OBSERVATIONS ON EUPLECTRUS PLATYHYPENAE HOW. (CHALCIDAE), A PARASITE OF NOCTUID LARVAE.[1]

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Early in June, 1926, the variegated cutworm, *Lycophotia margaritosa* Haw., was very plentiful in various localities in Kansas. This insect had not occurred in any numbers in the state since 1920. An outbreak with some damage was expected, but it did not occur chiefly because of prompt action on the part of the predators and parasites. The most abundant and effective Hymenopterous parasite observed was *Euplectrus platyhypenae* How. An opportunity was, therefore, provided to make some observations on its life history and habits because of its abundance. In spite of the fact that it is supposed to be a common Noctuid parasite, it has not been reported as a parasite of the variegated cutworm, and it has never been seen by the entomologists of this station on any hosts. It has not been encountered in seven seasons of study of alfalfa insects. Since it has such striking habits, and since so little has been recorded about it, these illustrations and rather fragmentary observations may be of interest.[2]

History and Review of Literature.

This parasite was described by Howard (1885) from adults bred from a larva of *Platypena* (*Platyhypena*) *scabra* Fabr. from the District of Columbia. The first biological observations of any consequence referable to this genus were published by Schwarz (1881), who gave an excellent account of *E. comstockii* How., a species very similar to this one. The habits of the two species are practically identical. A summary of Schwarz's account is given by Riley (1885), with three original illustrations. Vickery (1926)

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gives a brief but excellent account, with one photograph, of this parasite attacking *Cirphis latiuscula* (H. Sch.) in Texas. His observations are in complete accord with those made in the course of these studies. Swezey (1926) stated that this parasite had been introduced into Hawaii in 1923 to assist in the control of army worms. Large numbers have been bred and distributed over the islands where they have proved to be a valuable addition to the army worm parasites.

Hosts.—This species was described from specimens reared from the green clover worm, as the name indicates. It is recorded by Vickery (1915) as a parasite of the fall army worm (*Laphygma frugiperda* S. and A.), and three other Noctuids—*Heliophila unipuncta* Haw., *H. subpunctata* Haw., and probably from *H. multilinea* Walk. at Brownsville, Texas. He also stated that this parasite is attacked in some parts of the country by *Tetrastichus euplectri* Gahan. Mention has already been made of the host *Cirphis latiuscula* (H. Sch.) (Vickery, 1926) and of army worms by Swekey (1926).

During these observations, this parasite was taken on the variegated cutworm (*Lycophotia margaritosa* Haw. (Figs. 8 and 9), the green clover worm (*Platypena scabra* Fabr.), the forage looper (*Caenurgia erechtea* Cram.), the celery looper (*Plusia simplex* Guén), and a larva closely resembling the corn earworm (*Heliothis obsoleta* Fabr.). In all cases, these parasites successfully reached maturity and the adults emerged. There were several times as many variegated cutworms attacked by the parasites as of all other hosts combined. During the latter part of June and early July, 1926, an average of 20 per cent. of the larvae collected by sweeping were parasitized by this species.

Life History.—The oblong, oval, brownish-black eggs were generally deposited on the dorsum of the thorax of the host larvae when the hosts were half to nearly grown. Sometimes they occurred on the abdomen and not always on the dorsum (Fig. 8). They were laid in patches, which to the unaided eye appeared like a small, black spot. Sometimes they reminded one of a fleck of soot. The eggs (Fig. 1) are separated about equidistant from each other. The color at oviposition was not ascertained, but all eggs seen were shining brownish black, or dark shining chocolate brown. They measured 0.34 mm. long and 0.17 mm. in diameter. The eggs were securely glued to the host. They were laid in groups, 26 being the largest number seen on one larva.

Hatching occurred by the larva rupturing the shell along the mid-dorsal line (Fig. 2). The line of cleavage is straight and the larva gradually grows out of the shell. The two halves of the shell slipped down the sides of the embryo and were left on the back of the host. In a group of eggs, one often observed all stages of hatching with some unhatched eggs and some larvae (Fig. 2).

The length of the egg stage was not definitely determined. Oviposition was never observed, but embryonic development requires at least two days. The period is probably between two and three days, as Schwarz (1881) described for *E. comstockii.* The interval must be short, for if the host should molt before the eggs hatched, they would be cast off with the exuvium and the young larvae would perish. This, however, was never observed to take place.

