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"The Most Wonderful Plant in the World"

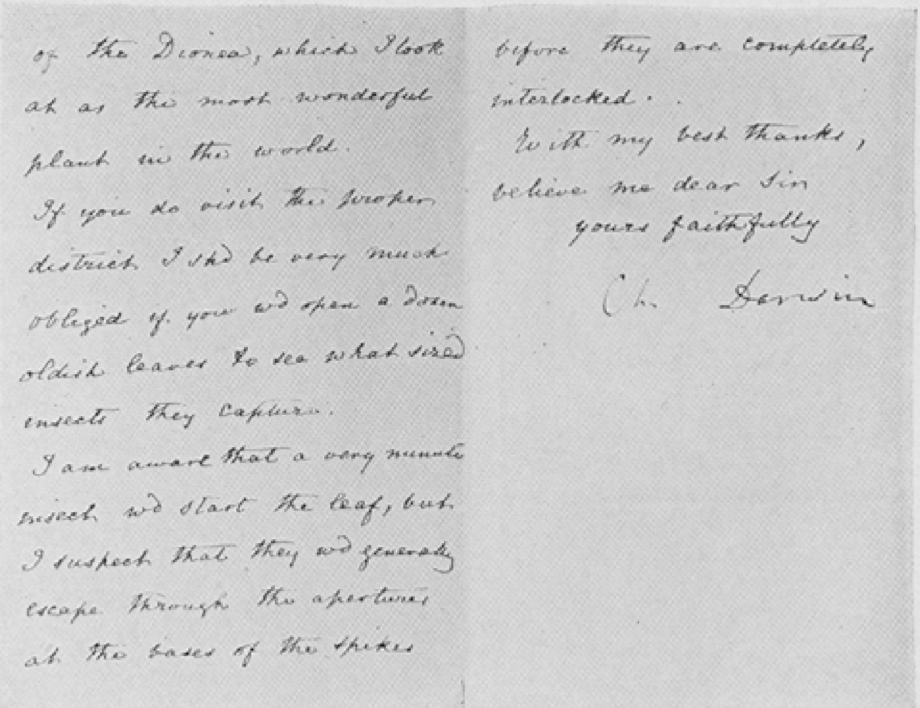
WITH SOME UNPUBLISHED CORRESPONDENCE OF CHARLES DARWIN

By FRANK MORTON JONES

IN 1867 Charles Darwin received a letter from his American correspondent, Asa Gray, enclosing one which Doctor Gray, in turn, had received from William M. Canby, of Wilmington, Delaware. The subject of the Canby letter was the American insectivorous plant, *Dionæa,* Venus's-flytrap; and Darwin's reply says,[1] "This letter fires me up to complete and publish on *Drosera, Dionæa,* etc., but when I shall get time I know not." Though he had also written,[2] "I care more about *Drosera* than the origin of all the species in the world," five years elapsed before Darwin was able to resume in earnest his work on insectivorous plants; then, recalling the American botanist as a source of information in regard to *Dionæa,* and admittedly confusing Mr. Canby's home, Wilmington, Delaware, with the habitat of the

[1]*Letters of Asa Gray.* Edited by Jane Loring Gray. Published by Houghton, Mifflin & Co., 1893.

[2]*The Life and Letters of Charles Darwin.* Edited by Francis Darwin. Published by D. Appleton & Co., 1899.


of the Dionea, which I look
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If you do visit the proper
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I am aware that a very minute
insect wd start the leaf, but
I suspect that they wd generally
escape through the apertures
at the bases of the spikes
before they are completely
interlocked.
With my best thanks,
believe me dear Sir
yours faithfully
Ch. Darwin

Dated from Down, Beckenham, Kent, February 19, 1873, this letter from Charles Darwin to the American botanist, William M. Canby, begins with the admission, "I find that I erred in supposing that the leaves never opened a second time. I did suppose that you resided near the habitation of the Dionea [Dionæa], which I look at as the most wonderful plant in the world" plant, Wilmington, North Carolina, he wrote requesting further information, and especially that field observations should be made on the insect-catching habits of the plant in its native home.

