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OBSERVATIONS ON THE BIOLOGY OF TWO REMARKABLE CIXIID PLANT-HOPPERS (HOMOPTERA) FROM CUBA.¹

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Our knowledge of the biology of those families of Auchenorrhynchous Homoptera which reach their greatest development in the Tropics is scanty in the extreme. This is especially the case with the Cixiidae, the intermediate stages of which are passed underground. There are not half a dozen species of these small but very interesting plant-hoppers of which the life-history is known.

The two species considered here present highly remarkable features, the one, *Mnemosyne cubana*, for its association with Ponerine ants, and for peculiar features in its metamorphosis, and the other, *Bothriocera signoreti* from its fossorial habits and modified front legs in the nymph.

These notes, which are by no means complete, were made during the tenure of an Atkins Research Fellowship at the Harvard Tropical Laboratory in Cuba. They constitute the seventh paper on the Hemiptera studied at Soledad. For acknowledgments see the first of the series (*Contr. Harvard Inst. Trop. Biol. and Med. III*: pp. 63-110, 1926).

¹Studies from the Harvard Biological Laboratory and Botanic Garden in Cuba (Atkins Foundation).

Mnemosyne cubana Stal 1866.

Myers, *Harv. Biol. Lab. and Bot. Gdn. Cuba. Studies on Cuban Insects 1.*, p. 15, 1928.

I saw no specimens of this, the largest of Cuban Cixiidae, at Soledad, during February, March and most of April, but Mr. R. M. Grey took eighteen specimens (3 males and 15 females) on the 27th and 28th of April, just after my departure.

The nymphs were discovered by Dr. George Salt while we were collecting together near the Mina Carlota, in the Trinidad Mountains of Cuba, on 23rd March. He has kindly allowed me to quote his detailed notes extensively, as follows:

“A rotten tree stump about 3 feet high on the west side of a gully running south of the mine, revealed several large brown and black ants (*Odontomachus haematoda insularis pallens* Wheeler) when split open by Myers. The ants are able to inflict a most painful sting, grasping the skin with the jaws and then doubling the abdomen underneath to plunge the sting rapidly in several places within its reach.

“The ants were traced down in the trunk and below the surface of the ground, a few immature stages being found. A small colony of a tiny brown ant was found apparently entirely enclosed in the larger ant's colony and later another of these small colonies of only 2" diam., in a large chamber surrounded by galleries of the larger ant. This later colony taken.

“Two patches of white silky material were noticed among the galleries but as parts of them were composed of short radiating wheel-like threads, it was thought to be a fungus. In one, however, was found a Fulgoroid nymph which crept out of this white chamber and which I attempted to catch. It was protected by three ants, which, when the nymph was lifted, grasped it in their mandibles and were themselves carried up by it. Later others were found of various instars, from the 2nd to the 5th; many having a whorl of radiating short white silky threads attached to the tip of the abdomen.

(These "tails" were often larger than insect itself). They were always in or near the silk material first noticed. A number were found arranged in a linear series along a root of about $3/16$ " diameter; the root for a length of 4" being covered with their silk masses. The arrangement seemed to be perfect that the older nymphs were at that end of the root lower in the soil and towards the ant nest—the younger nearer to the surface of the ground and farther from the nest. Ants well in attendance and in two places of this series a large drop of clear yellowish fluid, sweet to the taste, was found. This particular root was about 3 inches below the surface of the soil running almost horizontal but a little higher towards the hill. Most of the nymphs found were thus situated, under the ground, but two chambers were found in a cavity in the rotten stump at about the surface of the ground but covered with trash of dead leaves etc., and in the dirt and debris of very rotten wood. Roots of a small vine twining around the stump passed close to the chambers.

"That the ants attended the nymphs is without doubt. Not a single nymph of about 30 was out of the company of ants, and one found under a bit of rotten log about 3' away as well as one found through on the other side of the stump had ants in attendance.

"Nymphs —— were active when disturbed and could jump quite well."

In the same nest was a tiny but advanced nymph of another species of Cixiid (?) with no signs of a flocculent tail-appendage.