The Larva.—The larva was a footless, gray, soft-bodied creature without clearly differentiated regions (Figs. 3–6). Vickery (1926) stated that the color was greenish-yellow when feeding on *Cirphis latiuscula,* and darker green when feeding on *Laphygma frugiperda.* All of our material was distinctly gray with at times a tinge of yellow. The parasite larva spent its entire life as an external parasite on the host. During hatching, the head of the parasite was extended somewhat beyond the shell, enabling the needle-like mandibles to pierce the body wall, and the larva fed upon the exuding body fluids. The parasites appeared to gradually expand in size. Growth proceeded rapidly, maturity being reached in four to six days. The space between the parasites was soon taken up and the group of parasites presented a piled-up appearance (Figs. 3, 8, 9). It was first thought that they were holding on by their mandibles, but it was found that this was not necessarily the case. It was found that the egg shell holds the first instar larva in place. The first exuvium lies under the larva and holds it to the old egg shell and host. The second exuvium occurs above the first. It is in this manner that the whole of the dark-brown somewhat gelatinous mass (Fig. 6) beneath the larva which holds it in place is formed. This and similar methods of holding on have been described by Cushman (1926). It is not necessary, therefore, that the parasite keep its mandibles inserted into the host to hold on. The parasite remains in normal position when it and the host are preserved in formalin or alcohol. The character of the surface of the cuticula of the parasites also causes them to adhere somewhat to each other (Fig. 3).

There was no observed migration of parasites to unparasitized larvae. In fact, the parasites practically never shifted their positions. Their movements were exceedingly slow and appeared to be aimless. It was found impossible to transfer parasites to unparasitized larvae and have them mature. Schwarz also found this impossible with *E. comstockii.*

The exact number of molts could not be determined, but it is at least two. In one case, a larva was observed to be in the process of molting, and a brownish dried exuvium was found beneath it. Since this parasite appeared to be nearly grown, there may be only two molts.

The parasites ceased feeding before molting and withdrew their mandibles. The cuticula became dull in appearance. Molting was effected by the splitting of the old cuticula in the mid-dorsal line. The rent was gradually widened and the old cuticula slipped down the sides of the larva similar to the manner in which the egg shell did at hatching, and was left beneath the parasite on the host. The larval movements involved were few and rather indefinite or irregular.

The morphological features of the larvae reminded one of other chalcid larvae. The head was poorly differentiated, except in the fully grown parasite where it appeared similar to the head of a small caterpillar. It could always be determined by finding the mandibles. There was present a pair of very short and inconspicuous antennae. Eyes were absent or at least they were not found. The mouth was readily located. It appeared as a small slit within which were the rather peculiar mandibles. The mandible may be described as short, sharp, stout spines protruding from the apex of a semi-circular chitinous plate. Judging from their appearance and movements, they functioned by piercing the body wall of the host and the exuding fluids were then sucked up.

At first the segmentation of the body was very indefinite, but soon after feeding began, the segments could be differentiated. The body consisted of 12 segments. There were three pairs of small spiracles on the thorax and six pairs of larger ones on the abdomen. When fully grown and ready to spin, the average length of four larvae was 2.6 mm. and the largest diameter was 1.4 mm.

The posterior end of the abdomen, consisting of the last three segments, was extensile, tubular and highly movable. The silk was spun from the anus (Fig. 6) and the coarse pupal protection

(Fig. 7, 10), for it was scarcely a cocoon, was fashioned by this portion of the body. It could be extended to reach half way to the head. It touched the substratum, the dead host larva or itself, and exuded a drop of clear gelatinous fluid which was then drawn out into a coarse thread. This process was continued until the parasite was enveloped by this webbing within which pupation took place. It required at least two hours to accomplish this. All the movements were very slow and indefinite. The extensile portion or " tail " had two pairs of small papillae at the end surrounding the anal opening.

Beneath the transparent integument one could see masses of fat cells. The imaginal discs were likewise readily seen. There were three pairs of large ones seen in the dorso-lateral region of the thorax, and three pairs of smaller ones from the venter for the pupal legs. These discs were all flat sacks with relatively long stalks.

