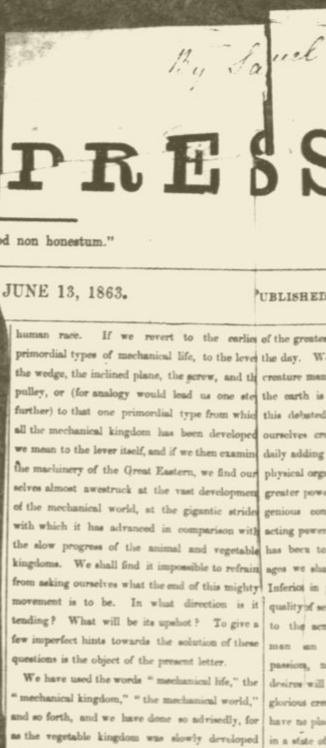
Review.

THE POWER OF MOVEMENT IN PLANTS. By CHARLES DARWIN, LL.D., F.R.S., assisted by FRANCIS DARWIN. London: J. Murray. 1880.

In his work on 'Climbing Plants,' Mr. Darwin has already given us the main facts regarding the interesting phenomena connected with climbing stems, tendrils, etc. In the present volume he collects together these, the phenomena of sensitiveness, as exhibited by *Mimosa*, many leguminosæ, and other plants, of heliotropism and geotropism, and attempts to associate them together as manifestations of a single law.

The law is that of "revolving nutation," as it was termed by Sachs, of "circumnutation," as Darwin prefers to call it, and is thus stated:—"All the parts or organs in every plant, whilst they continue to grow, and some parts which are provided with pulvini after they cease to grow, are continually circumnutating. This movement commences even before the young seedling has broken through the ground." The explanation of this phenomenon in the more marked cases where it has long been known was, until recently, the increased growth of the side which becomes for a time convex; but, although undoubtedly true, Darwin believes this not to be the cause, but only a result of the primary cause, itself inexplicable, viz., the greater turgescence of the cells and extensibility of the cell walls alternately on the one and the other side of the organ in question. To this cause are due, not only the phenomena of climbing stems and tendrils, but those of positive and negative heliotropism, and of positive and negative geotropism—or, to adopt the phraseology in the present volume, of heliotropism, apheliotropism, geotropism and apogeotropism—all of which are but modifications of circumnutation.

Probably the series of observations which will present the greatest novelty to most readers is that which demonstrates that those movements of nutation are as universal in the roots and other underground parts of plants as in the ordinary aerial stems. "Even the stems of seedlings before they have broken through the ground, as well as their buried radicles, circumnutate as far as the pressure of the surrounding earth permits." The tip of the radicle is sensitive to contact or irritation, and this sensitiveness causes movements in the adjoining parts. This peculiarity is confined to the tip of the radicle for a length of from 1 to 1·5 mm.; and when that part is irritated by contact with any object, by caustic, or by a thin slice being cut off, the upper adjoining part of the radicle, for a length of from 6 to 7 or even 12 mm., is excited to bend away from the side which has been irritated; and the curvature thus caused is generally symmetrical. Although this movement can aid the primary and secondary rootlets but little in enabling them to penetrate the soil, it is of material service to them in greatly enlarging the area from which they and their root hairs draw their nourishment.

If the circumnutation of growing organs were quite regular, their apex would describe a circle, or rather, "as the stem is always growing upwards, a circular spiral. But it generally describes irregular elliptical or oval figures. . . In the case of leaves the ellipses are generally narrow. Whilst describing such figures the apex often travels in a straight line, or makes small subordinate loops or triangles." We have in the volume a large number of reproductions of these zigzag lines, drawn on an ingenious plan contrived by the authors.

After describing the very remarkable phenomena connected with the circumnutating movements and growth of seedling plants, and the sensitiveness of the apex of the radicle to contact and other irritants, the authors proceed to discuss in like manner the circumnutating movements in mature plants—a very curious instance of which occurs in the oscillatory movements of the leaves of *Dionæa*;—the modified circumnutation exhibited in the phenomena of climbing plants, the sleep or "nyctitropic" movements of leaves and other organs, and in the movements excited by light, together with the general phenomena of sensitiveness to light and to gravitation. It is needless to add that this latest volume by Mr. Darwin forms no exception to the characteristic accuracy and minuteness of observation with which we are so familiar in his other researches. Like his previous works, it sums up the whole of our previous knowledge of the subject, adds vastly to it, and must form the necessary starting point for all future investigations.