

FAIRY FLIES AND THEIR HOSTS.

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To some the title of my lecture may appear to be somewhat ambiguous, so I will at once say that the family of Fairy Flies consists of the most minute winged insects known to science—some of them measuring not more than one-ninetieth of an inch in length! (Fig. 9.)

It was not until the year 1833 that they received any attention from entomologists, who evidently considered them too small to merit a name.

In that year they were named by the late A. HALLIDAY and FRANCIS WALKER, and were placed in the family of the Mymaridae, consisting of about twenty species. Unfortunately for science, no figures were given, but only short Latin descriptions from which only the genera could be identified. From this fact, it is not to be wondered at that few students were found to work at this much-neglected family.

In the year 1876 the Royal Microscopical Society held a *conversazione*, and under one of the microscopes was exhibited by the late FREDERICK FITCH a minute insect, described as "A Fairy Fly caught in a Spider's Web." (Fig. 10.)

It was the sight of this most exquisite insect that first determined the writer to commence the study of the family, but this was easier said than done, for the materials were so meagre. The whereabouts of HALLIDAY's collection was unknown for several years, and when found in the Dublin Natural History Museum it was in such a dilapidated condition that it was not of much service. There were 167 specimens, mounted on small pieces of card, but so dirty and covered with crystals that it was next to impossible to name them until I had made an enlarged drawing of each specimen under the microscope, showing as much as possible the various parts, but here again the accumulated mass of dust and crystallization of nearly a hundred years had completely obliterated the delicate joints of the antennæ and tarsi. In spite of these drawbacks, I was enabled to identify the genera to which they belonged, but several of the most interesting types were missing from this collection.

The following names are those of HALLIDAY's genera: *Ooctonus*, *Litus*, *Mymar*, *Anaphes*, *Anagrus*, *Polynema*, and *Eustochus*.

To these, in 1846, F. WALKER had added *Arescon*, *Alaptus*, *Panithus*, and *Caraphractus*.

In the 'Entomologist,' vol. 6 (1872 and 1873), we find that the German entomologist FOERSTER added several new genera, about some of which there appears to be a little doubt as to their occurrence in Great Britain. Their names are as follows: *Camptoptera*, *Limacis*, *Gonatocerus*, *Dorichlytus*, and *Stichothrix*. I have not yet captured the last two.

The Rev. T. A. MARSHALL, M.A., F.L.S., under the title of 'Hymenoptera Britannica,' gives a list of the British Mymaridae: *Ooctonus insignis*, *O. vulgatus*, *O. notatus*, *O. hemipterus*, *Limacis dimidiata*, *Litus cynipseus*, *Gonatocerus acuminata*, *G. pictus*, *G. litoralis*, *G. fuscicornis* and *G. crassicornis*, *Alaptus minimus*, *A. fuscus*, *Eustochus atripennis*, *Mymar pulchellus*, *Cosmocoma ovulorum*, *C. flavipes*, *C. fumipennis*, *C. pusilla*, *C. fuscipes*, *C. atrata*, *C. euchariiformis*, *Caraphractus cinctus*, *Anaphes fuscipennis*, *A. collinus*, *A. longicornis*, *A. regulus*, *A. auripes*, *A. latipennis*, *A. punctum*, *Anagrus atomus*, *A. incarnatus*, *A. ustulalus*, *A. flavovarius*.

Strange to say, FOERSTER did not give any figures by which species could be identified; long descriptions of these microscopic insects are of little help to either young or old entomologists, and for some years I could do little more than collect and mount specimens in Canada balsam, which medium is the only one for permanent preservation, though most of the natural colours are lost—but these can be noted down before mounting.

From 1876 to 1907 (thirty-one years) I was the sole entomologist working up this hitherto much-neglected family of insects. In 1907 Mr. CHARLES OWEN WATERHOUSE, I.S.O., late of the Natural History Museum, commenced to collect the Mymaridae, and ever since has helped me in naming the numerous new genera and species which we have discovered. During a three years' sojourn at Woking (1882 to 1885) I was fortunate in discovering seven new genera, which we have since named as follows: *Stethynium triclavatum*, male and female; *Cleruchus pluteus*, male and female; *Parallelaptera panis*, male and female; *Erythmelus Goochi*, male and female; *Enaesus laticeps*, female only; *Stephanodes elegans*, male and female; *Dicopus minutissima*, female only; also at Richmond Park in 1908 *Oophilus longicauda*, males and females; and last year in August I added another altogether new to science, and which we christened *Neurotes iridescens*. Of this beautiful species I caught a male and a female. No doubt, were there more workers among this family, many more new species would be added.