The next day another nest of the same ant species was found *under* a log in the same general locality. We exposed a gallery along a root $1/4$ - $1/2$ inch thick and exuding a milky juice when cut. In this gallery were numerous nymphs of *Mnemosyne* and several more of the much smaller Cixiid (?). When the ants were disturbed by the digging they became very much entangled in the flocculent material secreted by the plant-hopper nymphs. In the same gallery

were also a wood-louse, a cockroach and specimens of the curious scale-insect, *Mixorthezia* sp.¹

This is one of the few known cases of Ponerines attending Homoptera.

A number of the *Mnemosyne* nymphs were preserved in alcohol for description later, while live ones were provided with decayed wood, rootlets and nest-material, but no ants; and an attempt was made to rear them. This was successful only with some of the older nymphs; but the exigencies of travelling made the test an unfair one. From these nymphs the first adult—a female—emerged on the 14th April. A second female appeared on the 18th and a third in the early morning of the 19th. The only male came out on the 20th. One female survived in captivity until the 25th and was then preserved for the journey north.

Professor S. C. Bruner, since my return to England, sent me nymphs of apparently the same species, attended by the same ant, at the roots of sugar-cane,—a very different habitat from that in which we found them.

Description of the nymphs:

Neither the eggs nor the younger nymphs were found, nor could adults be induced to lay in captivity.

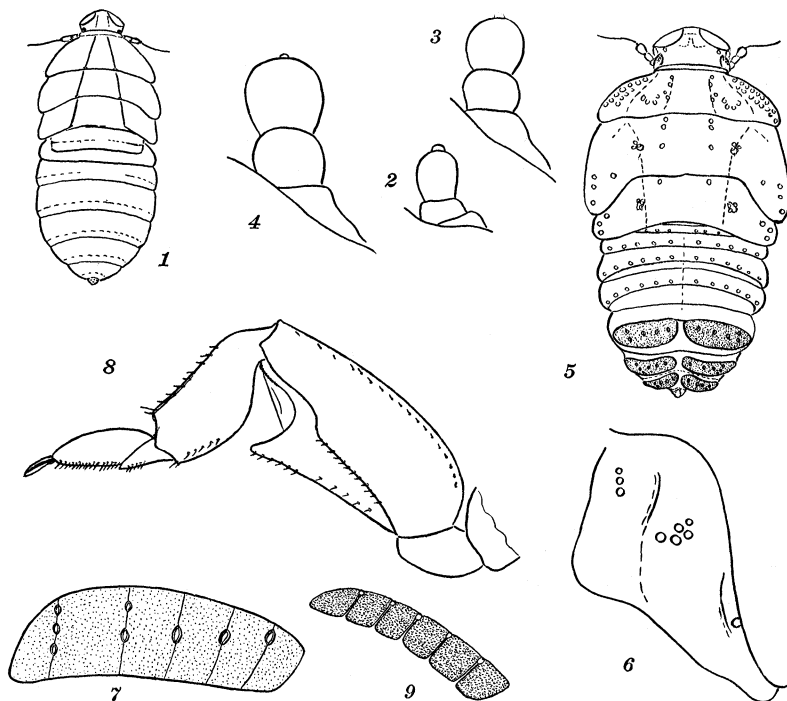
In the preserved material on which the descriptions are based, it was found that in the same instar, some had longer abdomens than others, apparently according to the time since they had moulted. The total lengths given below have been measured all on specimens with long abdomens,—thus near the end of stadium concerned.

Antepenultimate nymph: (Figure 1, outline only).

Length, 4.3 mm. Colour white, the more strongly “chitinised” dorsal sclerites of thorax and of abdomen faintly

¹This Coccid was taken in or near the nests of the following three other species of ants (kindly determined by Dr. Wheeler), *Brachymyrmex heeri obscurior* Forel, *Euponera (Trachymesopus) stigma* F. and *Camponotus santosi* Forel; and in that of Termite, *Anoplotermes* sp. (kindly determined by Dr. T. E. Snyder).

No ants were seen attending these Coccids nor was there any indication that the association was anything but accidental.



