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NEW PUBLICATIONS.

MR. DARWIN'S NEW WORK.

INSECTIVOROUS PLANTS. By CHARLES DARWIN, M.A., F.R.S. With illustrations. London: JOHN MURRAY.

In this work Mr. Darwin's patient and painstaking methods of investigation appear to the best possible advantage. It is impossible to read it without enthusiastic admiration for the ingenuity which he displays in devising tests to determine the characteristics of the plants the peculiarities of which he was studying; and, as is always the case with him, he presents the conclusions arrived at in language so lucid that he who reads simply for information is sure to be attracted and charmed quite as much as the professional student.

The number of insectivorous plants in nature is by no means numerous, and nothing could better illustrate the thoroughness with which Mr. Darwin prosecuted his studies of their characteristics than the fact that of the 479 pages in this volume, 278—more than one-half—are taken up with an account of his experiments upon a single species of the Drosera; the *Drosera rotundifolia*, or common sundew. During the Summer of 1860 Mr. Darwin tells us that he was surprised by finding how large a number of insects were caught by the leaves of this plant, which he found growing upon a heath in Sussex. He gathered by chance a dozen plants, bearing fifty-six fully expanded leaves, and on thirty-one of these dead insects or remains of them adhered, and he adds that no doubt many more would have been caught afterward by these same leaves, and still more by those as yet not expanded. On one plant all six leaves had caught their prey; and on several plants very many leaves had caught more than a single insect. On one large leaf he found the remnant of thirteen insects. Flies, he assures us, were by far the most numerous victims, but larger than a small butterfly among these insects, but he cites a well-authenticated instance of a large living dragon fly having been discovered with its body firmly held by two leaves. As the sundew is extremely common in some districts, Mr. Darwin remarks that the number of insects thus annually slaughtered must be prodigious. He was soon satisfied that, unlike the horse-chestnut, the sticky ends of which cause the death of insects without receiving any perceptible advantage, the drosera was evidently adapted for the special purpose of catching insects. The subject therefore seemed to him well warranting investigation. The results, he tells us, proved highly remarkable, the more important ones being firstly the extraordinary sensitiveness of the glands to slight pressure and to minute doses of certain nitrogenous fluids, as shown by the movements of the so-called hairs or tentacles; secondly, the power possessed by the leaves of rendering soluble or digesting nitrogenous substances, and of afterward absorbing them; thirdly, the changes which take place within the cells of the tentacles when the glands are excited in different ways. The following brief description of the plant under investigation is given by Mr. Darwin. It bears, he tells us, from two or three to five or six leaves, generally extended more or less horizontally, but sometimes standing vertically upward. The leaves are commonly a little broader than long. The whole upper surface is covered with gland-bearing filaments or tentacles, as he calls them, from their manner of acting. The glands were counted on thirty-one leaves. Many of these were of unusually large size, and the greatest number of glands found was 260, the least 130, giving an average of 192. The name of sundew is given to the plant from the fact that the glands are each surrounded by large drops of extremely viscid secretion which glitter in the sun.

As would, of course, be [illegible] very, and, [illegible] first will [illegible] human body. This, however, Mr. Darwin says is not so remarkable as might at first sight appear, when it is remembered how very sensitive the organs of smell are in the human being, and even more so in the deer, whose power of detecting the presence of the hunter under favorable conditions at astonishingly long distances is proverbial. It is also very remarkable that the glands of the Drosera are insensible to the weight and repeated blows of drops of rain, and also to the effect of high winds. They are thus saved from much useless movement. At the same time they are exquisitely sensitive to the slightest pressure if prolonged for a few seconds, and this capacity is manifestly of service to the plant in capturing small insects. Even gnats if they rest on the glands with their extremely delicate feet are quickly and securely embraced.