The habits and economy of these Fairy Flies are so cryptic that it is a most difficult matter to follow them up, when circumstances prevent one from making continuous observations upon insects which are microscopic in size—all (so far as the writer knows) being ovivorous in their habits. Searching for the eggs of Lepidoptera is no easy matter, and my experience leads me to think that the Mymaridae do not oviposit in the eggs either of Butterflies or Moths, but in those of Homoptera, Hemiptera, and Coleoptera. The difficulty of

discovering the eggs of the two first named is increased from the fact that they are deposited in the stems and leaves of grasses and various plants, and it is only by careful dissection of such that the *host* eggs are found, sometimes embedded in the stem or actually between the upper and lower skins of a blade of grass! or in the soft pith of a rush (*Juncus*), where a large Frog-hopper occasionally lays a row of twelve to fifteen flask-shaped eggs, each of which may contain four to five larvæ of an *Anagrus*. In another species of Frog-hopper, another species of *Anagrus* lays but a single egg, the transformation of which from egg to perfect Fairy Fly I have frequently observed.

I first noticed that some of the rushes were covered, at the lower part, with rows of minute punctures, which, on being examined under the microscope, revealed the heads of from six to nine eggs. On stripping the outer covering from the rush, I found embedded in the white pith these flask-shaped eggs, fitting close together and white in colour—the head ends converging, so that the tips could just be seen through the hole in the rush. Some years elapsed before I discovered one September a Frog-hopper, *Liburnia* (Fig. 11), in the act of laying these delicate eggs; and when lying flat down on my stomach, with my head buried among the grass and rushes, I saw a Fairy Fly (*Anagrus*) walking up a rush, and as it walked it beat its clubbed antennæ against the rush, until they came into contact with the heads of the Frog-hopper's eggs, when the Fairy Fly showed great excitement as she rapidly examined and felt the eggs with her antennæ. In less than half a minute she protruded her ovipositor and pressed the tip against one of the eggs, and after straining a good deal the delicate auger went through and was driven half its length into the egg. For eleven minutes there was no apparent movement of the body, and then the ovipositor was slowly withdrawn and another egg attacked in the same manner. After this I observed the Fairy Fly go from egg to egg. In one case, immediately on the ovipositor being withdrawn, I isolated and cut open the host egg and succeeded in finding the egg of the Fairy Fly (Fig. 12), and in each one so dissected from the host egg I could with a high power see the nucleus and nucleolus. As the host egg was semitransparent, I could just detect the larva of the Fairy Fly moving about in the fluid matter. In March the larva appeared full-grown and about filled the host egg, the mass of cells being of a red colour. I then dissected several and made enlarged drawings. (Fig. 13.) The mouth was a sucking one—with two simple curved organs which I diagnosed as the mandibles. At each side of the mouth were soft fleshy protuberances, not unlike short stumps, which the larva used as forelegs. The tail was the narrowest part of the body, with a slight projection on the ventral side.

When full-grown, the body of the larva appeared full of reddish cells. In a few weeks these cells began to move slowly and crowd together, and as I watched them day by day under the microscope,

