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VOL. XLVII MARCH, 1940 No. 1

OBSERVATIONS IN CUBA ON INSECT MIMICRY AND WARNING COLORATION.

By C. T. Parsons

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The following cage experiments on mimicry and warning coloration were conducted at the instance of an article by P. J. Darlington, Jr.[1] This paper is intended to supplement rather than to repeat Dr. Darlington's extensive remarks on the environment in which the mimicry occurs. These few observations, incidental to other work, are fragmentary. Yet opportunity to gather such information is so rare that the following notes are thought worthy of record.

The writer is greatly indebted to Dr. Thomas Barbour who made possible the stay in Cuba under a Harvard Fellowship of the Atkins Institution at Soledad, near Cienfuegos. Professor C. T. Brues very kindly took charge of the special photography involved. Also to Dr. Darlington and Doris H. Blake for advice and assistance in identifying the insects the writer is under obligation.

Dr. Darlington described an example of mimicry, occurring at Soledad, in which a lizard, *Anolis sagrei* (D. & B.) is the chief predator. In his experiments Darlington observed that the *Anòlis* refused beetles of several different families. Apparently these were mimics of two very similar species of inedible Lycid beetles, *Thonalmus suavis* (J.—D.) and *T. aulicus* (J.—D.).

An examination of the plate of photographs should elucidate the descriptions that follow.

[1] P. J. Darlington, Jr., 1938, Experiments on mimicry in Cuba with suggestions for future study. Trans. R. ent. Soc. London, 87: 681-695.

Examples of Mimicry: Thonalmus-like Beetles

Callopisma adjuncta E. Oliv. (Lampyridæ): Darlington states that it is a forest dweller, but one specimen was found in open country on the same tree with *Thonalmus.* Since no more were seen, it was not used experimentally. This *Callopisma* is about the same size as a small *Thonalmus;* the pronotum and anterior fifth of elytra are orange and the rest of the elytra are black. Two specimens of a yellow and black Lampyrid (*Photinus nefarius* E. Oliv.), of similar size, were readily eaten by an *Anolis sagrei.*

Drapetes bicolor Cast. (Throscidæ): This beetle was not mentioned by Darlington. It was found in company with *Thonalmus* but is only 4.2 mm. long, whereas the length of the smallest *Thonalmus* is 6 mm. The head and pronotum are reddish orange and the elytra are metallic blue-green. Unfortunately *Drapetes* quickly died in captivity. Of six examples placed with three separate *Anolis sagrei,* all died within 24 hours, but only one of them was eaten.

Chalepus sanguinicollis Linn. (Hispidæ): Although not mentioned by Darlington, *sanguinicollis* occurred in company with *Thonalmus.* It is larger than the smallest *Thonalmus* and with orange or red on the pronotum and anterior third of elytra, extending posteriorly along the lateral margins. The head and remainder of the elytra are black. One specimen, placed with *Anolis sagrei,* was eaten by the following day.

Trichrous pilipennis Chev. (Cerambycidæ): In Darlington's cage experiments an example of this species survived five days, at which time his experiment was closed. During the writer's experiments, in the course of a week, six *Trichrous* were placed with an *Anolis sagrei,* two of which were eaten the first day, another two days later; two died after being in the cage two days; and one was alive after three days in the cage. Of three *Trichrous* placed with another *sagrei,* one was eaten and one died on the second day, and the remaining example died four days later. Still another *Anolis sagrei* failed to eat a *Trichrous* during five days, when the experiment was closed. During these experiments a variety of other insects were eaten. In order to test the edibility of *Trichrous,* a *Thonalmus,* placed in the mouth of a *sagrei,* was rejected; then a *Trichrous* was swallowed at once. The observations indicate that although the *Trichrous* is edible, the *Anolis* has a strong tendency to avoid this Cerambycid.

A single specimen each of *Anoplischius venustus* (J.—D.) (Elateridæ) and *Calocosmus venustus* Chev. (Cerambycidæ) were taken at Soledad in June, but no more were found. Darlington collected both these species in May and illustrated them in his paper.

Examples of Possible Warning Coloration

In company with *Thonalmus* and therefore in the same environment as *Anolis sagrei* occurred several brightly colored inedible insects. The cage experiments strongly suggest that these insects are examples of warning coloration.

Hemiptera Refused

The following Hemiptera were not eaten, although *Anolis* readily ate plain-colored Hemiptera. Both the *Dysdercus* and the *Oncopeltis* exude a pink body fluid when handled; also *Dysdercus* has a characteristic odor.