1. *Mnemosyne cubana*. Antepenultimate nymph.
2. *Mnemosyne* antenna of antepenultimate nymph.
3. *Mnemosyne* antenna penultimate nymph.
4. *Mnemosyne* antenna last nymph.
5. *Mnemosyne* penultimate instar nymph.
6. *Mnemosyne* right hind-wing pad of last instar nymph.
7. *Mnemosyne* first left wax-plate of last instar nymph.
8. *Bothriocera signoreti*, last instar nymph, outer view of first left leg.
9. *Bothriocera signoreti* first left wax-plate.

yellowish. Eye-spots pink. Several large sensoria on head, thoracic nota and the 1st-6th abdominal tergites. A pair of large dorsal wax-plates on segments VI-VIII inclusive (strictly, on the intersegmental membranes). First wax-plate with three pores, in a row parallel to the long axis of the plate. Second and third plates also with 3 pores. Antennae shown in Figure 2.

Penultimate instar: (Figure 5, antennae, fig. 3.)

Length, 6.4 mm. (measurement of a long-abdomen form, but the figure represents an individual with short abdomen), white, the head and the other more strongly "chitinised" dorsal sclerites of thorax and abdomen yellowish. Sensoria more numerous and grouped as in the figure. On the wax-plates, extra pores have appeared as follows:—on first plate, 2 pores in a line parallel to long axis of body, and lateral to the original three; on the second, 3 such pores; and on the third, again two. Eyes larger and red.

Last instar: (Figures 4, 6 and 7.)

Length, 10.0 mm., colour as before, but the chitinised pieces a brighter brownish yellow. Large circular sensoria arranged as follows: 2 roughly parallel longitudinal rows on each side of disc of front, 2 or 3 on each side of disc of vertex, about 12 on expanded lateral border of pronotum, and 2 groups and a solitary one on each side of its disc; several scattered over tegminal pad, and a close row on its lateral margin; 2 groups and a solitary one on each side of disc of mesonotum; several on wing-pad (fig. 6), and two groups and a solitary one on disc of metanotum (each side); a single transverse row along every abdominal tergite at least up to and including V; a close row of minute ones, 6 or 7, in a yellowish "chitinised" lateral sclerite (pleural?) at the lateral border of each of the three wax-plates. Posterior edge of metathoracic pleuron edged strongly with dark red. First wax-plate (fig. 7) with 3 single pores, in a transverse row followed by two longitudinal rows, the first with 2 and the second with 3 pores, making 8 altogether; second and third wax-plates like the first. The number of pores varies somewhat, however, even on the

two sides of the same insect. The pores are connected, in a fore and aft direction, with their fellows before and behind or with the posterior and anterior edge of the plate. These lines, which are apparently fine grooves, are smooth and shining, as also are the pores themselves; but the wax-plate surface is dull dead white, due to a minute hexagonal sculpturing like that of many insect choria.

Towards the end of an instar the abdomen lengthens greatly (fig. 1.) At other times the abdomen is shortened and turned slightly upward, so that the three pairs of wax-plates occupy by far the greater part of the dorsal aspect of the abdomen, the tergites of segments I-V being squeezed considerably.

Curiously enough, while the penultimate instar hind wing-pad (fig. 5) has 3 large circular sensoria near its apex, the last instar has only one, which just misses being covered by the growing tegminal pad. The other two, which would be covered and thus presumably unable to function, have become obsolete.

***Bothriocera signoreti* Stal, 1864.**

Myers: *loc. cit.* p. 15.

The striking, dark brown-marked adults of this species, with a curiously squarely-expanded head were swept during March, when the dry season was at its height from vegetation of various types, but nearly always in close proximity to water. Thus it occurred on flowering heads of papyrus in the Botanical Garden, on *Commelina nudiflora*, on two species of ferns growing in moist but not shaded situations, almost plentifully on pure stands of *Polygonum acre* along a nearly dry ditch and finally from a tangle of bushes, trees and lianes in a creek-bed.

The tegmina, in life, are held perfectly flat, like those of certain small moths, which these hoppers resemble also in general appearance.