I saw them crowding closer together until a narrow curve was distinguished at the head of the larva, and other curved lines were formed by the red cells forming up into close order, which increased in intensity as more cells appeared to be attracted and drawn together, until in from four to five weeks there was a distinct form of the imago marked out by the massed cells, which week after week became more distinct (Fig. 14), and I could clearly see the shape of the head, thorax, and abdomen. Then the limbs were mapped out in the same wonderful manner, and just the delicate outline of the legs, ovipositor, antennæ, and wings. On turning to the head, I noticed some minute crimson specks at exact distances from each other, which after much thought I realized as the facets of the compound eyes! In two months from the time when the larva became full-grown, I had seen taking place under the microscope the formation, by the gathering together of the cells, of all the various organs of the embryo, which in another week or two appeared to have absorbed all the cells, which commenced to lose their red colour and become brown chiton, the various parts being more or less covered with hairs. After another week I could see the tiny jaws at work, endeavouring to nibble a hole through the old eggshell. (Fig. 15.) Some hours were occupied in this work before the tiny parasite was able to wriggle through the pith to the opposite side, where its further progress was barred by the thick green covering of the rush; but, nothing daunted, it went on diligently nibbling until it had made a hole large enough for its passage (Figs. 16, 17) and emerged for the first time into light and air. A short rest on the rush, to brush its body and limbs with the wonderful brushes and combs which are so artfully concealed on each limb, some used for brushing out the long cilia round the margins of the wings, and those on the front tibia, of semicircular form, specially contrived to fit the antennæ, which were brushed one at a time most carefully. A final shake of the exquisite wings and away flew the Fairy Fly on its virgin flight (Fig. 18), soon to find a partner, and then to search for the eggs of *Liburnia*, and another brood is started. In some genera (especially in that of *Anagrus*) the males are fairly common, but when scarce (and among some, the males are still unknown) the females are parthenogenetic, or, as in some instances, the males are apterous, and do not leave the host egg, copulation taking place before the females emerge from the host egg. I have frequently observed this in an allied species, *Prestwichia aquatica* (Lubbock), which oviposits in the eggs of the Large Water Beetle. Several times I have bred from thirty to forty from a single egg!

As might be expected from this little-known family of ovivorous parasites, many wonderful facts in their habits and economy are brought to light by constant research, and even then we feel how little we know about most of the genera, in many instances the only known facts being their date of capture and locality. Take, for instance, the genus *Gonatocerus*. Many times we have swept up twenty to

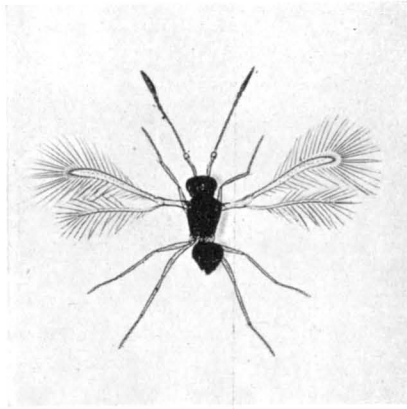


FIG. 9.—CAMPTOPTERA PAPAVERIS.
(*One ninetieth of an inch long.*)

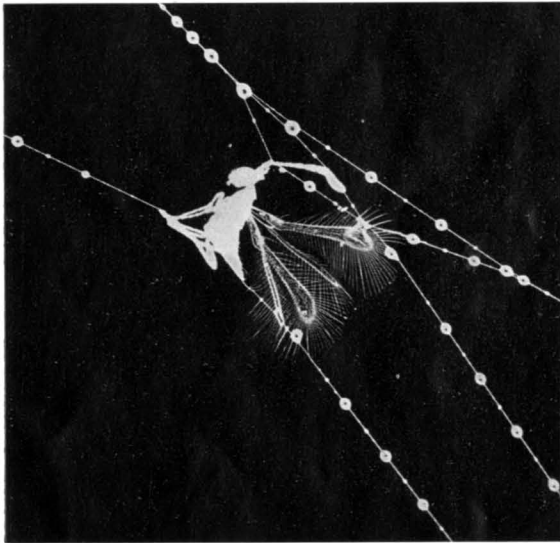


FIG. 10.—FAIRY FLY CAUGHT IN A SPIDER'S WEB.

[*To face p. 48.*

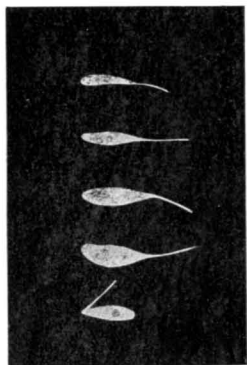


FIG. 12.—GERMS OR EGGS OF FAIRY FLY.