The experiments by which Mr. Darwin claims to have demonstrated that the leaves of the Drosera are capable of true digestion and that the glands absorb the digested matter are, of course, by far the most interesting and important. We therefore quote his statement of the results reached in this connection. He writes:

"The gastric juice of animals contains, as is well known, an acid or 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 acid and pepsine, unless certain substances, which he calls 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 and solid animal matter was clearly proved by adding minute doses of an alkali which immediately arrested the process of digestion, and by its renewal being induced as soon as the alkali was neutralized by a little weak hydrochloric acid. [illegible] secretion [illegible] under the influence of [illegible] analogous to, or identical with, the pepsin of animals. The substances which act on the glands of Drosera act on them very differently, some cause much more rapid and rapid inflection of the tentacles, and keep them flexed for much longer time than do others. We are thus led to believe that the former are more nutritious than the latter, as is known to be the case with some of the same substances when given to animals, for instance meat, in comparison with gelatine. As carbide is so tough a substance, and is so little affected by water, its prompt dissolution by the secretion of Drosera, and subsequent absorption, is, perhaps, one of the most striking cases. But it is remarkable that the secretion dissolves the digestion of meat, which is dissolved by this secretion in the same manner as by the same stages as gastric juice. The secretion dissolves bone, and even the enamel of teeth, but this is simply due to a large quantity of acid secreted, owing, apparently, to the desire of the plant for phosphorus. In the case of bone, the ferment does not come into play until all the phosphate of lime has been decomposed and acid is present, and then the fibrous base is quickly dissolved. Lastly, the secretion attacks and dissolves matter out of living seeds, which is sometimes killed by Drosera, as shown by the diseased state of the seedlings. It also dissolves matter from pollen and from fragments of leaves."

A long series of experiments with the salts of ammonia showed that while they all cause the tentacles, and even the blade of the leaf, to be inflected, they act with very different power; the citrate being the least powerful, and the phosphate, owing no doubt to the presence of phosphorus and nitrogen, being the most powerful. It was further developed that the absorption of a little less than the one-twenty millionth of a grain of the phosphate on a gland of the Drosera is sufficient to cause the tentacle bearing this gland to bend to the centre of the leaf. Touching this remarkable fact Mr. Darwin writes: "In this experiment, owing to the presence of the water of crystallization, less than the one-thirty millionth of a grain of the efficient elements could have been absorbed. There is nothing remarkable in such minute quantities being absorbed by the glands, for all physiologists admit that the salts of ammonia, which must be brought in still smaller quantity by a single shower of rain to the roots of [illegible] and yet so as to touch it, did not excite any movement. But when a rather thick cotton thread of the same length was similarly swayed the lobes closed. Pinches of fine wheaten flour, dropped from a height, produced no effect. The above-mentioned hair was then fixed into a handle and cut off so that one inch projected, this length being sufficiently rigid to support itself in a nearly horizontal line. The extremity was then brought by a slow movement laterally into contact with the tip of a filament, and the leaf instantly closed. On another occasion two or three touches of the same kind were necessary before any movement ensued. When it is remembered how flexible a fine hair is, some idea may be formed of how slight must be the touch given by the extremity of a piece one inch in length moved slowly. If a minute insect alights with its delicate feet on the glands of Drosera, it is caught by the viscid secretion, and the slight though prolonged pressure gives notice of the presence of prey, which is secured by the slow bending of the tentacles. The sensitive filaments of Dionæa, on the other hand, are not viscid, and the capture of insects can be assured only by their sensitiveness to a momentary touch, followed by the rapid closure of the lobes. The Venus fly-trap does not close its lobes for the falling rain nor for the wind, however severely it may blow; nor did the heat from the rays of the sun, concentrated by a lens on the bases of several filaments, so that they were scorched and discolored, cause any movement, though the leaves were active, as they closed, rather slowly, however, when a filament on the opposite side was touched. Non-nitrogenous matter, such as bits of wood, cork, moss, paper, stone, or glass, may be left for a length of time on the [illegible] [illegible] any difference if the [illegible] closed very much. On the other hand, if a bit of damp crushed fly is placed on the surface of an expanded leaf the glands [illegible] quite freely, but only on the spot where the animal matter actually touches it. When the lobes are made to close over a bit of meat or insect, the glands over the whole surface of the leaf secrete copiously. "As in this case," Mr. Darwin writes, "the glands on both sides are pressed against the meat or insect, the secretion from the first is twice as great as when a bit of meat is laid on the surface of one lobe, and as the two lobes come into almost close contact the secretion containing dissolved animal matter spreads by capillary attraction, causing fresh glands on both sides to begin secreting in a continually widening circle. The secretion is almost colorless, slightly mucilaginous, and, judging by the manner in which it colored litmus paper, more strongly acid than that of the Drosera. It is so copious that on one occasion, when a leaf was cut open on which a small cube of albumen had been placed forty-five hours before, drops rolled off the leaf. On another occasion, in which a leaf with an inclosed bit of roast meat spontaneously opened after eight days, there was so much secretion in the furrow over the midrib that it trickled down." Numerous other experiments with similar results are detailed, and finally Mr. Darwin claims for the Dionæa powers of digestion as well pronounced as those possessed by the Drosera.

