

behind the middle, apices separately rounding, surface minutely alutaceous, finely punctate in rather obscure rows which fade at tip so that the apical area becomes almost smooth and shining. Abdomen above with four full dorsal segments, as well as the basal lateral portion of another, exposed behind the elytral tips, this uncovered surface being strongly shining and sparsely punctate. The segmental edges have a peculiar laminate appearance, as if folded over. The terminal segment is nearly semicircular in outline and strongly hairy. Underside very shining, sparsely and finely punctured, the prosternal and abdominal apices tinged with yellow. Legs rather slender, the femora and tibiæ flattened, front tibiæ wider, denticulate and strongly hairy, all the tarsi slender, hairy and with large simple claws. Length, if straightened out, nearly 5.00 mm.

Compared with the description of the Guatemalan specimen, this insect is considerably larger, attaining a length of about 5.00 mm., against 3.25 of the southern form. The coloration is also different and there are some diversities in sculpture and structure, which, however, may perhaps be due to unlike interpretation. I think that the funiculus has six joints in *C. championi*, though Dr. Sharp, while admitting difficulty in counting, allows only five in *C. mollis*. He makes no mention of a groove on the posterior half of the head nor of a marginal prothoracic bead.

NOTES ON THE EGG-PARASITES OF THE APPLE TREE TENT-CATERPILLAR (*MALACOSOMA AMERICANUM*)¹

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The object of the following observations during the spring and summer of 1915 was to make a detailed study of the life-histories of some of the egg-parasites of the apple-tree tent-caterpillar. For reasons which will presently be stated this purpose was not fulfilled; but as some new species were bred from the eggs, a supposedly erroneous record of Ashmead's verified, and some other

¹Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 117.

points of possible interest noted, a list of the parasites found, together with some comment on their behavior and relative abundance, seemed to be worthy of publication.

The eggs used for one experiment were separated into four lots, according to the dates of collection and the conditions under which they were kept. Box No. 1 contained about 350 egg-masses, collected between February 20 and March 22, in the immediate vicinity of the Bussey Institution, and kept in a greenhouse until the caterpillars and parasites emerged. Box No. 2 contained about 180 egg-clusters, collected in a locality a few miles south of the first (Stony Brook Reservation, near Hyde Park, Mass.) from June 19 to June 29 (mostly on the earlier date). Box No. 3 contained about 50, collected at the same place as those in Box No. 1, but kept out of doors, so that the exact date on which they were gathered is immaterial. Box No. 4 contained about 60, accumulated in the laboratory from time to time, but, for one reason or another, not placed in the other boxes. The results in these last three boxes were almost identical.

In addition to these, about 30 egg-masses were collected in early spring and placed in cold storage for the months of April, May, and June. The box containing these was known as No. 5. Six more masses were isolated in test-tubes for individual records.

Caterpillars hatched from the eggs in the greenhouse about two weeks after collection, and the first parasites emerged March 29, or about five weeks after collection. Under natural conditions the first caterpillars appeared April 19, and the first parasites, June 19. An attempt was made to rear the early hatched caterpillars in order to secure their eggs for experiment, but they contracted the wilt disease, and perished to the last individual. It was, therefore, necessary to rely on pupæ collected in the field, and as these were heavily parasitized the number of adults reared from them was small. The first female emerged and laid her eggs on June 29, probably a day or two earlier than it would have done under natural conditions.

Six species of parasites were bred from the eggs. They will be taken up in the order of emergence.

1. *Ablerus clisiocampæ* Ashm., Family Eulophidæ.

Six individuals, males and females, issued in Box No. 1 March 29. It was the most abundant parasite till April 10, when it gave

place to others. May 31 was the date of the last specimens to appear in this box. In all, twenty-two males, twenty-four females and five or six which escaped before their sex was determined issued from this box.

Under natural conditions this parasite was, oddly enough, the last to make its appearance. In Box No. 2 four males and one female issued between July 26 and July 31, over two weeks after all the other species (except for those in the cold-storage box) had ceased to emerge, and in Box No. 3 six females and four males appeared, at about the same time. The total from all the boxes was thus about 66, and the percentage of parasitism, counting 200 eggs to the cluster, was only 0.06 per cent. This is, of course, economically negligible, supposing it to represent typical conditions.

As its name shows, this insect was described as a caterpillar parasite, but as the Aphelininæ, the subfamily to which it belongs, are otherwise exclusively parasites of the Coccidæ, and as it was afterwards reared by Howard and others from *Aspidiotus* and *Chionaspis*, it was naturally assumed that Ashmead had been mistaken. In the present case, not only were the trees from which the eggs were taken practically, if not absolutely free from scales of any kind, but the egg-masses were in all cases removed from the twigs on which they had been deposited and placed in the boxes by themselves. Under these conditions the corroboration of the original record is certainly ample.

So far as I know, there are few parallels to this case among the Chalcidoidea. The exact relationships of this insect to such widely separated hosts would appear to be a problem of considerable biological interest.

The Alerus is a very attractive little insect, blue-black in color with bright red eyes, which appear, owing to the iridescent cornea, to be surrounded by a band of brilliant metallic blue. The male has not been described, so far as I know. It is smaller and somewhat slenderer than the female. The antennæ are seven-jointed as in the female, but are relatively longer, lack a definite club, and are uniformly straw-colored instead of being banded. The head, testaceous in the female, is dusky in the male, and the wings are completely hyaline whereas those of the female have a distinct median cloud.