Within the last few months, in a half-forgotten chest in the attic of Mr. Canby's home, this Darwin-Canby correspondence of fifty years ago, relating to *Dionæa* ("which I look at as the most wonderful plant in the world"), has been found. These letters, with the published letters of Darwin and Gray of the same period and regarding the same subject, typically illustrate Darwin's intuitive, almost uncanny, facility in seizing upon apparently minor characters of structure or behavior and in finding there significances hidden from the observers upon whose evidence he builds his edifice of inference and deduction; and they most forcibly call to our attention the paucity in our literature of direct and detailed field observations on *Dionæa*,—if not "the most wonderful plant in the world" yet undeniably among the most remarkable of all our native flora.

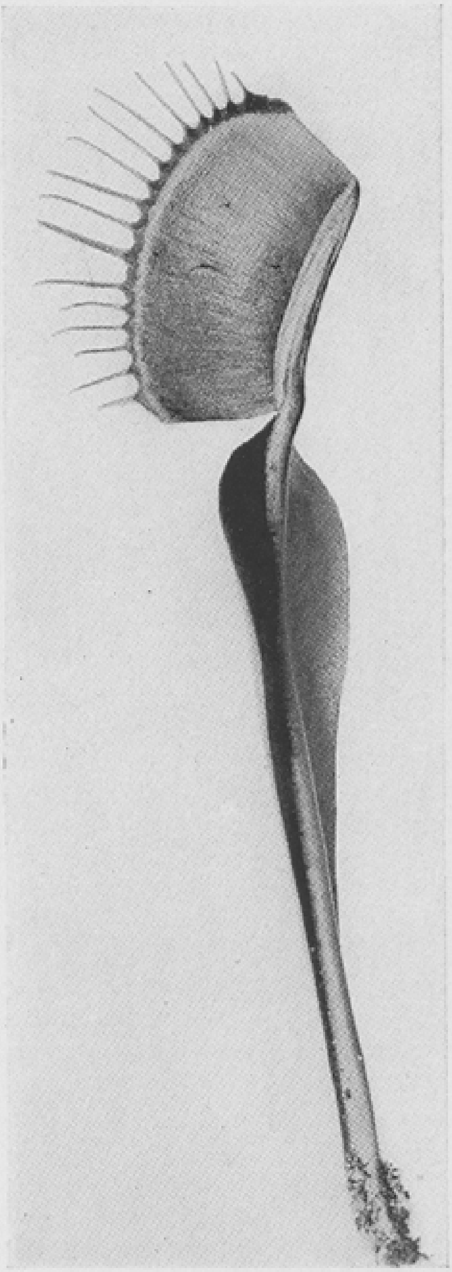
Dionæa muscipula, Venus's-flytrap, belongs to the same plant family as the more familiar *Drosera*, the sundews; but while some species of *Drosera* are almost world-wide in their distribution, *Dionæa*, represented by its single species *muscipula*, is confined, if one excepts hothouse specimens, to a narrow strip of about fifty miles along the coast of North and South Carolina; and even within these limits its dis-

Dionæa is not a conspicuous plant, for its leaves rise, at most, only a few inches above the sand, where they are often half-hidden by other herbage

Only when the slender flower stalk raises its cluster of modest white flowers above the level of the leaves, is the discovery of *Dionæa* always possible without prolonged search

tribution is strictly localized, for it seems to be very particular in the selection of its growing place.

To the non-botanical observer, untroubled by problems of comparative morphology, the "leaf" of *Dionæa* is borne on a flattened or winged petiole; the broadly rounded halves of the leaf are set at an upward angle to the midrib, and the outer edge of each half bears more than a dozen evenly spaced finger-like spikes; the slightly concave disk of each leaf-half bears three (sometimes more), fine, short, tapering bristles, which are the "triggers" to set off the trap; for the whole structure is a trap for the capture of insects. Touch one of the trigger hairs twice, or any two of them in close succession (gently, even with a hair) and like a closing hand the halves of the leaf clap to, the marginal fingers interlace, and if the capture be of nutrient material (an insect), or if it continues its struggles (for the leaf responds both to chemical and mechanical stimulation), the leaf-halves press more and more closely together, the innumerable glands which stud their upper surface pour out an abundant ropy secretion, which bathes the captive in a digestive juice, and when days later the leaf reopens, the insect has been reduced to a mere chitinous shell from which all the softer parts have been dissolved out and absorbed for the nourishment of the plant.