The *Aldrovanda vesiculosa*, a miniature aquatic Dionæa; the *Darlingtonia californica*, a rare plant, found only in Portugal; the *Pinguicula vulgaris*, which grows generally on mountains, and several other plants which are classed by Mr. Darwin as insectivorous, are described in detail, and by the same method as those already mentioned, and in general they are shown to possess characteristics similar to those of the Venus fly-trap and the sun-dew.

On page 301 Mr. Darwin [illegible]

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He found, 267, and, but within

ments which Mr. Darwin made upon this or any of the other plants whose characteristics he spent so much time in investigating. We shall, therefore, content ourselves with briefly touching upon the more remarkable facts which he developed, relying mainly for this purpose on the summaries which he has conveniently placed at the end of each division of his extremely interesting treatise.

The poor development of the roots of the Drosera satisfied Mr. Darwin that the plants gained little beside moisture through them. This is also apparent from the fact that the Drosera often grow in places where hardly any other plant except mosses can exist. He inferred, therefore, that these plants must gain the larger part of their nutriment from the insects which they capture through the drops of extremely viscid fluid surrounding the glands, and by the inward movement of the tentacles. Further, he claims to have established, through a long series of experiments, the very remarkable fact, not before known to exist in the vegetable kingdom, that the Drosera "possessed the power of dissolving solid animal matter;" "that the leaves are capable of true digestion, and that the glands absorb the digested matter." The bare statement of this discovery, so confidently claimed to be fully established by Mr. Darwin, will lead all the naturalists to the study of the work itself, and we may safely leave to them the discussion of the tenableness of his conclusions.

Some of the many notable facts regarding the Drosera Mr. Darwin states as follows: The glands of the plant are extremely sensitive to various stimulants, namely, repeated touches, the pressure of minute particles, the absorption of animal matter and of various fluids, heat and galvanic action. A tentacle with a bit of raw meat on the gland has been seen to begin bending in ten seconds, to be strongly incurved in five minutes, and to reach the centre of the leaf in half an hour. The blade of the leaf often becomes so much inflected that it forms a cup, inclosing any object placed on it. A gland, when excited, not only sends some influence down its own tentacle causing it to bend, but likewise to the surrounding tentacles, which become incurved; so that the bending place can be acted on by an impulse received from opposite directions, namely, from the gland on the summit of the same tentacle, and from one or more glands of the neighboring tentacles. Tentacles, when inflected, re-expand after a time, and during this process the glands secrete less copiously, or become dry. As soon as they begin to secrete again the tentacles are ready to react, and this may be repeated at least three, probably more, times. Animal substances placed on the discs cause much more prompt, and energetic inflection than do inorganic bodies of the same size, or more mechanical irritation; but there is a still more marked difference in the greater length of time during which the tentacles remain inflected over bodies yielding soluble nutritious matter than over those which do not yield such matter. The smallest particles of glass, emblem, &c., when placed on the outer tentacles cause them to bend; but to effect this they must sink through the secretion and actually touch the surface of the gland with some one point. In one experiment a little bit of thin human hair, 6-1000 of an inch in length, and the pressure of which could not have exceeded the millionth of a grain, sufficed to induce movement, and even smaller particles produced the same result, as could be seen through a lens. Yet particles even larger than this bit of hair cause no sensation when placed on the tongue, one of the most sensitive parts of the

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by the

other necessary elements are present. But is it an astonishing fact that so inconceivably minute a quantity as the one-twenty millionth of a grain of phosphate of ammonia should induce some change in a gland of Drosera sufficient to cause a motor impulse to be sent down the whole length of the tentacle; this impulse exciting movement often through an angle of above 180°. I know not 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 human body, as well as the power of transmitting various impulses from one part of the leaf to another, have been acquired without the intervention of any nervous system." Homeopathists are fairly entitled to all the advantage they may gain from these very remarkable facts thus emphatically affirmed by this distinguished naturalist.

