THE POWER OF MOVEMENT IN PLANTS.

This is a contribution to biological science, of a rather high order, published in the form of a popular treatise. It is an illustration, very marked of its kind, of the power of a high scientific reputation to carry a work before the general public, which published under any other authorship would find, no matter how great its scientific merit, only a comparatively limited circle of appreciative readers. The name of Darwin, which, as some one has lately said, is popularly attached to one-half of all science, and the theory of evolution, would almost make a memoir on a subject as abstruse as quaternions a popular work and a paying business investment for its publisher.

It is not meant by the above that the present volume is incomprehensible or uninteresting to at least the average student of natural science. It is one that every student in biology will do well to peruse, and it is well that the subject is introduced under such favorable auspices, as it will the more readily receive the attention it deserves. It is not an unattractive one; there are few observers of nature who have not wondered at and speculated upon the varied, and in some cases, extraordinary-appearing motions of vegetable organisms, such as the sleep of flowers and leaves, and the almost animal irritability of the sensitive plant. But some of the most universal and apparently commonplace phenomena of plant-life are, when we consider them, not less remarkable. In some of his former works Mr. Darwin has discussed the more obvious and striking peculiarities of climbing and insectivorous plants; in the present one he takes up and studies the less striking but not less wonderful phenomena of the movements of growth; how, from the buried seed the plant finds its way to the light and how the rootlet selects its downward route, the sleep of leaves, etc. He finds that the most widely prevalent movement, and one common to nearly all plants, is rotation of its growing tip to all points of the compass, and to this motion he gives the name circumnutation. This is due, not to an alternating increased growth on the different sides of the plant, as was once supposed to be the case, but to an increased turgescence of cells on different sides of the tip successively, which is prior to and therefore independent of growth proper. Moreover, in cases of plants provided with pulvini, or little cushions of small cells that early cease to grow, this movement is kept up long after the growth of the plant has ceased. This motion of circumnutation in all its phases and modifications covers a large part of the useful movements of plants, and is therefore essential to their existence. Among its modifications are included by Mr. Darwin the revolving nutation of the tendrils and tips of climbing plants, the nyctitropic or sleep movements of leaves and cotyledons, and the immense class of movements excited by light and gravitation. It is not a property of the aerial system alone; the tip of the rostel or radicle possesses the same motion, and by it selects its passage through the more resistant materials through which it makes its downward progress. This tip of the radicle alone is sensitive to gravitation, and, being thus sensitive, it leads, so to speak, the root downward toward the centre of the earth. Circumnutation is not in itself explained; the fact that it occurs and is essential to the life of the plant, and that its modifications account for the greater part of vegetable movements, is noted and closely followed out. These modifications themselves are not always explainable,—at least they are not explained in the present state of our knowledge. A few movements of plants are not apparently to be referred to modified circumnutation, such, for example, as the movements of plants sensitive to contact on being touched, the curling of a tendril, etc. These, however, do not form so large and important a class as do the others, though they are not at all infrequent or unimportant.

In the concluding paragraphs of the book attention is called to the resemblance of the foregoing movements of plants and the unconscious actions of many of the lower animals. *The most striking resemblance, however*, is in the localization of their sensitiveness, and the power of transmitting an influence from the excited part to another which consequently moves, almost suggesting the *idea of a nervous connection, as in the higher* organisms. Mr. Darwin says: "We believe that there is no structure in plants more wonderful, as far as its functions are concerned, than the tip of the radicle. If the tip be lightly pressed, or burnt, or cut, it transmits an influence to the upper adjoining part, causing it to bend away from the affected side; and, what is more surprising, the tip can distinguish between a slightly harder and softer object, by which it is simultaneously pressed on opposit sides. If, however, the radicle is pressed by a similar object a little above the tip, the pressed part does not transmit any influence to the more distant parts, but bends abruptly toward the object. If the tip perceives the air to be moister on one side than on the other, it likewise transmits an influence to the upper adjoining part, which bends toward the source of moisture. When the tip is excited by light (though in the case of radicles this was asserted in only *a single instance*) the *adjoining part bends* from the light; but, when excited by gravitation, the same part bends toward the centre of gravity. In almost every case we can clearly perceive the final purpose or advantage of the several movements. Two, or perhaps more, of the exciting causes often act simultaneously on the tip, and one conquers the other, no doubt, in accordance with its importance for the *life of the plant*. 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."

We have spoken of Mr. Darwin as the writer of this book, but, as indicated in its title page, he is not its sole author, he having been assisted by his son, to whom the credit for a large part of the labor of the investigation is probably due. The rising scientific reputation of *Mr. Francis Darwin is an instance* in favor of the hereditary transmission of qualities, one of the bases of the Darwinian theory. While the book is not likely to be as attractive to the general reader as the earlier contributions of the senior author, it is a most valuable member of the series that the student in biology cannot afford to be ignorant of, and one worthy of a place in any library. It is very clearly written, and the elaborate and novel nomenclature employed is very fully explained. Even to the reader hitherto unfamiliar with the general subject of botany and biology it is a very intelligible work.

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