In this photograph one half of the leaf has been removed, to show distinctly the marginal spikes, the three trigger hairs, and the slightly concave and densely glandular area forming the digesting and absorbing surface of the leaf

This is the usual (and apparently justified) interpretation of the activities of *Dionæa*. The mechanism of the closing of the leaf; the conditions under which the digestive liquid is poured out and nutritive material absorbed; even the minute electrical disturbances set up in the leaf in closing,—all these have been made the subject of extended research; but it was in reference to none of these that Darwin wrote Canby. In the closing movement of the leaf one detail had puzzled him. When the trigger hairs are touched and the leaf claps to, it does not at first close tightly; the fingers interlace but do not close to their bases, and a row of crevices remains through which for a time a small insect might squeeze out. Darwin's son actually observed a small ant make its escape in this manner. But after the first quick closing movement, if a capture is actually made, the marginal fingers soon tighten their grip, the leaf edges are pressed into closer contact, and eventually even the form of the imprisoned insect, under the pressure

Why does the leaf of *Dionæa*, in its first quick closing movement, leave a row of crevices between the "fingers," through which a small insect may make its escape, and then very gradually close these orifices? It looks as though the small insects were given an opportunity to escape; but why?

exerted, becomes visible as it bulges out the thin walls. In explanation of these peculiarities of the closing movements of the leaf Darwin had a theory; but his sickly greenhouse plants ("I cannot make the little creature grow well," he wrote[1] Hooker) did not furnish conclusive evidence of its correctness; so his queries to his American correspondent were, "How many times, successively, does a single leaf capture and digest prey? What sized insects do they capture?" Canby replied, writing from memory, six years after his observations had been made: "As to the specific point about the plant capturing large or small insects, the answer is that so far as I am aware it catches everything it can, large or small. . . . As far as I can remember, any insect from the size of a small fly, say a line or two in length, to a beetle or other insect of *nearly* the length of the leaf would be closed upon and . . . devoured. As to the proportion of 'large' or 'small,' I cannot distinctly remember; but after what I have written it would be fair to suppose that within the limits mentioned above it would probably be almost the proportion of insects in the neighborhood of the leaves, except that insects which habitually fly, as a class, would probably be less liable to capture than those which crawl. . . Now about the leaves becoming callous and unexcitable after 'catching' an insect, I have several times known leaves to devour insects *three* successive times, never more than that, and then they were the most vigorous. Ordinarily twice, and quite often once, was enough to render them unserviceable."

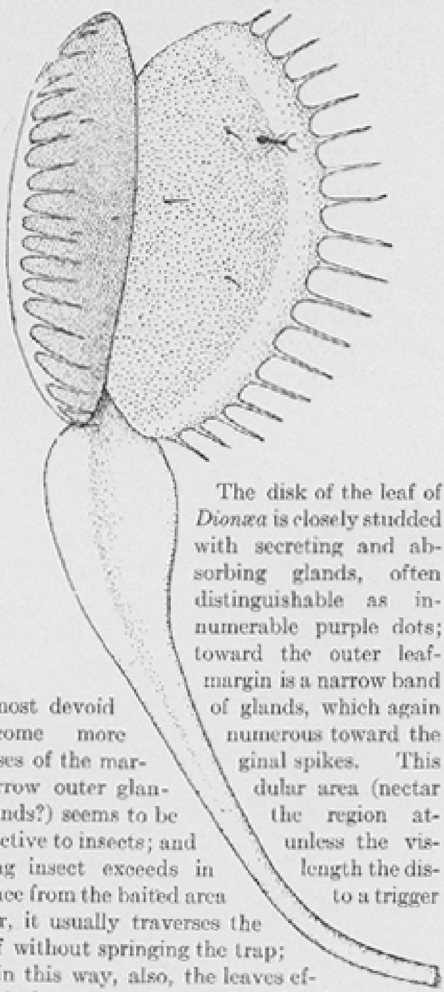
This reply was not conclusive, and on February 17, 1873, Darwin wrote Canby: "I find that I erred in sup-

[1] *More Letters of Charles Darwin*. Edited by Francis Darwin. Published by D. Appleton & Co., 1903.