Euryopthalmus sellatus (Guér.) (Pyrrhocoridæ): This species is 9-12 mm. in length. On the upper side the pale markings are cream colored, with a narrow orange margin. The anterior, middle, and base of posterior femora are orange. The rest of the upper surface is black. Of two pairs placed with two separate *Anolis sagrei,* two died the following day and two were alive five days later.

Dysdercus andreæ (Linn.) (Pyrrhocoridæ): The length of this species is 8-10 mm. The pale markings, as indicated in the photograph, are red and the rest of the upper surface black. Of two pairs placed with two separate *Anolis sagrei,* both were dead the next day. Darlington also found that this and the preceding species were not eaten.

Oncopeltis fasciatus (Dall.) (Lygæidæ): This species is 12 mm. long with pale markings orange and the rest black. One example was alive after four days with an *Anolis sagrei.*

It seems pertinent here to quote a passage from Usinger (Univ. Calif. Publ. Ent., 7: 38, 1939). "It is interesting that several predaceous Hemiptera from Cuba are strikingly marked with the same brilliant red and sharply contrasting black colors as are seen in *Callotriatoma*. Thus *Apiomerus burmeisterii* Guerin and *Enicocephalus cubanus* Bruner are the only representatives of their respective genera (excepting other closely allied Antillean species) with such coloration. Too much of the literature on mimicry and warning coloration is made up of idle speculation based upon museum specimens, but suggestions from this source may be of value if they point out where field work may best be concentrated. If the species just named occur in the same area, it would appear that they would be mutually benefited by combining their efforts along a single line of sematic coloration."

Edible Hemiptera

In company with the inedible Hemiptera were placed several plain-colored species that were taken readily by *Anolis*. In addition to the following, two other unidentified bugs were quickly eaten.

Mormidea pictiventris Stal (Pentatomidæ): The length is 8 mm., with cream colored marks on a brownish grey upper surface. Of five specimens fed to three separate *Anolis sagrei*, all were eaten within twenty-four hours.

Oedancala cubana Stal (Lygæidæ): The length of *cubana* is 8 mm. and the upper surface is yellow brown. One example was eaten at once.

Coleoptera Refused

Pachnæus azurescens Sch. (Curculionidæ): This 10 mm. bluish cream weevil was not eaten after six days with an *Anolis sagrei*, whereas several greyish black weevils (*Lachnopus* near *hispidus* Boh.) of the same size were taken readily.

Oedionychis fasciata Fabr. (Chrysomelidæ): According to Mrs. Blake the specimen used is actually a new species heretofore confused with *fasciata*. The pronotum and transverse elytral band are orange, and the rest of the elytra are bluish-purple. This 5 mm. beetle was not eaten after two days with an *Anolis sagrei*.

A striking example of what is apparently warning coloration is shown in the case of the Chrysomelid *Cryptocephalus viridipennis* Suffr., a shining metallic blue-green beetle with dark reddish brown pronotum and transverse band on elytra. Of three specimens placed with three separate *Anolis sagrei,* one was not eaten after six days, another after five days, but one was taken after four days. Whereas *Anolis* ate more or less quickly three closely related species: *Cryptocephalus 5-punctatus* Suffr. yellow with black spots, *C. commutatus* Suffr. reddish brown to metallic blue with yellow marks, and *Pachybrachys parallelopedus* Suffr. with brown and yellow markings.

Three species of brightly colored Coccinellidæ, *Chilocorus cacti* (L.) *Cycloneda sanguinea* (L.) and a third unnamed, were refused by *Anolis sagrei.*

Edible Coleoptera

With the bright colored inedible beetles were put sombre beetles that *Anolis* usually ate without hesitation. Two such beetles were the Elaterids *Conoderus bifoveatus* (Beauv.) and *Aeolus* sp. Darlington mentions others that he used. Also an occasional house fly and a cockroach nymph was greedily snapped up by the lizards.

Discussion

Darlington found, in his feeding experiments with *Thonalmus,* that his results were absolute and surmised that they might prove to be statistical instead. That they may be statistical is shown by the present writer, especially in the case of *Trichrous.*

Another implication brought out by the experiments is that the feeding habits vary with the individual, probably as a result of the experience of each lizard.

An interesting aspect of the experiments is the variation in the markings of insects which are refused for no apparent reason other than mimicry or warning coloration. In some cases, as *Chalepus* and *Drapetes,* the mimicry is not close. Or a beetle, such as *Oedionychis,* may have the models' colors in a very different pattern. One beetle, *Cryptocephalus viridipennis,* has only one of the models' colors. Also the colors of *Thonalmus* and the inedible Hemiptera are similar. So

Anolis seems to refuse all bright red and blue and red and black insects. If this should turn out to be true, then there would be a mutual Müllerian reinforcement of mimicry by warning coloration.

