## Darwin's Latest Addition to the Literature of Evolution.

### Science for Children—A New and Weak History of Greece.

To the theory of evolution Mr. Darwin has already devoted his life. The hypothesis, as it stands, has met the concurrence and approval of scientific men all the world over; it is accepted as a perfectly satisfactory explanation of a great many things that have hitherto gone unexplained, but thorough and perfect as the theory is, it has not yet been carried out to its logical consequences in a great many directions. Of course in this use of the words, Theory of Evolution, we mean not evolution alone but the ordinary unscientific acceptation of the terms which includes the whole doctrine of the survival of the fittest natural selection and evolution. Mr. Darwin's latest volume, "The Power of Movement in Plants" (New York: D. Appleton & Co.), is only an additional chapter to the new Gospel. The name of the book explains its purpose, and when it is added that it is written in the inimitably graceful and simple language with which the father of the new philosophy knows so well how to clothe his thoughts, but little more remains to be said about it.

It is an inquiry principally into the circumnutating movement of plants, a word which may be rendered in the vulgate, "bending" or "nodding around." This movement is common to all, and enters more or less prominently into each of the other motions of vegetable life; and as the common idea of life itself is movement, it will readily be seen how interesting this inquiry becomes. As a matter of fact science is knocking at the portal of the last great riddle which time has left us to solve, and this volume is another step, probably we should better say another nutation in the relation of light.

In the first place, to begin logically with the beginning, here is how the motions of the plants was observed:

Plants growing in pots were protected wholly from the light, or had light admitted from above, or on one side as the case might require, and were covered above by a large horizontal sheet of glass, and with another vertical sheet on one side. A glass filament, not thicker than a horsehair, and from a quarter to three-quarters of an inch in length, was affixed to the part to be observed by means of shellac dissolved in alcohol. The solution was allowed to evaporate, until it became so thick that it set hard in two or three seconds, and it never injured the tissues, even the tips of tender radicles, to which it was applied. To the end of the glass filament an excessively minute bead of black sealing-wag was cemented, below or behind which a bit of card with a black dot was fixed to stick driven into the ground. The weight of the filament was so slight that even small leaves were not perceptibly pressed down. Another method of observation, when much magnification of the movement was not required, will presently be described. The bead and the dot on the card were viewed through the horizontal or vertical glass plate (according to the position of the object), and when one exactly covered the other a dot was made on the glass plate with a sharply pointed stick dipped in thick Indian ink. Other dots were made at short intervals of time, and these were afterwards joined by straight lines. The figures thus traced were therefore angular; but if dots had been made every one or two minutes the lines would have been more curvilinear, as occurred when radicles were allowed to trace their own courses on smoked glass plates.

It is useless to attempt to bring the reader over the five hundred pages of recorded experiment which follow the introduction—to do that would be to reprint the whole volume; the last chapter, however, sums up the results of the whole and from it we shall quote a paragraph or two to indicate its scope:

All the parts or organs in every plant whilst they continue to grow, are continually circumnutating. This movement commences even before the young seedling has broken through the ground. The nature of the movement and its causes, as far as ascertained, have been briefly described in the introduction. Why every part of a plant whilst it is growing, and in the same case after its growth has ceased should have its cells rendered more turgescent and its cell walls more extensile first on one side and then on another, thus inducing circumnutation, is not known. It would appear as if the changes in the cells required periods of rest.

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The circumnutating movement when viewed under the microscope is seen to consist of innumerable small oscellations. The part under observation suddenly jerks forward for a length of .002 to .001 of an inch and then slowly retreats for a part of this distance; after a few seconds it again jerks forward, but with many intermissions.

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The phenomenon is a remarkable one. The whole hypocatyl of a cabbage or the whole leaf of a Dionæa could not jerk forward unless a very large number of cells on one side were simultaneously affected. Are we to suppose that these cells steadily become more and more turgescent on one side until the part suddenly yields and bends, inducing what might be called a microsopically minute earthquake in the plant? Or do the cells on one side suddenly become turgiscent in an intermittent manner, each forward movement thus caused being opposed by the elasticity of the tissues?

Circumnutation is of a paramount importance in the life of every plant, for it is through its modification that many highly beneficial or necessary movements have been acquired. When light strikes on one side of a plant, or light changes into darkness, or when gravitation acts upon a displaced part, the plant is enabled in some unknown manner to increase the always varying turgescence of the cells on one side; so that the ordinary circumnutating movement is modified, and the part bends either to or from the exciting cause; or it may occupy a new position as in the so-called sleep of leaves.

How the root itself works its course downwards is thus explained and told:

After the tip has penetrated the ground to a little depth, the increasing thickness of the radicle, together with the root-hairs, hold it securely in its place; and now the force exerted by the longitudinal growth of the radicle drives the tip deeper into the ground. This force, combined with that due to transverse growth, gives to the radicle the power of a wedge. Even a growing root of moderate size, such as that of a seedling bean, can displace a weight of some pounds. It is not probable that the tip when buried in compact earth can actually circumnutate and thus aid its downward passage, but the circumnutating movement will facilitate the tip entering any lateral or oblique fissure in the earth, or a burrow made by an earth worm or larva; and it is certain that roots often run down the old burrows of worms. The tip, however, in endeavoring to circumnutate, will continually press against the earth on all sides, and this can hardly fail to be of the highest importance to the plant; for we have seen that when little bits of card-like paper and of very thin paper were cemented on opposite sides of the tip, the whole growing part of the radicle was excited to bend away from the side bearing the card or more resisting substance, towards the side bearing the thin paper. We may, therefore, feel almost sure that when the tip encounters a stone or other obstacle in the ground, or even earth more compact on one side than the other, the root will bend away as much as it can from the obstacle or more resisting earth, and will thus follow with unerring skill a line of least resistance.

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The course pursued by the radicle in penetrating the ground must be determined by the tip; hence it has acquired such diverse kinds of sensitiveness. It is hardly an exaggeration to say that the tip of the radicle thus endowed, and having the power of directing the movements of the adjoining parts, acts like the brain of one of the lower animals; the brain being seated within the anterior end of the body, receiving impressions from the sense-organs, and directing the several movements.