remains to be seen why it is that when roots and stems are planted for some time in a horizontal position, the proper elasticities of the superior parts become increased, while those of the inferior become diminished. These phenomena can be explained by recollecting that the ascending sap is a heterogeneous fluid, composed of mucilage and syrup, mixed with light water and carbonic acid, which have been drawn up unchanged from the extremities of the roots, and are destined to escape, or undergo decomposition in the leaves. It is not difficult to imagine that this heterogeneous fluid contained in the intercellular passages should be subjected to the influence of gravity; if this be admitted, we can then understand how in a horizontal root or stem the heavier and more viscid portion of the sap should descend into the inferior half, and the lighter ascend between the cells of the superior half; endosmose will take place in proportion to the differ-

ence of density between the liquid in the intercellular passages and that contained in the cells; therefore it will take place more energetically in the superior half, where is the lighter fluid; and as the elasticity depends upon the energy of endosmose, the upper portion will, according to its nature, curve with greater force, while the elasticity of the lower part will be lessened. This explanation acquires increased weight from the fact that the specific gravity of the most depending portions of stems and roots growing horizontally in the dark, is greater than that of the upper.

But we have stronger arguments in favour of the supposition that gravity is essentially connected with the several directions of stems and roots. These directions take place naturally in the "line of gravity," that is, parallel to a line drawn from the centre of the mass towards the centre of the earth; at the same time it is to be remarked, that although roots grow in the direction of gravity, that is, towards the centre of the earth, stems grow in exactly the opposite way. An experiment made by Mr Knight has been repeated by different philosophers, to determine whether these directions of stems and roots bear to other physical laws the same relation they do to gravity. Seeds permitted to germinate in wet moss were attached to the circumference of a wheel made to revolve constantly in a vertical manner; under these circumstances the roots grew outwards, away from the circumference of the wheel, and the stems towards its centre; the roots were thus found to obey the centrifugal force, and the stems the centripetal; but while the wheel revolved vertically, gravity and the centrifugal force were operating in the same direction. It was necessary to cause them to act in different directions, and for this purpose the wheel was made to revolve horizontally: in this case the centrifugal force acted at right angles to the line of gravity, and it was accordingly found, in obedience to the law of the composition of forces, that the roots no longer grew towards the centre of the earth, nor towards the circumference of the wheel, but in a plane between these two forces; and the angle which they formed with the line of gravity could be rendered more or less acute by increasing or diminishing the velocity with which the wheel rotated. It was thus made evident that roots and stems were influenced by physical laws, although growing in opposite directions.

We have thus shown why roots grow downwards and stems towards the heavens: in the dark these things arise through the influence of gravity controlling endosmose, and thus producing the proper incurvations of the parts of stems and roots. Under the influence of light the same phenomena more energetically arise from the agency of this element over vegetable growth. J. A.

THE LADY WITH THE SPECTACLES.