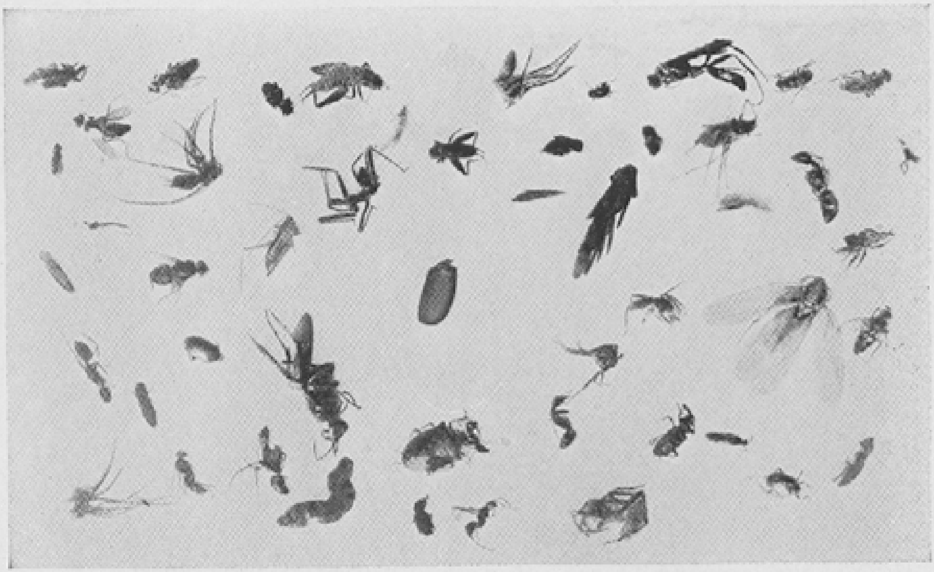
"Conundrum? Why does the *Dionæa* trap close only part way, so as to cross the bristles of edge only, at first, and afterwards close fully? Darwin has hit it. I wonder you or I never thought of it. . . Think what a waste if the leaf had to go through all the process of secretion, etc., taking so much time, all for a little gnat. It would not pay. Yet it would have to do it except for this arrangement to let the little flies escape. But when a bigger one is caught he is sure for a good dinner. That is real Darwin! I just wonder you and I never thought of it. But *he* did." Gray was right, and "That is real Darwin!" But is it true? Darwin, after examining the captures of fourteen leaves gathered in the field, writes, "I think my results may be trusted." Perhaps by these methods his theory of this significance of the leaf behavior is not susceptible of absolute proof; but it seemed worth while, by further direct observation upon the plants in their native home, and by the examination of a large number of leaves which had made captures, to determine whether an actual sorting out of visiting insects by size does take place.

On May 31, 1921, *Dionæa* was found in full bloom, in abundance, and in fine condition, within a few miles of Wilmington, North Carolina. It was an easy task to gather fifty well-developed leaves with captures; these were opened carefully, and their captures were dropped into alcohol, for measurement and approximate identification at leisure. Of the fifty, only one was less than 5 mm. in length, and only seven, less than 6 mm.; ten were 10 mm. or more in length, with a maximum of 30 mm. We may then safely conclude that the habitual captures of mature leaves range from the largest insect the leaf is able to close upon and hold, down to those approximately one quarter of an inch in length; and that insects materially smaller than this, if they spring the trap, usually take advantage of the opportunity afforded by the partially closed leaf and make their escape.

One capture not tabulated deserves special mention. When one leaf was opened, its contents were found to be a single wing cover of a large beetle (shown in the center of the plate of captures) and an ant much smaller than any of those captured by the other leaves examined. It is not diffi-



The disk of the leaf of *Dionæa* is closely studded with secreting and absorbing glands, often distinguishable as innumerable purple dots; toward the outer leaf-margin is a narrow band almost devoid of glands, which again become more numerous toward the bases of the marginal spikes. This narrow outer glandular area (nectar glands?) seems to be the region attractive to insects; and unless the visiting insect exceeds in length the distance from the baited area to a trigger hair, it usually traverses the leaf without springing the trap; so in this way, also, the leaves effectively sort out their captures by size



The captures of fifty mature leaves of *Dionæa* consisted of Hymenoptera (wasps and large ants), 10; Diptera (flies), 9; arachnids (spiders), 9 (one with an egg sack); Coleoptera (beetles), 9 (each distinct as to species); Orthoptera (grasshoppers, locusts, roaches), 7; Hemiptera (predacious bugs and leaf hoppers), 4; Lepidoptera (caterpillars), 2. The average length of the fifty victims was 8.6 mm., or about one third of an inch

posing that the leaves never opened a second time. . . If you do visit the proper district I shd be very much obliged if you wd open a dozen oldish leaves to see what sized insects they capture. I am aware that a very minute insect wd start the leaf, but I suspect that they wd generally escape through the apertures at the bases of the spikes before they completely interlocked."