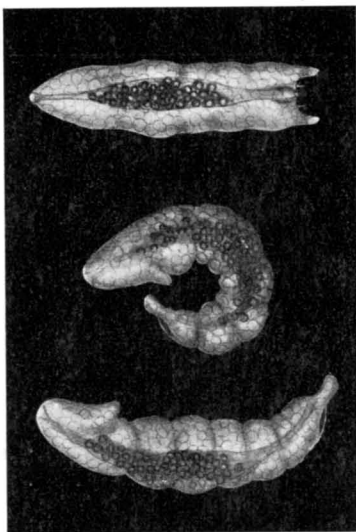


FIG. 13.—LARVÆ OF FAIRY FLIES.
(Magnified 40 diams.)

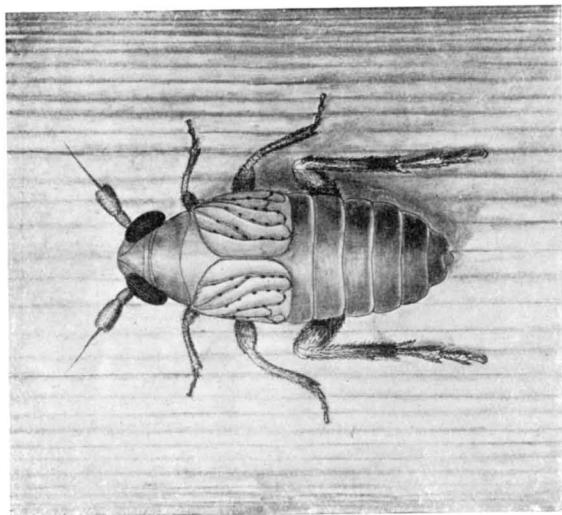


FIG. 11.—FROG HOPPER (*Libinia*).

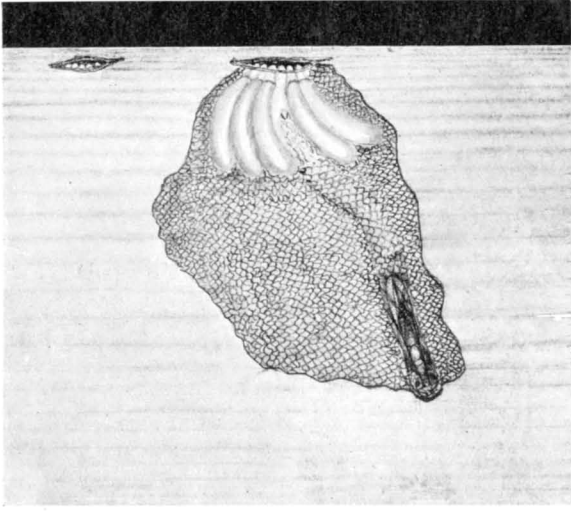


FIG. 16.—FAIRY FLY FORCING ITS WAY THROUGH THE PITH.

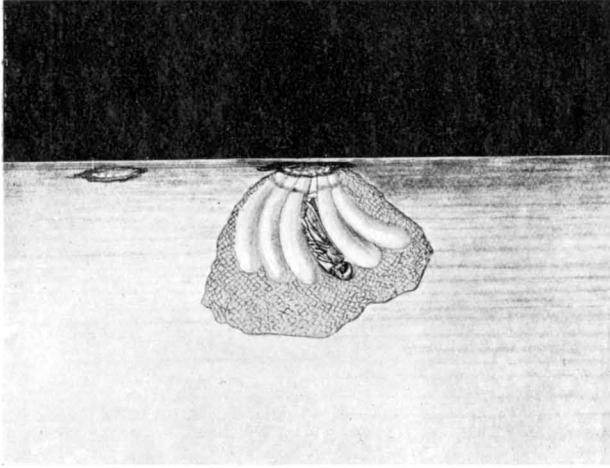


FIG. 15.—FAIRY FLY FULLY DEVELOPED IN HOST EGG.

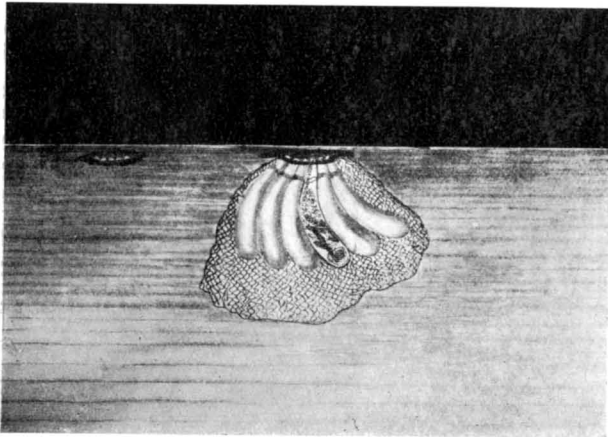


FIG. 14.—DEVELOPMENT OF IMAGO IN HOST EGG.