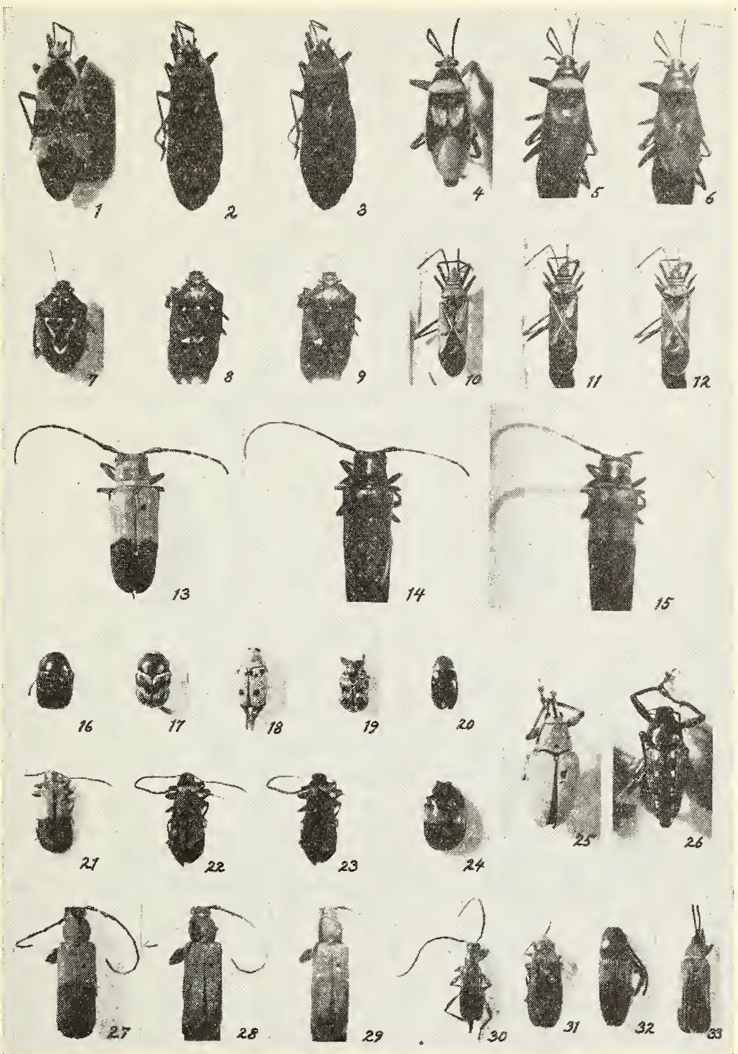
Professor Brues' photographs show that the pattern appears in ultra violet light in only one instance but is more or less present in the longer wave-lengths emitted by fluorescense.[2] Apparently the visible spectrum must be approximately the same for *Anolis* and man. Certainly, the testing of the visible spectrum of *Anolis* would be a pertinent study.

EXPLANATION OF PLATE I.

Figs. 1-33. Insects used in mimicry and warning coloration experiments. Unless stated otherwise, the photographs were taken by white light. 1, *Oncopeltis fasciatus;* 2, by fluorescent lights; 3, by ultra violet. 4, *Euryophthalmus sellatus;* 5, by fluorescent light; 6, by ultra violet. 7, *Mormidea pictiventris;* 8, by fluorescent light; 9, by ultra violet. 10, *Dysdercus andreae;* 11, by fluorescent light; 12, by ultra violet. 13, *Calocosmus venustus;* 14, by fluorescent light; 15, by ultra violet. 16, *Cryptocephalus viridipennis.* 17, *Cryptocephalus commutatus.* 18, *Cryptocephalus 5-punctatus.* 19, *Pachybrachys parallelopedus.* 20, *Drapetes bicolor.* 21, *Thonalmus aulicus* (small specimen); 22, by fluorescent light; 23, by ultra violet. 24, *Oedionychis* n.sp. (near *fasciata*). 25, *Pachnaeus azurescens.* 26, *Lachnopus* near *hispidus.* 27, *Trichrous divisus* Chev.; 28, by fluorescent light; 29, by ultra violet. 30, *Trichrous pilipennis.* 31, *Callopisma adjuncta.* 32, *Anoplischius venustus.* 33, *Chalepus sanguinicollis.*

[2] The photographs were made with a mercury vapor source with quartz condensing lens. To register reflected ultra-violet light a dark purple filter excluding wave lengths longer than 4000 angs. was interposed between the source of light and object. To register fluorescence, an additional filter excluding lengths below 4000 angs. was added, between the object and the camera lens. Photographing by white light was done with tungsten filament flood-lights, without filter, on a panchromatic emulsion.

