Literature.

"INSECTIVOROUS PLANTS."*

It is superfluous to praise Mr. Darwin for exact and patient observation, ingenuity in devising and executing experiments to separate the essential from the accidental phenomena he is investigating, and skill in recognising their correlation. These are features of the same clear and trained intellect which appear in his unsurpassed faculty of lucid exposition, and have caused his name to be inseparably associated with the theory which he has done more than any living man to popularise and establish. It is enough to say that these characteristics appear prominently in the volume before us; and the subject he is here illustrating is one of enthralling interest to those who love to learn something of the habits of plants, while his experiments demand the most careful consideration from students of physiology, both animal and vegetable. We do not purpose in this article to give any account of his series of experiments—that would be more fit for the columns of a specially scientific journal than for those of the *Nonconformist*—we wish to give our readers a brief description of some of the results at which he has arrived, with their bearing on one or two points in biology.

The name "insectivorous" or "carnivorous," when applied to plants, cannot fail to excite some questions in the mind of a thoughtful reader. Parts of many plants are found either constantly or occasionally covered with a clammy substance which destroys insects as ruthlessly as the "fly-papers" sold in London streets. Is this secretion associated in any cases with the nutrition of the plants? Is there any real absorption of the succulent parts of the insect, for which the plant has specialised organs? Or is the plant as little concerned with the insects it catches, as little benefited by them, as the paper is with the flies that are retained by the clammy mixture spread over it? These are the questions Mr. Darwin answers; he proves that in many plants he has examined there is a real process of digestion; that their leaves become for the time a kind of stomach, in which an acid secretion, like the gastric juice, and a ferment like animal pepsin, are poured on the contents; and that organs exist in the plant, having for their function not only to secure the insect they catch, but to pass it into the stomach, which, in the meantime, has begun to secrete the digestive fluid needful for its dissolution. A further series of experiments establishes that the fluid which results from this digestion is absorbed into the cells of the plants; that, in short, we have a complete and developed nutritive system strikingly analogous to that of animals.

The greater part of the volume is occupied with a description of this process in the common "sundew" of our bogs (*Drosera rotundifolia*). Collectors are familiar with the aspect of the plant; its rounded leaves commonly found with insects adhering to them, and the glandular hairs covering the leaves, the viscid secretion from which appears to have attracted the insects as it certainly retains them. Mr. Darwin calls these glandular processes "tentacles," because they close when substances press upon the terminal glands and carry them on to a set of glands in the centre of the leaf. The action of the tentacles and the glands varies according to the nature of the substance exciting them. Bodies yielding soluble nitrogenous matter—that is, bodies such as are fit for the nutrition of animals—have the tentacles closed over them much longer than bodies which yield none, and excite the glands to a distinctive secretion. Both mechanical irritation of a central gland, and the absorption by any glands of albuminous matter, will cause the secretion from all the glands to increase in quantity and to become acid. But the glands in the latter case also secrete a "ferment proper to digestion," which Mr. Darwin believes they never do in the former. Professor Frankland has detected the odour of pepsin in the secretion of *Drosera*, and the whole process of digestion is marvellously like that of animals. "Mechanical irritation "excites the glands of the stomach to secrete "an acid, but not pepsin"; so Schiff asserts, and he says also that "the glands of the stomach "of animals secrete pepsin, only after they have "absorbed certain soluble substances, which he "designates as peptogenes."

