Insectivorous Plants. By Charles Darwin, M.A., F.R.S., &c. London: John Murray. 1875.

Mr. Darwin has written no book of more real value, and displaying more accurate research, than this. The subject until very recently has been a most obscure one; but a most valuable series of facts has been discovered, pre-eminently by Mr. Darwin, but also by Dr. Mellichamp, Dr. Hooker, Mrs. Treat, and Dr. Bennett.

The distinction between plants and animals has never been held by Biologists to be very clear; but under the influence of research it has become gradually more cloudy, until now the last element of difference has melted away, for it can no longer be maintained that plants differ from animals in that the latter assimilate proteinaceous matter already organically prepared, while plants can produce protoplasm and maintain life from inorganic elements. It has recently been shown that animals of a lowly order belonging to the *Paramecea* can live, flourish, and rapidly multiply in a fluid composed only of mineral salts and tartrate of Ammonia,* and therefore without the trace of albuminous or organic material; it is true that Professor Huxley believed he had discovered a slimy formless organism in the ooze of the Atlantic which he named "Bathybius," the vitality and animal nature of which he affirmed; this, from its utter dissociation from vegetable life at the bottom of the ocean, was supposed to have the power—otherwise

* *Monthly Microscopical Journal*, Vol. xiii. p. 190.

only possessed by plants—of elaborating organic compounds out of inorganic materials. But we have maintained more than once in this journal that the Bathybius of Huxley was simply an invital slime resulting from the dissolution of the myriads of minute forms constantly dying and sinking to the bottom, as Professor Huxley now admits. Under the pressure of facts furnished by the scientific men on board the *Challenger* he sees that it is hopeless longer to seek to retain Bathybius in the "animal series." But the fact remains that animals have lived on inorganic elements; and now Mr. Darwin gives us a wonderful series of experiments which demonstrate that plants can and do appropriate and digest for their nutrition animal forms and organized substances. There does not now remain a single feature by which a definition of "Animal" can be given which will not include the vegetable.

The greater part of the book is taken up with the behaviour of a little plant known commonly as the Sun-dew (*Drosera rotundifolia*). It will be known to most readers that this plant grows in boggy soils; bearing from two to six leaves, which generally extend in a horizontal direction. The leaves are broader than long, and their whole surface is covered with gland-bearing filaments or "tentacles." These tentacles are long, and the glands at their extremities are surrounded by large drops of a clear viscid secretion, to which its name is due.

It has long been known that these leaves entrapped insects; but the reason of this was unknown, or merely guessed at. But by a series of researches extending over years, Mr. Darwin has discovered what he admirably details in this book, that the animals are taken by an apparatus specially prepared for that purpose: that the viscid fluid is a digestive fluid allied to pepsine in its action, and that by a process of true digestion the animals captured are assimilated to the building up of the structure of the plant. The process is remarkable. An insect alights, or creeps upon the glandular part of the leaf; something equivalent to sensation instantly ensues, the tentacles begin at once to curve over upon the imprisoned body and the process of digestion begins: this may last from one to seven days, when the tentacles re-expand and are once more ready to perform their functions. At first, indeed, Mr. Darwin believed, what Mrs. Treat still maintains, that the plant had a capacity almost equal to the sense of *taste:* for whilst it would quickly curve its tentacles over a minute piece of beef or mutton or any animal substance, it was quite inoperative when a piece of chalk or glass or any inorganic substance was laid upon it. This, however, is now by our author modified. He affirms after repeated experiments that the effect of inorganic substances upon the action of the tentacles is far less powerful, and that they very shortly release it from their embrace, but they do possess the power of irritation.

One of the marvels of the whole process is the extreme sensitiveness of the glands, and the communication which immediately takes place from tentacle to tentacle. If the gland of only *one* be touched, each of the others (numbering sometimes over 200) is aroused to action, and invariably turns its gland upon the spot from whence the communication of sensation arose: while if *two* glands be irritated at the same time, all the tentacles near each will turn to it; thus there will be *two* centres of operation on one leaf; and the precision of the tentacles in directing themselves to the point of irritation is remarkable—indeed, the idea suggested is that of a lowly organized animal of the class Actinozoa, seizing its prey. More surprising still is the intense susceptibility to irritation exhibited by the glands. Thus a small quantity of a perfectly impalpable powder shaken up in water, will by its slow precipitation, if a leaf be inserted in it, cause the inflection of all the tentacles. A particle of thread weighing less than the eight thousandth of a grain, and even a particle of human hair weighing less than the seventy-eight thousandth of a grain, are sufficient to transmit a motor impulse to cause a tentacle to sweep through an angle of over 180°. And yet this minute particle is laid on the surface of a *dense fluid* through which the impression has to pass to the gland. Anyone may discover for himself how far this sensitiveness surpasses that of some of the most sensitive parts of the human body: a piece of hair, for instance, the fiftieth of an inch—very much larger than the above—if laid on the tongue is perfectly unperceived. Indeed, Mrs. Treat affirms that a fly fastened half an inch away from the leaf of an American species (*D. filiformis*) caused the leaves to bend towards it and reach it in less than an hour and a half. This Mr. Darwin has not confirmed; but the delicate susceptibility of the plant to irritation is proved by him to be astonishing in a very high degree: and this is rendered the more wonderful by the fact that rain-drops falling heavily upon the leaves produce no effect whatever.

