papillæ. The lamina and its appendages occupy different positions with respect to one another, so that the leaf may be either open or closed. The entire mechanism acts in the same way as that of *Dionæa*.

Power of Movement in Plants.*—Mr. Darwin's book under this title is an extension, as it were, of his previous treatise on climbing plants. He shows that every growing part of every plant is continually moving round—"circumnutating" as he calls it. The movements of climbing plants, the upraising and depression of leaves, the movements of certain parts towards or from the light, all are modifications of this circumnutatory tendency. The most novel portions of the treatise are those relating to the movements of seedling plants, the upper part of which is alone sensitive to light and transmits an influence to the lower part, causing it to bend. If, therefore, the upper part be shielded from the influence of light, there will be no movement of the seedling, even though the lower portion be exposed to the light for hours. Still more novel and remarkable are the facts that Mr. Darwin brings forward with reference to the movements of the radicles and minute root-fibres. These, as it appears, are in constant movement, so far as the obstacles in their way will permit, and it is easy to see of what use this rotating movement is in enabling them to penetrate between some obstacles or to avoid others. The tip of the root, moreover, is sensitive to the touch and to various stimuli, and when thus excited it transmits an influence to the upper part, causing it to bend from the pressed side. On the other hand, if the tip be exposed to a current of watery vapour on one side the upper part of the radicle bends to that side.

The bulk of the book consists of the record of a series of elaborate experiments proving the existence and nature of the movements alluded to. The experiments were made by affixing to the part to be examined, by means of shellac, a fine thread of glass tipped by a minute dot of sealing-wax. A card with a similar black dot was affixed close by, and so arranged that on beginning an observation the black dot on the glass filament and that on the card coincided in position. As the plant or part of the plant moved, while the card was fixed, the relative position of the two black dots of course varied, and the degree of variation was marked upon the horizontal or vertical glass plate through which the plant was observed by a series of marks, which, when subsequently connected by lines, represented to some extent the course of the moving object. It is probable that some more accurate and "self-recording" register will hereafter be devised; but for Mr. Darwin's present purpose, for the mere establishment of the facts in their broad outlines, this plan is sufficient.

The tendency of modern investigation has been to break down in many points the alleged distinctive marks between plants and animals. One by one the old supposed distinctions have been abandoned, so that at present the prevalent belief is that all life is essentially one,

* Darwin, C. (assisted by F. Darwin), 'The Power of Movement in Plants,' 573 pp. and 196 figs. (8vo, London, 1880.)

and that its manifestations are exerted through the medium of machinery fundamentally identical in character. In accordance with these views Mr. Darwin points out the resemblance between the movements of plants and many of the actions performed unconsciously by the lower animals, the most striking illustration being in the kind of imperfect reflex action which is shown to occur when a certain portion of a plant is stimulated by a touch or otherwise, the influence being transmitted from the point of contact to some other point, which, as a direct consequence of this transmitted influence, moves just as the telegraph needle moves when a current is generated in the far-off battery. "It is hardly an exaggeration to say," remarks Mr. Darwin, "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."

Auxotonic Movements of Vegetable Organisms.*—The term *auxotonic* is applied by de Vries to the movements caused by an augmentation of the turgidity of an organ which is not followed by contraction, as in heliotropism, geotropism, nutation, epinasty, and especially in the movements of tendrils; *allassotonic* to those in which the augmentation of turgidity alternates with a diminution of volume, as in the movements of the sensitive plant and of the stamens of the Cynaraceæ. He now investigates the problem of the part played by turgidity and by intussusception in the phenomena of auxotonic curvatures of multicellular organs.

The general result of his experiments is stated by de Vries to be that the cause of auxotonic curvatures is an augmentation of the force of turgidity in the cells on the side which subsequently becomes convex. This augmentation causes the cells on that side to absorb more water, and in consequence to increase in size; thus originating the curvature. The enlargement of the cells causes a distension of the cell-walls, and this promotes intussusception; and the curvature thus becomes permanent.

Irritation determines a production of osmotic substances in the parenchymatous cells; and this production is the more abundant, the nearer the cells are to the point of irritation. The commencement of the epinastic movement is caused by the passage of substances by osmose into the parenchyma. In multicellular organs which are in process of growth, specific gravity and light, as well as other exciting causes, bring about curvatures by accelerating endosmosis on one side of the organ, which determines the increase in length. Among the osmotic substances which give rise to turgidity in the cells of plants, the author considers vegetable acids to play the principal part; the unilateral acceleration of growth, due to external causes, being dependent on the acceleration of the production of these acids.

As stated by Sachs, the geotropic and heliotropic movements of

* Arch. Néerl. Sci. exact. et nat., xv. (1880) pp. 295-312.