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2. ON OBJECTIONS TO DARWIN'S THEORY OF FERTILIZATION THROUGH INSECT AGENCY. By THOMAS MEEHAN, of Germantown, Penn.

It often occurs that in the enunciation of new theories the authors meet with facts which seem to oppose them, and for a time present insurmountable difficulties. But it not unfrequently happens that these very objections ultimately prove to aid rather than to obstruct the progress of the newly discovered law in popular favor.

Mr. Darwin has shown that in many plants fertilization is carried on by means of insect agency; and he has proved this to be so important a law that, he says, "if the race of Humble Bees were to die out, some species of plants would soon become extinct in Britain."

The objection to this is that some plants appear to have their sexual organs admirably adapted to the use of these insect agencies, and yet the bees seem to studiously avoid using them; and again, often where the structure is the best suited to throw the pollen on the insect which is to carry it away, there is the least inducement for bees to make use of the opportunity.

There is probably no plant which has its organs more beautifully adapted to the work of this insect agency than the *Salvia*. The anthers are divided on the filaments, and while one part is extended towards the mouth of the corolla, and performs its pollen-bearing functions, the other extends down towards the base of the corolla tube, and assumes a petaloid form. The divided anther is thus balanced on a pivot. The lower petaloid portion so closes the mouth of the corolla tube that any insect thrusting its probos-

cis down it must lift the lever, when the polleniferous portion is brought down on the insect's back. When it attempts to enter another flower, the pistil is usually exerted; and the pollen is thus brought into exact contact with it. In addition to this, there is usually an abundance of sweet liquor at the base of the corolla tube; all things tending, as one would suppose, to make the illustration of insect agency as perfect as possible. But now come the objections. In many *Salvias*, the petaloid prolongations of the anthers are very poorly developed; and yet many of these abound in the honeyed juice. If the bee enters them, the chance of its having any pollen thrown on its back is comparatively small. At other times the mouth is so completely closed that the slightest touch will cause the pollen to fall, but there is little sweet to invite bees. *S. Egyptica* is an excellent illustration of this. I am aware that the mere reasoner might say that this was a proper arrangement; that with less inducements for the presence of insects, the arrangements for making use of them when they do come should be more perfect. But against all this comes the fact that the bee never enters either class of flowers at all. I have watched by the hour, and never saw an insect enter that was large enough to make the slightest use of all this beautifully contrived arrangement for cross-fertilizing flowers. But the bees get the honey. They bore a small hole near the base and suck the honey through the tube from the outside, without the slightest regard to the theories of Darwin.

I have tried to harmonize these facts with Darwin's, and failing have sometimes thought they should weigh against his results; but his facts were so direct, so conclusive as far as they went, that it was more reasonable to hope something would explain them, rather than that there should be a lasting contradiction. This view was the more reasonable, as it was a fact that these *Salvias*, which were thus treated by the bees, seldom perfected seeds.

I think I can now harmonize these facts with the theory, by an analogous case with *Petunia*. Here also the Humble Bees refuse to draw the honey up through the tube. I have seen an occasional one, evidently a greenhorn, attempt it; but after trying three or four, it would fly away from the whole bed full of flowers, in disgust. The more experienced fellows make a slit in the base of the tube, through which they get the honey. By examining *Petunia* flowers with a lens, these slits can be readily seen, or still better to watch the insect in the very act. Here was another puzzle. A large

bed under my office-window afforded an opportunity to see them every day. No insect that I could ever see assisting fertilization in any way, and the viscid nature of all the parts very much against any self-acting power. It was a worse case than the *Salvia*, because the *Petunia* is always highly productive of seeds.

But at length the mystery was explained. Though no insect but the Humble Bee visited the flowers by day, they were thronged by moths at night. These were the insects through whose agency the fertilization of these flowers is carried on.

I have thought that this account of the way the *Petunia* is fertilized may not only be a novel fact to many here, but convey a very useful lesson applicable to many things,—to theories of my own, as well as to Mr. Darwin's. No doubt the seeming difficulties of the *Salvia* could be settled as satisfactorily as this of *Petunia*, if one could be in a position to watch for the facts. Possibly, in the countries where *Salvias* abound, insects peculiarly adapted to operate on the Darwinian method exist, which choose their own time and way of doing it.

The *Petunia*, we certainly see, relies on the night moth, and not on the Humble Bee. They use their proboscis to extract the honey, and thus fertilize the other flowers. Here, at least, though at first in opposition, the facts wonderfully confirm Darwin's; and it seems a great point gained in the harmony of apparently conflicting facts.

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