Various other salts and acids were experimented with, and very interesting results were reached, but our space forbids further mention of these or of the conclusions which Mr. Darwin reached regarding the mechanism of the movements of the Drosera and the nature of the motor impulse. The following characteristically modest paragraph closes the discussion of this part of his subject, which, as we have said, extends over 278 pages of this volume, and gives the results of studies which were prosecuted for fifteen years: "I have now given a brief recapitulation of the chief points observed by me with respect to the structure, movements, constitution, and habits *of drosera rotundifolia*; and we see how little has been made out in comparison with what remains unexplained and unknown."

Six other species of this same plant, "some of them inhabitants of distant countries," were examined by Mr. Darwin, chiefly to determine whether they caught insects. This seemed necessary, he says, because the leaves of some of the species differ to an extraordinary degree in shape from the rounded ones of the plant so fully described. His conclusion was that "most, and probably all, the species of Drosera are adapted for catching insects by nearly the same means."

The "Venus fly-trap" (*Dionæa muscipula*) was the next of the insectivorous plants studied by Mr. Darwin, and as it is found only in the eastern part of North Carolina its characteristics are, perhaps, more interesting to American readers than are those of the plant just described. The Venus fly-trap has small roots, probably serving, mainly, as in the case of the Drosera, for the absorption of water. A peculiarity so has been stated of all insectivorous plants. The leaves are bilobed, and the two lobes stand at rather less than a right angle to each other. Three minute pointed processes or filaments, placed triangularly, project from the upper surfaces of both. These filaments are remarkable from their extreme sensitiveness to a touch, as some, not by their own movement, but by that of the lobes. The margins of the leaf are prolonged into sharp, rigid projections, that Mr. Darwin terms spikes, into each of which a bundle of spiral vessels enters. The spikes stand in such a position that when the lobes close they interlock like the teeth of a rat-trap. With reference to the very sensitive filaments mentioned above, Mr. Darwin tells us that "it is scarcely possible to touch them ever so lightly or quickly with any hard object without causing the lobes to close. A piece of very delicate human hair, two and a half inches in length, held dangling over a filament, and swayed to

cum, a rare plant, found only in Portugal; the *Pinguicula vulgaris*, which grows generally on mountains, and several other plants which are classed by Mr. Darwin as insectivorous, are described in detail, and after the same method as those already mentioned, and in general they are shown to possess characteristics similar to those of the Venus fly-trap and the sun-dew.

On page 361 Mr. Darwin says: "The three most remarkable characters

the leaves of some having the power of movement when excited, in their glands secreting a fluid which digests animal matter, and in their absorption of the digested matter." Then he adds the question, "Can any light be thrown on the steps by which these remarkable powers were acquired?" This interrogatory, of course, springs from the very natural desire of the great naturalist to make the results of his investigations into the peculiarities of these so-called insectivorous plants contributive to the support of his well-known theories of development. Yet, he nowhere shows that there are any connecting links between the plants which he claims digest insects and those which gain their nourishment exclusively from the soil. Indeed, so far as it appears from this treatise, both may always have existed as separate and distinct species. Such questions as this will very naturally excite the combativeness of those who cannot hear Mr. Darwin's name mentioned without placing themselves in the attitude of opposition. Yet, there are so few of these allusions in this volume that it may be read with unqualified pleasure by every student of nature.

BEMMERHAVEN CHARTERS.

The following letter has been addressed to the editor of the *Shipping and Mercantile Gazette*:

SIR: We, the undersigned seven shipmasters, desire to direct attention to the laws and customs of the port of Bremerhaven.

IMPACT OF THE LAWS AS REGARDS DISCHARGING AND COLLECTING FREIGHT.

ARTICLE 4. The time for unloading vessels up to the carrying capacity of seventy-five lasts-rye (a last is equal to 4,011 kilogrammes) is fixed, during the period from the 1st of March to the 31st of October, at eight days; but during the period from the 1st of November to the last of February at twelve days; and for larger vessels one day in addition for every thirty rye lasts, Sundays and holidays not to be counted.