Another fact of great moment clearly established is that the glands *absorb* what the fluid digests; and great changes may be seen with the microscope to have taken place in the enclosed protoplasm; while further evidence of true physiological action is seen in the fact that the fluid on the glands which have not been subject to irritation is neutral to tests for acid; while after irritation the fluid has a distinctly acid reaction; and Professor Frankland finds propionic, acetic, and butyric acids indicated. Thus we have in a plant a distinct and perfect digestive process and a motor apparatus specially for the seizure of prey.

What, however, exceeds in interest all the other facts in the volume is the result of Mr. Darwin's experiments with solutions of salts, acids, and poisons on the leaves. The series employed is

very large, the results in every case being of the utmost interest, and a comparison of these must afford profitable and suggestive facts to a generation of philosophical physiologists. Our space will only permit us to examine the results following from the employment of the salts of ammonia. Solutions were made so that it might be discovered what was the minutest quantity of the dissolved salt that would cause the inflection of the tentacles. It was found as a result that the *one-twenty-millionth of a grain* of the phosphate of ammonia had the effect, and as the salt contained 35·33 per cent. of water, the really efficient elements are reduced to *one-thirty-millionth* of a grain; yet this excited a distinct physiological action and led to a palpable motor impulse—every tentacle being inflected and sometimes the blade of the leaf itself being curved. This is only one of an immense series of experiments with various solutions, all yielding similar remarkable results. Surely we have here evidence of the physiological susceptibility of organisms to drugs which should be highly suggestive to the medical profession. Since the days of Hahnemann we have heard a great deal of controversy on the physiological action of poisons and drugs, and especially when administered in minute quantities. It is not a question which belongs to any system of medicine, but one materially affecting the whole philosophy of therapeutics. If the thirty-millionth of a grain of the *right drug* can produce so powerful a physiological effect upon the glands of *Drosera rotundifolia*, why may not similar physiological effects be produced on the organs of a horse or a man by approximately minute quantities? Surely it is a question for experiment. To found a system of medicine upon "infinitesimal doses" is simply absurd: but to ridicule or ignore the fact that minute quantities of drugs and poisons may have a powerful physiological effect on organs specially susceptible to their action, is, in the face of Mr. Darwin's facts, and indeed of many others, a more transcendent absurdity.

The remainder of the book is devoted to the consideration of similar powers possessed by other plants; all of which are full of the deepest interest. Especially is this the case with the plant of the genus *Utricularia* or Bladder-worts of our stagnant ponds and foul ditches. The fine needle-like leaves of this genus bear a number of bladder-like bodies of a minute size, at one end of these there is an opening armed with what appear like tentacles, and the whole appearance when slightly magnified is strangely near to some of the larger *entomostraca*, better known as "water-fleas," common to our ditches and ponds; at the entrance to the bladder there is a valve which can only open inwards; by this means minute animals are able to enter but never to escape; and in these small sacs they die and decompose and nourish the plant. For it is a remarkable fact that there is no digestive fluid in the bladders,

and no true digestion; it is merely nourishment by decomposition. So we have here two opposite means of securing the same result; in the *Drosera* perfect sensitiveness and power of digestion when an object comes to the leaf; in the *utricularia*, no digestive apparatus proper, but a most perfect *trap* to lure and catch prey.

We put the book down, having derived from its perusal the most complete and unalloyed pleasure. It is as nearly perfect a treatise as we can imagine a book to be: but we fancy that in it Mr. Darwin has put a new and powerful difficulty in the way of his favourite hypothesis of the origin of species by natural selection. Consider the facts. The *Drosera rotundifolia* has an exquisite sensitiveness, power of secreting a digestive fluid, power of absorption in the glands, power of communicating sensation from tentacle to tentacle, and power of motion in the required direction by its tentacles. If all this came to the plant by the agency of natural selection—that is, by the survival of minute modifications, these modifications must have been *improvements*—that is, they must have aided the plant in the struggle for existence. Now the value of the *perfect* digestive apparatus to the plant is plain enough. It has a small root and derives but little nourishment from the soil: hence the nutriment supplied by the leaves is essential. But this is the question: of what possible advantage to the plant could the initial and progressive stages in the development of these organs of digestion have been? Nothing short of perfect digestion—perfect sensitiveness—perfect motive power could be of *any conceivable use*. It is the survival of variations that *at the time* serve the species, and which accumulate with accumulating advantage along a certain line, that makes a natural selection possible. But here we have a set of organic functions that could only be of use when perfect, and therefore run counter to the whole hypothesis.