The larvae were gregarious and lived together (Fig. 3) until the pupal protection was spun, then they scattered somewhat, endeavoring to move around to the ventral side of the dead host to spin their flimsy cocoons. Often the cocoons were in rather definite rows on the underside of the blackened and shrivelled skin of their dead host (Fig. 10). Schwarz described similar behavior for *E. comstockii.* Practically all of the larvae reached maturity and were spinning at the same time. In several cases, the host appeared to die too soon and some of the parasite larvae died before reaching the spinning stage. In another case, a parasite larva was observed to bite and begin to feed upon its neighbor. Since there were often dead larvae in the groups, it is believed that the parasites may feed upon each other, though this is perhaps not a frequent occurrence.

The Pupa.—About a day after spinning, the parasite changed to a light brown pupa which later became almost entirely black. The pupal stage lasted four to seven days, five and six-day intervals predominating. The adults forced their way out of the cocoons, tearing the fibers or pushing them aside.

The males were somewhat smaller than the females. Their behavior as to feeding, copulation and phototropism conformed to that of other closely related forms. Adults were fed on water, sweetened water and mashed host larvae. The longest period any adults survived was a little over two weeks. While they were rather long lived, none could be kept alive for as long a period as

has been reported by other investigators. Egg-laying was not observed, but the actions of the parasites incident to it were observed. The adult parasites alighted on the thorax of the host larva and held on in spite of various movements of the host, which are sometimes almost violent, to dislodge them. The host cannot reach them in this region, so the eggs are generally deposited there. It is presumed that the female holds on until all of the eggs are deposited.

All parasitized host larvae were collected on the alfalfa plants, usually by sweeping. No parasitized larvae were taken under loose soil or trash in the fields, a common hiding place during the day for this species. The parasitized larvae refused to eat after the parasites hatched, and they always died a short time before the parasites began to spin.

Inducing parasitism with reared adults was unsuccessful in many trials on all species of larvae tried. Furthermore, they were not observed on any kind of larvae during the remainder of the season, though a constant watch was maintained for them. They could not be found at Hays, Kansas, on two collecting trips in August, though they had been plentiful there early in July. They disappeared as suddenly as they came, so there is nothing to report on their later activities, nor how they normally over-winter. It is, however, interesting to note that Vickery (1926) reared them in October, November, December, March and April. This state may, therefore, prove to be the northern limit of its range, and thus explain its rare occurrence.

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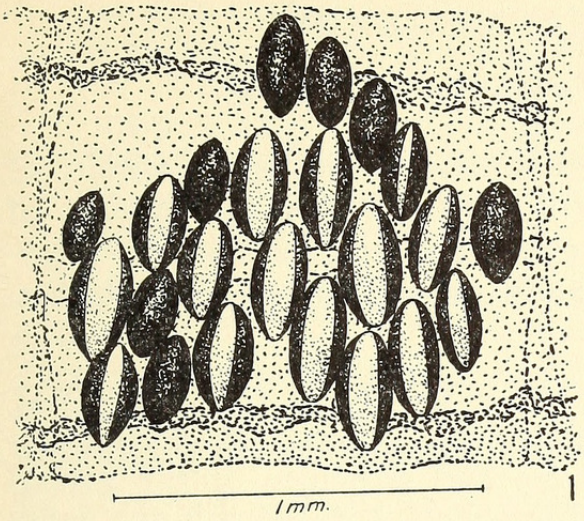
Explanation of Plate.

1. A group of eggs of *Euplectrus platyhypenae* How. glued to the dorsum of a nearly grown larva of the variegated cutworm (*Lycophotia margaritosa* Haw.) in the process of hatching.
2. Detailed drawing of an egg in process of hatching. The larva begins to feed at this stage and segmentation becomes apparent.
3. A group of half-grown parasite larvae in situ.
4. and 5. Larvae moving or shifting position. Note the exuviae beneath the larva by which it holds on to the host.
6. A grown parasite larva beginning to spin.
7. Prepupa enveloped in their flimsy cocoons.
8. Nearly grown variegated cutworm with a mass of parasites located dorsolaterally on the abdomen.
9. Same, but with a group of grown larvae in situ on thorax.
10. A dead host larva with cocoons of the parasite beneath it.