And again on May 7 of the same year Darwin wrote: "I thank you very sincerely for the leaves, of which I have examined the [captures] with great interest. The results support my anticipation that the leaves are adapted to allow of the smaller fry escaping. Eight of the fourteen leaves had caught beetles of relative considerable size. There were also a good-sized spider & a scolopendra. Three of the leaves had caught ants. I wish the leaves had been of full size, but I think my results may be trusted."

The examination of the captures of fourteen small leaves, then, is the principal basis upon which Darwin builds his theory of the significance of the initial partial closing of the leaf of *Dionæa*. In *Insectivorous Plants* he reviews this evidence, concluding, "It would manifestly be a disadvantage to the plant to waste many days in remaining clasped over a minute insect, and several additional days or weeks in afterwards recovering its sensibility; inasmuch as a minute insect would afford but little nutriment. It would be far better for the plant to wait for a time until a moderately large insect was captured, and to allow all the little ones to escape; and this advantage is secured by the slowly intercrossing marginal spikes, which act like the large meshes of a fishing net, allowing the small and useless fry to escape."

Before the appearance of *Insectivorous Plants* Gray wrote to Canby thus:[1]

[1] *Letters of Asa Gray.* Edited by Jane Loring Gray Published by Houghton, Mifflin & Co., 1893.

cult to picture the minute ant, desperately tugging the wing cover across the leaf, bumping into the trigger hairs, and refusing to desert its booty until the time for possible escape had passed.

With this evidence of the size of the actual captures of the leaves, it was desirable to determine what insects could be observed upon the leaves, subject to capture; and parts of two days were devoted to this, with some unanticipated results. Ants were the only insects frequently noticed upon the leaves. Nearly all of these ants belonged to small species, 3 mm. or less in length, and consequently smaller than any of those captured by the fifty leaves. None was actually observed to set off the trigger hairs, but we repeatedly sprung the leaf traps with slender grass stems without disturbing the ants, each leaf closing upon its visiting ant, which crept out after the expiration of a few seconds, either between the crossed fingers, as Darwin had surmised and recorded, or at the end of the leaf, where also a slight crevice remains after the first closing movement; and none failed thus to make its escape in time to elude the slow tightening and closing of these apertures.

The plants *were* sorting out their captures by size; but to accomplish this not one method, but two, were employed; and the second and unrecorded method with respect to these small ants was the more effective. Most of these little ants (sometimes two of them on a single leaf) were observed to occupy a uniform position on its upper surface, their heads close to the bases of the marginal spikes. As they moved slowly across this belt of the leaf, they made frequent and prolonged pauses, during which, their mouth parts were observed under the lens, to be in motion against the surface of the leaf. A larger and winged hymenopteron was observed to be engaged in the same performance. Obviously, they were feeding upon some attractive exudation of the leaf. The behavior of visiting insects is entirely convincing to the observer that a baited area extends across the leaf on its upper surface just within the bases of the marginal spines. This baited marginal band is so situated upon the leaf surface that a visiting insect *in length too small to extend from the bait to the trigger hairs*, usually does not spring the trap. Whether or not these conditions are to be interpreted as adjustments to that end, the effect of this arrangement, in conjunction with the peculiarities of the closing movement by which small insects are given an opportunity to escape, is to limit the usual captures of the leaves to insects approximating one quarter of an inch or more in length.

Living plants of *Dionæa* were exhibited in England more than 150 years ago, even prior to the first published description by Ellis (1775). The voluminous literature of research upon this plant has increased rather than decreased our recognition of its almost unique interest, and is at least proof that *Dionæa* still withholds answer to some of its more fascinating problems. As a hothouse plant it continues to be fairly familiar both here and abroad, but its survival in its restricted native habitat should not be left to chance. Let us hope that means for its preservation may be found, and that for all the future we may have opportunity to "look on *Dionæa* as the most wonderful plant in the world."