2. *Telenomus clisiocampæ* Ashm., Family Scelionidæ.

One male of this Proctotrypoid parasite emerged on March 30, or only one day later than the *Ablerus*. Small numbers of males continued to issue till April 13. After this, females began to appear, and both sexes were found in the tubes till May 31, the males remaining in the majority. Seventy-five males, thirteen females and two or three of undetermined sex issued from this box. In Box No. 2, one male and another, whose sex was not ascertained, issued on June 23. Four were recorded in all. In Box No. 3, one male issued July 1. In Box No. 4 one male and two females issued June 30 to July 3. One male issued in Box No. 5 (cold storage) August 3, or about three weeks after the eggs it contained were removed from the refrigerator and one female August 7. The total number is, therefore, approximately one hundred, or less than 0.1 per cent. of the number of eggs.

This species is very active, especially the male. The female, which is somewhat more sluggish may be superficially distinguished from the male by the clubbed antennæ.

3. *Tetrastichus* sp., Family Eulophidæ.

A single male of this undetermined species issued on March 31. It lived till April 2. This specimen, together with others of unknown or doubtful species, was sent to Mr. A. A. Girault of the United States National Museum, but its condition did not permit him to do more than determine the genus. It seems likely that the species is undescribed.

4. *Oöencyrtus clisiocampæ* Ashm., Family Encyrtidæ.

One female issued in Box No. 1 on April 10. It was followed at intervals by others till April 21, and then did not appear again till May 9. The last one issued June 2. In all ten males, ten females, and three of undetermined sex issued from this box. None came from Box No. 2, and only two (June 30) from Box No. 3. From Box No. 4, one male and three females issued, and from Box No. 5 (cold storage) one female on August 7. This makes thirty in all, less than half as many as the *Ablerus*, to which it comes next in point of numbers.

5. *Tetrastichus (sens. lat) sp.*, Family Eulophidæ.

A female of this undetermined species issued in Box No. 1 April 13. Others issued in small numbers thereafter till April 29, on which date about a hundred, mostly males, were found in the tube which had been left undisturbed for four days. They continued to issue in considerable numbers till June 2. In Box No. 2, the first individual appeared June 26 and the last July 7, and in Boxes Nos. 3 and 4 the periods of emergence were about the same. In Box No. 5, about eighty issued from the thirty egg-masses between August 2 and August 16.

Quite a large proportion of the parasites failed to find their way into the tubes. In Box No. 4 in particular about five hundred were found in the débris after living insects had ceased to emerge. It may very well be that some fault in the arrangement of the boxes prevented individuals of all the species from emerging, and made the records lower than they would otherwise have been.

No. 5 was the only species to appear in any of the tubes containing the isolated egg-masses. The percentage of parasitism varies from 1 to about 12 per cent., showing that the number taken was too small to justify any definite conclusions, although the average percentage is not far from that of Box No. 4 in which the dead insects were counted. Most of the egg-masses would seem to be attacked, but only a few eggs seem to be parasitized in any one egg-mass.

In spite of the comparative abundance of this species no details of its life-history could be ascertained, except that it passes the winter as a full-grown larva in the host egg, and emerges in June, a few days before the adults of *Malacosoma*. This failure was due to the fact that the insect could not be induced to oviposit in the eggs of its host. On one occasion a moth was secured in the act of laying, and a parasite placed on the egg-mass; but the latter did not oviposit, though it carefully explored the eggs. Finally, the parasites were attracted to the eggs by dipping the latter in syrup, but, as was to be expected, this did not overcome their unwillingness to oviposit. It cannot be stated with absolute certainty that they never did so, as eggs were sometimes left in the tubes while the parasites were not watched. However, observations lasting more than an hour, during which parasites were continually walking about on the eggs, failed to demonstrate any egg-laying

activity on the part of the females. Similar failures were noted in the case of *Ablerus*, *Telenomus*, and *Oöencyrtus*, but the rarity of these insects rendered a fair trial impossible, and the results are accordingly less surprising.

The failure of No. 5 to oviposit normally is the more peculiar in view of the fact that it frequently deposited eggs on the test-tube wall. These eggs, which were rather large, were of the ordinary stalked type. On one occasion some of these eggs apparently developed as far as the first larval stage. These larvæ were much damaged when discovered, and could not be figured or described, but a very distinct segmentation could be made out, and the form appeared to be somewhat flattened.

6. *Aphycoideus io* Girault., Family Encyrtidæ.

Two females issued from Box No. 2 before it had been fitted with a tube. One was found walking about on the laboratory desk, but the other was still in the box, so that there seems to be no reasonable doubt as to their source.

A specimen was sent to Girault, who pronounced it to be a representative of a new genus. Its reddish-yellow color distinguishes it at a glance from any of the other species, all of which are black or very dark.

These observations were undertaken at the suggestion and under the supervision of Professor Brues, whom I wish to thank for his aid during its entire course. Professor Wheeler, Dr. Chapman, and many students of the Department, have also furnished literature, or suggestions. I have already stated that I am indebted to Mr. A. A. Girault for the identification of several of the species.

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