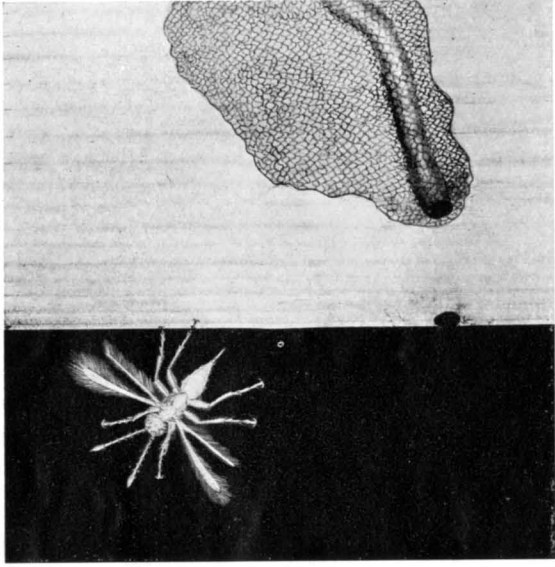


FIG. 18.—FAIRY FLY'S FIRST FLIGHT.

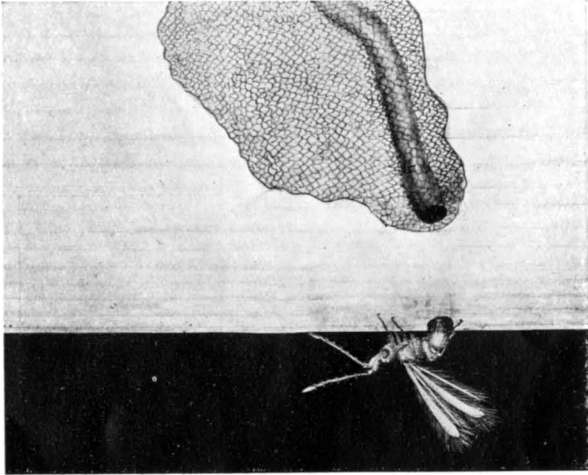


FIG. 17.—FAIRY FLY EMERGING
FROM THE PUPA.

thirty specimens from a clump of rushes, and though so plentiful we have not yet discovered the host egg, though we have bred numerous specimens from various growing plants.

In my endeavour to trace out the life-histories of the Mymaridae, I have often placed all kinds of eggs before the living Fairy Flies. In one instance I tried the following experiment: I bred a number of Alapti from eggs of *Psocus fasciatus*, and, desiring to ascertain whether they would oviposit in eggs of other insects, I carefully gummed twenty eggs of different insects on to a rose-leaf, and at the extreme tip a single egg of *Psocus*. I then placed an Alaptus on the leaf; it ran about and touched the first egg with its antennæ and turned from it, then sounded the second and refused it, and so on; every one of the twenty eggs was refused. I then guided the Alaptus up the midrib; it ran along and reached the egg of *Psocus*, touched it and instantly mounted it, inserted its ovipositor and placed an egg into it. By some marvellous power it was able to recognize the right host egg. I have proved that Alaptus will not oviposit in any other species of egg.

Unfortunately, our knowledge of the value of parasitic insects is very small, and the question has often been asked of the writer, viz.: "What good are these minute Fairy Flies?"—and the remark has frequently followed: "They are too small to be of any service." Of course such questions are only asked by those who do not appreciate or take notice of "creeping things." I think one instance will suffice to prove that nothing has been created in vain, and that all insects perform the function for which they were intended.

Many times have I found patches containing hundreds of eggs of Cabbage Moth, every one of which has been destroyed by a minute Fairy Fly, *Trichogramma evanescens* which lays its eggs in those of the Cabbage Moth, and so lessens the chance of the caterpillars that would otherwise have been bred from the eggs. Surely the most ignorant and prejudiced individual will not deny that this tiny parasite should have the credit due to it.