Mr. Darwin tried the effect of various articles of diet on *Drosera*. Meat raw and roasted, beef-tea, milk, the water in which peas and cabbage were boiled, and gluten, not cooked as we have it in bread, but partly digested with hydrochloric acid, all proved welcome to it. Cheese it found somewhat indigestible, and sugar in solution had only a mechanical effect. The result of some other experiments was to establish that while insects form the staple of its food, the plant derives some benefit from pollen grains and seeds which the wind may bring it. The outer tentacles of *Drosera*, and the glands of the disc, are specialised so as to retain the substance it is digesting until all its soluble matter is absorbed. A beautiful little plant, the butterwort (*Pinguicula vulgaris*), which may be gathered on mountain-bogs with the same hand that collects the sundew, is unable to retain its prey long enough for complete assimilation. The edge of its leaf curves over, forming a channel to hold the insects it has captured. "The glands of the overlapping margin are thus "brought into contact with such objects and "pour forth their secretion, afterwards ab-"sorbing the digested matter. But as the in-"curvation lasts for so short a time, any such "benefit can be of only slight importance, yet "perhaps greater than at first sight appears. "The plant lives in humid districts, and the "insects which adhere to all parts of the leaf "are washed by every heavy shower of rain "into the narrow channel formed by the "naturally incurved edges." The movement of the leaf is also such as to roll an insect slowly over a considerable portion of its surface, thus bringing it into contact with a large number of glands, all of which are stimulated to secretion and absorption. *Pinguicula* partially devours a number of insects while *Drosera* is wholly consuming one. The plant called Venus's fly-trap (*Dionæa muscipula*, a member of the family of the *Droseraceæ*) is a greedy feeder. Its leaves are so constructed as to retain only the larger prey, while small insects, as if not worth the trouble of digestion, are allowed to escape. Mr. Darwin mentions that *Dionæa*, although "one of the most "beautifully adapted plants in the vegetable "kingdom," is "apparently on the high road "to extinction." Can it be that it is perishing from the habit of over-feeding? Its leaves are found to be torpid on reopening, and several leaves are mentioned as "having died in the "attempt" to eat too much.

The delicacy of the action of *Drosera* is extreme. A bit of human hair weighing only 1-78740 of a grain by its pressure on a gland caused the tentacle to move through an angle of above 180°; while a bit of hair more than twice the size was not perceived when placed upon the tongue. By a calculation too long to be cited here, Mr. Darwin shows that one thirty-millionth of a grain of the efficient part of the phosphate of ammonia when absorbed by a gland led to a motor impulse being transmitted down the whole length of the tentacle, causing the basal part to bend, often through an angle of above 180 degrees. Incidentally these investigations are of value as showing how much plant life in general may be benefited by the absorption of the infinitesimal traces of ammonia contained in rain-water and the vapour of the atmosphere.

One of the most interesting parts of the book to physiologists is the investigation of the mode in which the motor impulse is propagated. Mr. Darwin maintains that it is by molecular change in the cell and its contents, and not along the fibro-vascular bundles. Dr. Burdon Sanderson has shown that the normal electric current is disturbed by irritation of the leaf in the same manner as takes place during the contraction of the muscle of an animal. No trace of nervous organisation is found in any plant; but the transmission of the motor impulse may yet be similar in molecular changes in the cells of animals and vegetables; although in the absence of nervous centres the plant is unable to store up and reproduce its impressions, and its ability to act on them is limited.

The investigation of the effects of the salts of ammonia on *Drosera* is of exceeding interest. The value of nitrogen and phosphorus to the animal economy is well known; and of the three salts, the carbonate, the nitrate, and the phosphate of ammonia, the effects on *Drosera* vary thus:—to the carbonate it is least sensitive, to the nitrate, which is richer in nitrogen, more so, while to the phosphate of ammonia it is most sensitive. Mr. Darwin's experiments with these ammonia salts suggest another line of investigation, which appears to us worthy of being pursued. It would be easy to keep specimens of *Drosera* from all contact with animal matter. We should like to know the result on the life history of the plant, and on its development through a succession of generations, of supplying it abundantly with the salts, regarding it from contact with organic matter. Would the plant survive such an interference with the purpose of its special functions, and what new development of its organs would follow?

The result of the whole series of investigations is to remove entirely another of the marks long thought to distinguish a plant from an animal. The dependence of the plant for subsistence on inorganic matter, while the animal appropriates what has already been organised by vegetable life, can be no longer affirmed. If it should appear that the animal form of the deep sea *Bathybius*, is able to feed on inorganic matter, the reversal of the old notion would be complete. We are compelled more and more to examine the whole life-history of the animal and vegetable kingdom for a systematic view of them, and to make the correlation of functions, and not any simple distinction of a single function, the basis of classification.

The two natural orders, the *Droseraceæ* and the *Lentibulariaceæ*, which have very little in common except their "carnivorous" habits, have furnished Mr. Darwin with the specimens he has examined. The ability to be benefited by the absorption of organised matter, Mr. Darwin believes, however, will be found by no means confined to a few orders.

* *Insectivorous Plants.* By CHARLES DARWIN, M.A., F.R.S. 8vo. With Illustrations. (London: John Murray.)

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