Two adults were taken under stones in a nearly dry creek-bed of a patch of rocky forest near the laboratory. Here also the nymphs described below lived in a truly remarkable association. Under the same stones occurred large

cockroaches, land-crabs¹ (*Epilobocera armata* Smith), crayfish,¹ (*Cambarus cubensis consobrinus* Sauss.), Phrynids, numbers of tiny frogs (*Sminthillus limbatus* Cope) and an occasional blind snake (*Typhlops lumbricalis* (L.))

Advanced nymphs only were found during March. These were in crevices under the stones, or in depressions in the soil itself. Across these cavities stretched various rootlets, on some of which were colonies of a queer yellowish aphid, with a white abdominal fringe (kindly determined by Dr. P. W. Mason as *Prociphilus* sp.) Under adjacent stones were other aphides (*Ceratoglyphina* sp., Mason) attended by ants which I failed to catch, but there were no signs of ants near the *Bothriocera* nymphs. *Cyphomyrmex rimosus minutus* Mayr (kindly determined by Dr. Wheeler) were cultivating fungus on caterpillar faeces, in their nest under another neighbouring stone.

Usually two or three or even five of the nymphs occurred together, covered entirely by fine white flocculent material. Often they occupied a narrow crevice lined throughout with this waxy fluff. An adult was sometimes found (14th March) waiting beside its cast nymphal cuticle, in a kind of transparent cell of the same material.

Last instar nymph: (Figures 8, 9).

Length (long-abdomen stage) 4.5mm.

Dorsal surface dark unicolorous brown, with a median paler dorsal stripe, under-surface paler.

“Frons” swollen, smooth, passing without distinction in one round curve into the crown, but separated from the swollen clypeus by a sinuate groove. An irregular double row of small sensoria on extreme edge of “frons”. None on clypeus. Rostrum just passing base of hind coxae. Crown with an irregular triple row of lateral sensoria, the inner two series large and circular; a single row of small ones continued nearly all round posterior margin. First and second segments of antennae short and very stout, the second greatly swollen. Eyes small, sunken between antenna and edge of crown.

¹Kindly determined by Dr. T. Barbour.

Pronotum with small, roughly circular sensoria as follows:—a double row (4-4) on disc, bordering median pale stripe, a single row on outer side of fore-border, continued as a triple row along lateral border; a sinuate group of six near posterior lateral border. Some of the larger sensoria have each a very tiny one contiguous.

Mesonotum with one sensorium anteriorly, on each side of median line, a diagonal row of five, graduated in size, outside this, and a number of scattered groups on the tegmen-pad.

Metanotum with one sensorium anteriorly on each side of median line, a diagonal row of three outside this; and one sensorium on the hind-wing pad just before it is covered by tegmen-pad. (There are none on the hind-wing pad below the tegmen.)

Abdomen in the specimens described long and distended preparatory to ecdysis, but normally with part of IV and all of VII and VIII segments partially retraced and turned more or less upwards as in *Mnemosyne*. IIIrd tergite with one sensorium on each side of disc; IV with a row along posterior margin, except medially, becoming double laterally; V is similarly supplied, but the posterior edge of VI has none, save at the extreme lateral margin where there is a small group of 4, close together. The VIth tergite is rather shorter and is followed by the first wax-plate, as in *Mnemosyne* the second and third following the still shorter tergites, VII and VIII respectively. VII and VIII bear only two or three sensoria, just beneath the extreme lateral margin (i. e. occupying a ventral position.)

Wax-plates of first pair with 5 pores, all situated along anterior border and connected with posterior border by grooves, wider proportionately than in *Mnemosyne* and dividing each wax-plate into 6 divisions (see fig. 9), roughly rectangular except the outermost, which is approximately triangular. Second and third pairs of wax-plates similar, though restricted in size by the decreasing width of their respective segments.

First pair of legs markedly fossorial (fig. 8), with quite a strong resemblance to those of a cicada nymph, especially in the swollen femur.

The only comparable structure in the Fulgoroidea is that of the first pair of legs in the North Australian Cixiid, *Cajeta singularis* Stal, of which only the adult is known. I have examined this insect (a male specimen) in the British Museum, and to me the legs in question do not look at all fossorial, but rather raptorial! The femur is swollen, with two minutely-toothed ridges beneath, between which the tibia would seem to fit. Observations on the habits of this very rare plant-hopper would be of extreme interest.