Beauty in spectacles is like Cupid in knee breeches, or the Graces with pocket handkerchiefs—an excrescence of refinement; an innovation of the ideas which spiritualize woman into a goddess; a philosophical blossom of the "march of mind." Beauty in spectacles! and has it come to this? Burke said that the age of chivalry was past, and publishers say that the age of poetry has followed it; powder and periwigs destroyed the one, and spectacles have gone far to annihilate the other. Think of the queen of beauty of some tournament—thanks to my Lord Eglintoun for making such words familiar to us—looking on the encountering knights through a patent pair of spectacles!—picture to yourself a beautiful and romantic young lady parting from her lover, taking the "first long lingering kiss of love," as pretty Miss Pardoe terms it, and just imagine the figure the spectacles would cut in such an encounter; think of Mary Queen of Scots, Lady Jane Grey, Scott's "Jewess," or Shakspeare's "Lady Macbeth," with such appendages! think of a heroine in a novel taking off her spectacles to shed "salt tears" for her lover's absence, or in the emotion of a distressing juncture throwing herself at the feet of some obdurate tyrant, breaking the lenses of her "sight preservers;" think of all this, and judge of the effect which spectacles, as an ornament, have upon romance. Beauty has three stages—the coy, the dignified, and the intellectual. The first exists until about twenty, the second until twenty-five, and the last until beauty has made unto itself wings and flown away. It is in this last stage that women wear spectacles. The symptoms of spectacles begin at an early age. The young Miss has a primness, a staidness, and a miniature severity of aspect, at variance from her years. They never seem young; there is no freshness of heart in them: they become women faster than other girls, and become old faster than other women; they are remarkable for thin lips, sharp noses, and white artificial teeth. They are walking strictures upon human life—bleak visions of philosophy in petticoats—daughters, not it would seem of love, but of Fellows of the Royal Society! They are fond of phrenology and meetings of scientific associations. They like a good pew in church, and write long letters to their unfortunate "friends in the country." They are generally spinsters, or, if married, motherless. No young wife with "six small children" ever wore spectacles. They go a good deal into company, where they are seen seated on sofas talking to ladies older than themselves, or turning over the leaves of a book, and with interesting abstraction poring over it. They dance quadrilles, but never waltz. Heaven and earth! think of a pair of spectacles whirling in a waltz. They have a genius for the "scholastic profession," and frequently exercise it as amateurs; "never eat suppers;" and are, many of them, members of the Horticultural Society. The lady with the spectacles! Half a century ago this would have been understood to refer to some one stricken in years, but now-a-days infirmity of eye-sight has been raised to the rank of a charm. The moment spectacles become really useful they are abandoned; it is the harmonious combination of youth and short-sightedness which gives beauty to the guise. Intense interest is expected to be felt towards her, who, still young and lovely, abandons the frivolities of her sex for the calm secluded pleasures of intellect. This is the point our heroines aim at. But we have done with them. They may be very good in their way, but their ways are not as our ways. Flirts, coquettes, prudes, and a host of other orders into which the sex are classified, have their failings, but they, at least, are women; while the "lady with the spectacles" seems hardly a daughter of Eve, but a mysterious being; a new creation, come into the world to gladden the lovers of modern science, and patronise the house of Solomons and Co. —*Court Gazette.*

Marriage.—It is the happiest and most virtuous state of society, in which the husband and wife set out early together, make their property together, and with perfect sympathy of soul graduate all their expenses, plans, calculations and desires, with reference to their present means, and to their future and common interest. Nothing delights me more than to enter the neat little tenement of the young couple, who within perhaps two or three years, without any resources but their own knowledge or industry, have joined heart and hand, and engage to share together the responsibilities, duties, interests, trials, and pleasures of life. The industrious wife is cheerfully employing her own hands in domestic duties, putting her house in order, or mending her husband's clothes, or preparing the dinner, whilst, perhaps, the little darling sits prattling upon the floor, or lies sleeping in the cradle—and everything seems preparing to welcome the happiest of husbands and the best of fathers, when he shall come from his toil to enjoy the sweets of his little paradise. This is the true domestic pleasure, the "only bliss that survived the fall." Health, contentment, love, abundance, and bright prospects, are all here. But it has become a prevalent sentiment, that a man must acquire his fortune before he marries—that the wife must have no sympathy, nor share with him in the pursuit of it, in which most of the pleasure truly consists; and the young married people must set out with as large and expensive an establishment as is becoming those who have been wedded for 20 years. This is very unhappy. It fills the community with bachelors, who are waiting to make their fortunes, endangering virtue and promoting vice—it destroys the true economy and design of the domestic institution, and it promotes idleness and inefficiency among females, who are expecting to be taken up by a fortune, and passively sustained, without any care or concern on their part—and thus many a wife becomes, as a gentleman once remarked, not a "help-mate," but a "help-eat."—*Winslow.*

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