ARTICLE 7. The freight is to be paid to the City of Bremen on the second day of payment following the arrival of the goods in the City of Bremen, (payment days are twice a week, Tuesdays and Fridays,) or after warehousing, but not before the goods are in, but in any case, however, the freight is to be paid latest on the tenth day after receipt of the goods from aboard the vessel, whether the goods have arrived at Bremen, or been warehoused or sunkipped or not. Another rules have become customary, as nearly all the ships coming to this port are chartered to be discharged with "customary dispatch."

Twenty-four hours are allowed, the merchant if orders are not given sooner. After receiving orders he has to remove to the river quay in the dock; master gives permission to enter the dock. Four days are not counted until the ship is in a discharging berth, and then if it does not suit the merchants to receive the goods, and another ship arrives some days after, the latter gets orders to discharge and cut take the berth of the former. Some ships, at the present time, have laid sixteen days before receiving to discharge, and when orders are given to shipmasters they are obliged to give the merchant the goods as fast as possible, if not demurrage will not be paid for discharging cargo after lay-days expire. The receiver has two days to weigh up and recount cargo before giving a receipt for the same, and the master has the ten days to wait before he can collect his freight, unless the merchant sooner chooses to pay before. It has now become customary for shipmasters to make the best terms possible with merchants, or for receivers to receive their cargoes in a reasonable time, and pay the freight as soon as they are in receipt of their cargo. A ship of about one thousand tons, not later, now here with refined petroleum, pays 1,000 marks, equal to £45 sterling to discharge cargo and obtain freight in ten days. They keep him for ten days discharging, and though one was here four days afterwards, the master went away without setting his freight, although the merchant had his receipt as soon as he was discharged. Shipmasters coming to this port should have the number of days mentioned in their charter-parties, or quick dispatch; otherwise they will find much delay and expense, as a watchman is appointed by the dock authorities for every twenty-four hours, and all persons are obliged to be on board while discharging petroleum, and no fire is allowed while it is on board. If ships are over one month in the dock, the masters are obliged to pay dues over again, the same as before, which would be on a ship of 1,000 tons register about £18 sterling. Yours, &c.,

SEVEN SHIPMASTERS.

BREMERHAVEN, July 3, 1875.

A RELIC.

The Pottsville, (Penn.,) *Miners' Journal* has this paragraph: "A gentleman in this borough has a silver coin which, was said as part of the wages

NEW PUBLICATIONS.

MR. DARWIN'S NEW WORK.

INSECTIVOROUS PLANTS. By CHARLES DARWIN M.A., F.R.S. With Illustrations. London: John Murray. 8vo.

In this work Mr. Darwin's patient and painstaking methods of investigation appear to the best possible advantage. It is impossible to read it without enthusiastic admiration for the ingenuity which he has displayed in devising to determine the characteristics of the plants he specialises of which he has made a study, and, as is always the case with him, he presents us on conclusion with a mass of incontrovertible facts that will remain sample for information to the philosophic and practical chemist quite as much as the professional student.

The number of insectivorous plants in our clime is in some sense immaterial, nothing could better illustrate the thoroughness with which Mr. Darwin has traced the action of their characteristics than the fact that the 42 pages in this volume, more than one-half—are taken up with an account of the sundew, the genus of which, one of the Drosera, the *Drosera rotundifolia*, or common sundew, forms the humble subject. Mr. Darwin tells us that he was surprised by finding how little was known about this plant, notably by the leaves of this plant, which he found growing upon a heath in Sussex. He gathered by chance a dozen plants, some with only expanded leaves, and on turning over a few of these to examine if they had insects, and he adds that no doubt many more would have been observed if he had searched more, and still more by those as yet not existing, that the plant will also have had insects their prey; and on several plants very many leaves had capture, which was a single case. On one large leaf he found the spinous of thirty insects. The Drosera appeared more to feed than other insects. Mr. Darwin found nothing larger than a butterfly among these insects, but he finds other well-authenticated instances of a large living dragon fly having been discovered with its body and legs held by its leaves. As this sundew is extremely common in some districts, Mr. Darwin remarks that the number of insects thus annually slaughtered must be prodigious. The author has counted the leaves, the same—the exact, the exact, the exact, the same—the exact, the exact, the exact,