LITERATURE.

INSECTIVOROUS PLANTS.*

There is no part of the science of botany that has of late attracted at once so much scientific and popular attention as that relating to insect-devouring plants. The anomalous character of this singular provision, and the additional proof which it affords of the essential unity of animal and vegetable life, fully account for the interest which the subject has awakened amongst the general reading public. To men of science it possesses other claims to attention, prominent amongst which are the probability that careful investigation of this class of plants may afford some light as to the natural steps and processes by which habits and capabilities of this and kindred nature are acquired or developed, and so contribute to the elucidation of the great biological problem over which the science of the last few years has been so assiduously working. It is to be noted that although the habits and formation of these plants have been matter of inquiry for some years, a difference of opinion has existed amongst naturalists as to whether the function they exercised was one of true digestion. It has been held that many of these plants catch insects without digesting them, or deriving any direct advantage from their capture. If this could be substantiated, the fact would form a problem which it would be difficult to solve on the principles of natural selection. Such an aimless, purposeless peculiarity would stand until otherwise explained as one of the fanciful freaks of nature, of which rudimentary science knows so many, and advanced science so few. By other observers it has been believed that, although at any rate some of the insect-catching plants could not digest and absorb their prey, they derived indirect benefit from the capture by the bodies of the imprisoned insects decaying, and the product being washed down the leaf-stalks to the roots, and there being absorbed as manure. For some time it has been known that the greatest naturalist of the day has been engaged in an extensive series of experiments upon these plants, with the view of deciding some doubtful points, and of ascertaining, as far as possible, the precise means and processes by which their curious function is performed. The result of these patient and comprehensive labours is before us in Mr. Darwin's book, just published, on *Insectivorous Plants*. The book exhibits all its author's mastery of the experimental method as applied to natural history, his careful and untiring faculty of observation, his caution in inference, and his power of luminous statement. To say that it is the most valuable contribution to the subject that has yet been made is far to underrate its originality of investigation, its fresh, vigorous handling and exhaustive comprehensiveness, which leaves so little for any after inquirer to glean.

The larger portion of the book is devoted to a record of observations of the common sundew (*Drosera rotundifolia*) which is taken as a type of the insect-catching plants in general. The observations are given in extreme detail, and in the subsequent part of the book it is shown how far they are also applicable to other classes of plants which were made the subject of experimental inquiry. The experiments made on the Drosera showed—"firstly, the extraordinary sensitiveness of the glands [on the ends of the tentacles] to slight pressure, and to minute doses of certain nitrogenous fluids, as shown by the movements of the so-called hairs or tentacles [on the surface of the leaves]; secondly, the power possessed by the leaves of rendering soluble or digesting nitrogenous substances, and of afterwards absorbing them; thirdly, the changes which take place within the cells of the tentacles, when the glands are excited in various ways."

The description of the common sundew is familiar to all who have read any of the many disquisitions that have lately been published on the subject of insectivorous plants. It bears from two to six leaves, of about half an inch in diameter, which are covered on their upper surface by hair-like filaments. These bear a gland at their upper extremity, and each gland exudes large drops of extremely viscid secretion "which, glittering in the sun, have given rise to the plant's poetical name of the 'sun-dew.'" Flies and other small insects are caught by this secretion. "When an insect alights on the central disc, it is instantly entangled by the viscid secretion, and the surrounding tentacles after a time begin to bend, and ultimately clasp it on all sides. Insects are generally killed, according to Dr. Nitschke, in about a quarter of an hour

can grow but a moss which depends wholly on the atmosphere for its nourishment.

The experiments made by Mr. Darwin show that the irritability of the gland is very differently affected, according to the nature of the substance placed upon it. Animal substances, such as a bit of raw meat, placed on the glands, caused more rapid and more energetic inflection than inorganic bodies of the same size. Moreover, the tentacles remain inflected a much longer time over bodies yielding soluble and digestible matter than over those which are quite indigestible. The sensitiveness of the glands is almost beyond belief; a little bit of very thin human hair, 8-1,000th of an inch in length, and weighing only 1-78,740 of a grain, was found to be sufficient to cause movement when laid lightly on the gland, although a much larger piece caused no sensation to the human tongue, one of the most sensitive parts of the body. Yet, strange to say, the glands are quite insensible to the effects of high wind or heavy rain, and the same remark applies to several other plants of this nature. A noticeable effect of the irritation of the gland is the change which takes place in its cells. The cells are, when the gland is unexcited, filled with homogeneous purple fluid, but if the gland is affected, either by repeated touches, by a particle being laid upon it, or by the absorption of certain fluids, the cells are seen to be filled with colourless fluid, in which variously shaped masses of purple matter are suspended. In other words, the colouring matter of the fluid becomes, so long as the inflection lasts, aggregated into masses of protoplasm. This effect may be regarded as analogous to the molecular change which physiologists believe to be induced in a nerve when it is touched, and transmits nervous influence. A number of experiments were made to ascertain whether the glands possess the power of dissolving solid animal matter, and they showed that the leaves are capable of true digestion, and that the glands absorb the digested matter.

"These are," says our author, in summing up the results of these experiments, "perhaps, the most interesting of all my observations on Drosera, as no such power was before distinctly known to exist in the vegetable kingdom. It is, likewise, an interesting fact that the glands of the disc, when irritated, should transmit some influence to the glands of the exterior tentacles, causing them to secrete more copiously, and the secretion to become acid, as if they had been directly excited by an object placed on them. The gastric juice of animals contains, as is well known, an acid and a ferment, both of which are indispensable for digestion, and so it is with the secretion of Drosera. When the stomach of an animal is mechanically irritated, it secretes an acid, and when particles of glass or other such objects were placed on the glands of Drosera, the secretion, and that of the surrounding and untouched glands, was increased in quantity and became acid. But, according to Schiff, the stomach of an animal does not secrete its proper ferment, pepsin, until certain substances, which he called peptogenes, are absorbed; and it appears from my experiments that some matter must be absorbed by the glands of Drosera before they secrete their proper ferment. That the secretion does contain a ferment which acts only in the presence of an acid on solid animal matter was clearly proved by adding minute doses of an alkali, which entirely arrested the process of digestion, this immediately recommencing as soon as the alkali was neutralised by a little weak hydrochloric acid. From trials made with a large number of substances it was found that those which the secretion of Drosera dissolves completely, or partially, or not at all, are acted on in exactly the same manner by gastric juice. We may, therefore, conclude that the ferment of Drosera is closely analogous to, or identical with, the pepsin of animals."

The digestive power of the secretion is remarkable. Amongst the substances which were found to be dissolved by it were bone, and even the enamel of teeth. The application of salts of ammonia was found to cause the tentacles, and even the blade of the leaf, to become inflected and the protoplasm to be aggregated. In illustration of the extreme susceptibility of the glands to the action of these salts it may be mentioned that the absorption by a gland of only the 1-19,760,000th—that is, a little more than the one twenty-millionth part—of a grain of the phosphate of ammonia is sufficient to cause the tentacles bearing this gland to bend to the centre of the leaf, or to perform a sweep often through an angle of above 180deg. The plant thus "can detect, as shown by the movements of its leaves, a very much smaller quantity of the phosphate of ammonia than the most skilful chemist can of any substance." "I know not," says Mr. Darwin, "whether to be most astonished at this fact, or that the pressure of a minute bit of hair, supported by the dense secretion, should quickly cause conspicuous movement. Moreover, this extreme sensitiveness, exceeding that of the most delicate part of the

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