Progress of Economic Entomology in Missouri.—In Growers' Bulletin No. 34 on "Reed's Insecticides and Their Effect on Soil Insects," published by the United Sales Company of Carthage, Missouri, there appears on page 9 a testimonial signed by the assistant prosecuting attorney, the deputy recorder, a shoe merchant, two clothing merchants, two dry goods merchants, the county collector, two bank cashiers, the janitor of the courthouse, the deputy county collector, a probate judge, the deputy county clerk, an editor, the county assessor, the chief of police, the county agricultural agent, the secretary of the chamber of commerce, a real estate agent, a capitalist, two judges and two persons, presumably citizens and taxpayers.—Harry B. Weiss.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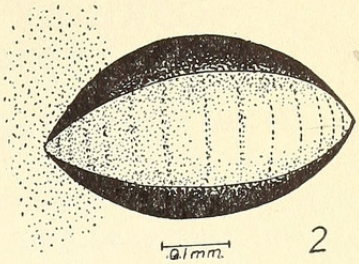
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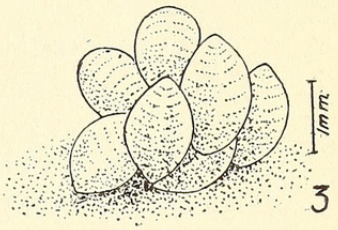
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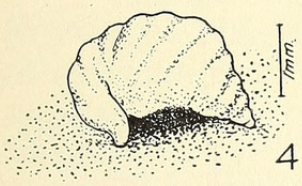
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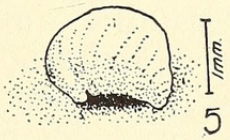
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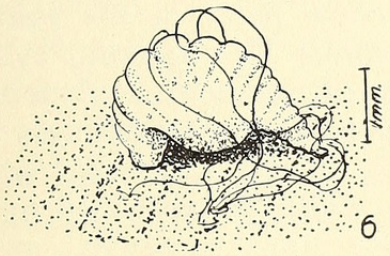
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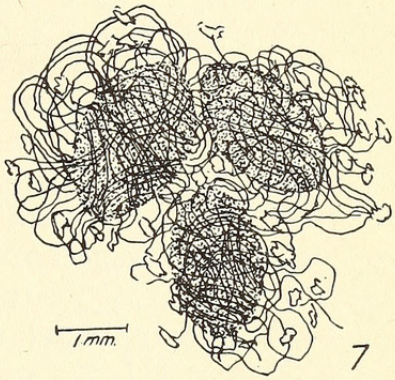
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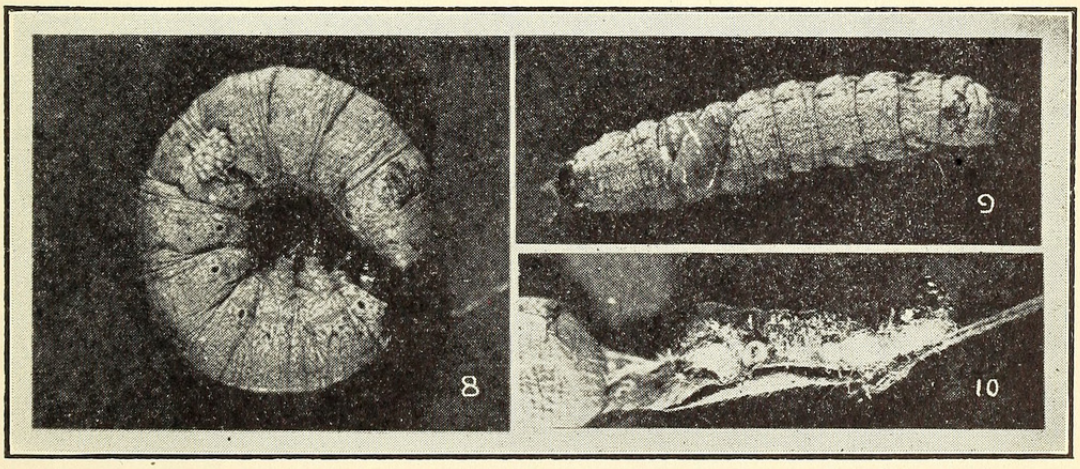
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