

## MOVEMENTS OF PLANTS.

Most persons will no doubt be surprised to learn that plants have any power of movement at all. We have always been taught that one great distinction between plants and animals is that the latter have the power of movement, while the former have not. But there are movements and movements; and the kind of movement in which plants are deficient as contrasted with animals is that of locomotion. So far as observation has hitherto gone, plants have no power of changing their place by their own impulse. But, with this exception, the readers of this, the latest, work from the fertile brain of our greatest biologist will learn that every part and every organ of a growing plant is in a state of ceaseless motion. All Mr. Darwin's works have a family likeness. Starting with some suggestive fact or idea, he records a long series of experiments conducted with the greatest precaution and delicacy, and from these he deduces with the greatest caution and reserve the most obvious conclusions to which they point. Such, also, is the method of the work before us. One or two German botanists have noticed that certain parts of plants are constantly moving in a special kind of orbit, to which they have given the name of circular nutation. The point of a leaf of a growing plant, for example, describes during the twenty-four hours a small orbit more or less elliptical, and in the case of climbing plants creeping round their supports this course is approximately circular. Mr. Darwin and his son Francis, who has himself already done some remarkable work in botanical research, have for some time been conducting a long series of experiments to discover what is the real nature of this curious elliptical motion, to which they give the name of circumnutation, and to what extent it prevails among the various classes of plants, and the various organs by which plants carry on their functions. The conclusions which they have been able to reach are very remarkable. The motion of the root downwards in the ground, the motion of the stem upwards to and in the air, the motions of the leaves from day to day, the peculiar nightly set of leaves known as sleep, the tendency of leaves to seek the light, the action of gravitation, and so on, are all modifications of this one movement of circumnutation, adaptations of what seems a primitive innate motion to suit a great variety of circumstances. The tiny rootlet or radicle emerging from the seed gyrates as far as it can in its earthy home, ever tending downwards, but seeking out invariably the path of least resistance, and the soil from which it can extract the greatest moisture and nourishment. The embryo leaf-bearing stem in the same way oscillates upwards to the light; and when it spreads out its two first leaflets, these also begin their career of oscillation in the open air. And so with every leaf, and petiole, and other part as it comes forth, until every detail of the growing plant is in a state of constant elliptical motion. Here is Mr. Darwin's graphic account of the phenomenon:—

"Our seedling now throws up a stem bearing leaves and often branches, all of which, when young, are constantly circumnutating. If we look, for instance, at a great acacia tree, we may feel assured that every one of the innumerable growing shoots is constantly describing small ellipses, as is each petiole, sub-petiole, and leaflet. The latter, as well as ordinary leaves, generally move up and down in nearly the same vertical plane, so that they describe very narrow ellipses. The flower-peduncles are likewise continually circumnutating. If we could look beneath the ground, and our eyes had the power of a microscope, we should see the tip of each rootlet endeavouring to sweep small ellipses or circles, as far as the pressure of the surrounding earth permitted. All this astonishing amount of movement has been going on year after year since the time when, as a seedling, the tree first emerged from the ground."

Mr. Darwin's experiments were made on plants belonging to the most diversified classes, so that he is justified in concluding that the varied movements he noticed in these are common to nearly all plants. Among the special kinds of movements investigated by him are those to which plants are subject under the influence of light, and these which are peculiar to the leaves of certain plants on the withdrawal of light and the approach of night. The tendency of plants to seek the strongest light is well known, and Mr. Darwin made many experiments in reference to this characteristic. Even the very smallest amount of light has an influence on most plants, though in many experiments it was found that after bending towards a strong light a feebler light failed to unbend them in an opposite direction. In the case of seedling plant—such as the bean say—Mr. Darwin found that the sensitiveness to light dwells in the tip of the stem, and if that were cut off from the source of light, the lower part of the stem refused to expand to its influence. In the root, also, it is the tip of the radicle and the subsidiary roots that are the sensitive feelers, so to speak; and if these tips are cut off the remaining parts are practically motionless. Indeed, so important is the function of the tip of the radicle, and so sensitive is it to the slightest touch or pressure, and so marked is the influence it transmits to the rest of the radicle, that Mr. Darwin likens it to the brain of the lower forms of animal life. With regard to the sleep of plants, Mr. Darwin records a long series of observations in the volume before us. The conclusion he comes to is, that it is not the mere absence of light that leads to these leaves assuming a vertical position at night, either by rising up or drooping down. "The presence of life or its absence cannot be supposed to be the direct cause of the movements, for these are wonderfully diversified, even with the leaflets of the same leaf, although all have, of course, been similarly exposed. The movements depend on innate causes, and are of an adaptive nature. The alternatives of light and darkness merely give notice to the leaves that the period has arrived for them to move in a certain manner. We may infer from the fact of several plants not sleeping unless they have been well illuminated during the day, that it is not the actual decrease of light in the evening, but the contrast between the amount at this hour and during the early part of the day, which excites the leaves to modify their ordinary mode of circumnutation." The object gained by all the varied positions assumed by leaves at night is, Mr. Darwin tells us, the protection of the upper surfaces of the leaves from radiation, often combined with the mutual protection of the several parts by their close approximation. The so-called diurnal sleep of some plants, he finds, is merely a twisting of the leaves to avoid receiving the glare and heat of the sun on the upper surfaces, to which it would be injurious. But whatever may be the object or the special nature of the various motions to which the different parts of plants are subject, Mr. Darwin comes to the conclusion, from his long and varied series of experiments, that they are all adaptations to suit special circumstances of the one primitive motion which he has called circumnutation; one more proof of the great law of natural selection, and the tendency of all living things to adapt themselves to their surroundings.