Insectivorous Plants. By Charles Darwin, M. A., F. R. S., &c. New York: D. Appleton & Co.

SOME few years ago the general idea was that the animal and vegetable kingdoms parted from each other like two forks of a tree: in contact only at the lowest part; and diverging more widely the further each developed. In some of the *protozoa* there is either no structure at all, or else a structure of such character as resembles vegetable forms as nearly as it does animal; so that it is not easy to decide where animal life begins. Low plants and low animals swim about freely in a fluid medium, absorbing their nutriment through their cell-walls; while plants of higher type are fixed to one spot and feed by roots, and animals of higher type preserve the faculty of locomotion and feed by means of a mouth and digestive apparatus.

Recent investigations, however, have shown that these distinctions are not universal: there are animals that are fixed to their habitat by roots through which they feed; and there are plants which feed by mouths and a genuine process of digestion. More than this; there are plants provided with a complex and highly organised mechanical apparatus for catching and destroying the prey on which they feed; so that we may regard them as true carnivora of the vegetable kingdom. To the investigation of the strange properties of some of these, Mr. Darwin has brought those faculties of patient, minute, and conscientious research for which he is so eminently distinguished.

There is a genus of plants, common in Europe and parts of the United States, known by the name of Drosera or "sun-dew," distin-

guished by a peculiar apparatus of hairs or filaments springing from the leaves, and tipped with globules of a clear viscid fluid, which, glistening in the sun, resemble dew-drops, and hence the scientific and popular names of the plant. If a small insect lights upon one of these tentacles he is caught at once by the viscid fluid; the tentacle then slowly bends inward and carries the insect to the centre of the leaf. The contiguous tentacles also bend in the same manner, so that the insect is firmly clasped by them and pressed down upon the glands which arise from the surface of the leaf. These glands, and similar organs which tip the tentacles, now exude an acid fluid which dissolves all the soft parts of the insect, and then re-absorb the resulting solution; so that when the tentacles at last unclose, nothing is left but the scaly insoluble portions, the rest having been digested and absorbed. In this way is this highly organised plant able to support itself on soil so barren that nothing but moss (which is nourished by the air) can grow upon it.

Mr. Darwin found, by repeated and careful experiments, that the plant would not only digest insects, but also particles of meat, of hard-boiled egg, of cheese, and fibrin, gluten, and legumin from vegetables. Bone was first decalcified and then digested, and even dentine and enamel were softened. This process is a true digestion: the neutral secretion of the glands becomes acid after the nitrogenous substance has been seized by the tentacle; and the substance dissolves without putrefying, while similar particles laid on damp moss beside the plant soon became putrid. While this process of digestion and absorption is going on, the masses of protoplasm in the cells of the glands were affected in very curious ways.

If the particle of matter be laid on the side of the leaf, only the tentacles of that side fold down; and they do not, in that case, bend in to the centre, but fold immediately over the particle; showing that they have a power of directing their motions.

Mr. Darwin tried the effects of a great variety of substances on this plant. Inert, insoluble bodies, like bits of glass, coal, &c., were seized, but soon released. Some of the vegetable alkaloids and other strong narcotics were poisonous to the plant; others, even curare and the venom of the cobra, which act so energetically on animal organisms, were not poisonous. Many of the acids were poisonous; but formic acid was innocuous. As many of the insects on which this plant subsists have the power of secreting formic acid, we can easily see why this exception should occur.

Another curious phenomenon about this plant is its susceptibility to almost incredibly small quantities of certain substances. This was most marked with phosphate of ammonia, which produced strong inflection when applied in a solution of one part of the salt to 2,187,500 of water, being in the proportion of one grain to about more than thirty-one gallons. Of this solution about half a drachm was poured over a leaf; so that the amount of the pure salt sufficient to produce this action was less than the thirty-millionth of a grain. There is no test known to science, except the spectroscope, that can at all approach this delicacy.

Far more curious than this, however, is another member of the

same family, the *Dionaea muscipula*, or Venus' fly-trap, which grows only in the eastern part of North Carolina. This plant is perhaps the most wonderful in the world. The leaf is bi-lobed, with a leafy footstalk, and the two expanded and somewhat recurved lobes are fringed with a row of rigid spikes. From the upper surfaces of each lobe project three filaments. The lobes themselves are covered with minute purplish glands.

When one of these filaments is touched, ever so lightly, the lobes instantly close, the marginal spikes interlocking. If an insect has been the exciting cause, it is captured, unless small enough to escape between the spikes. When thus imprisoned, its struggles to escape cause the lobes to close still more tightly and subject it to severe compression. The glands on the surface now pour out an acid secretion which dissolves it, and the resulting fluid is absorbed by the glands. This secretion, however, is only excited by nitrogenous substances: if the lobes are made to close on a substance that the plant can not assimilate, such as a bit of glass or blotting-paper, there is no secretion; an elective power which is not shown by the sun-dew. The closed lobes, as Mr. Darwin expresses it, form a temporary stomach, in which a true process of digestion and absorption goes on. Pieces of bread, boiled egg, of meat, raw and roasted, of gelatin, of cheese, &c., were tried with the same results; in some cases the absorption being so complete as to leave not a trace of the substance experimented on. When this digestion is accomplished, the lobes sometimes re-open, but with sensitiveness much impaired; while in other cases the leaf withers and drops from the stalk. When the captured object, however, has been of an indigestible character, the leaf opens much more speedily, and is ready for another prey.

The mechanical action of closure seems to be primarily effected by the contraction of the thick mass of cells overlying the midrib, and secondarily by a contraction of the whole upper surface of the leaf. How the motor impulse is transmitted from the sensitive filaments, is yet a mystery: nothing resembling nerve-fibres has been discovered. Dr. Sanderson has shown that "there exists a normal electric current in the blade and footstalk; and when the leaves are irritated, the current is disturbed in the same manner as takes place during the contraction of the muscle of an animal."

We may thus construct a sort of scale of development of these two functions, motion and digestion of nitrogenous substances, in the vegetable world. The pitcher-plants are furnished with an organ for containing water, in which insects drown and decompose, thus serving, it is believed, the nutrition of the plant. A small water-plant (*utricularia*) is provided with bladder-like organs, fitted with a light valve, into which insects push their way, the valve closing behind them by its own elasticity. A little mountain-plant (*pinguicula*) secretes from its leaves a viscid fluid by which insects are caught, and their bodies are then enclosed by the edge of the leaf slowly folding over them until they are digested. In *drosera rotundifolia* we have the special apparatus of tentacles and glands which has been described.

On the other hand, as regards motion, we find various plants pro-

vided with organs that have a power of moving upon being touched, or even spontaneously. This faculty is usually connected with the process of fertilisation, as in the stamens of *berberis* and *kalmia.* More remarkable is the power possessed by some of the mimosa family, of closing their leaves when touched: with what object, is, we believe, unknown. But in *dionaea* both these faculties are exalted and combined in an extraordinary way; so that in these respects it approaches the animal kingdom more nearly than any other known plant. It seems strange that a plant so remarkably endowed and specialised should be confined to one very limited district of the world, and even there it is thought to be failing, so that it is not impossible that our descendants may read of the *dionaea* with much the same feelings as we read of the dodo; or perhaps with keener regret, for the latter, at best, was but a queer gallinaceous bird, while the former is perhaps a key to some of the most interesting problems of biology.

W. H. B.