Psyche, 1940 Vol. 47, Plate I.



Parsons — Insect Mimicry

A NOTE ON THE EARLY STAGES OF *LEPISELAGA CRASSIPES* FAB. (DIPT., TABANIDÆ)

By G. B. Fairchild,

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Information about the early stages of Neotropical Tabanidæ may almost be said to be non-existent. Bodkin and Cleare (1916) have given a brief description of the larvæ and a figure of the pupal aster of *Tabanus desertus* Wlk. Ad. Lutz (1920, 1922 and 1928) has mentioned raising a few species from larvæ, and has described a method of rearing using agar as a medium (1920), but so far as I am aware these are the only descriptions or figures of larvæ or pupæ of any of the many Neotropical forms that have ever been published.

Inasmuch as the classification of the Tabanidæ, so far based entirely on adult characters, is in a very unsatisfactory condition, I feel that any information about the structure and habits of the early stages is very important, and may throw some much needed light on the relationships of the many forms.

The present species has apparently been reared more often than any other, and has been mentioned several times in the literature. Ad. Lutz (1928) raised a single adult from a larva collected in plants of *Pistia stratiotes,* the water lettuce, in Venezuela, and gives an unrecognizable figure of the pupal shell. Dunn (1934) also raised the adults from larvæ taken in the same habitat in Panama, but says nothing about the appearance of either larva or pupa.

During the early months of 1929, while searching for mosquito larvæ in the floating vegetation along the Chagres

River between Gamboa and Madden Dam in the Panama Canal Zone, I occasionally dipped up small pupal shells of what I suspected might be *Lepiselaga*. Comparison of these with a specimen in our collection from which Dunn had bred *Lepiselaga* confirmed my suspicion.

Although, for reasons which are not known, *Pistia* has become very scarce throughout the Canal Zone this year, I have taken the adult *Lepiselaga* in fair numbers throughout the year. I suspect, therefore, that it is not entirely dependent on this plant, but may be associated with other types of aquatic vegetation as well. In April 1939, while collecting in a small slough near the laboratory's station at Juan Mina on the Chagres River, I secured two small greenish larvæ from the matted floating vegetation near the shore line. This vegetation consisted of floating debris, mats of filamentous algæ, the water-fern *Salvinia*, and a few small plants of *Pistia* not over 1.5 inches in diameter. The larvæ were associated with a rather rich fauna of aquatic insects, including larvæ of *Odonata*, *Ephemerida* and *Stratiomyiidæ*, and numerous species of aquatic *Coleoptera* and *Hemiptera*. At the same time I also took two pupal shells. Later, in mid-May of the same year, I collected two more larvæ of *Lepiselaga* in a grassy swamp near Gamboa. They were in the floating scum on the water, and no *Pistia* was present in the swamp.

The first two larvæ were kept in the laboratory in shell vials measuring 3 x 1 inches, into which about 1 inch of 2% agar had been poured. This medium remains more or less transparent for one or two weeks, when the larvæ may be removed to a new tube if it is desired to keep them under close observation. Inoculation of the medium with some unicellular green alga seems to keep the medium from becoming putrid for a longer time, but the dark green color interferes with observation. To provide a suitable place for pupation, paper towelling is cut into strips 1.5 inches wide and 3 or 4 inches long, rolled into a cylinder the size of a lead pencil, moistened and inserted upright into the agar. The tubes are stoppered tightly with cotton, which must not touch the roll of paper, or it will suck all excess moisture from the paper and agar. The larvæ may be fed upon aquatic earthworms, *Chironomid* larvæ or other small softbodied forms, but I have found the most satisfactory food to be ordinary earthworms. A culture of these may be kept in the laboratory for long periods, and one fair-sized worm cut in pieces will feed ten or a dozen larvæ.

After about 3 weeks in the laboratory, during which they both fed several times, one of these larvæ pupated, yielding a pupa which resembled the empty pupal shells I had previously found. The other was hastily preserved for study. I was obliged to leave the laboratory for five days after this, and when I returned, found that a male *Lepiselaga* had emerged in my absence, so that the pupal period is not more than a week and probably 4 or 5 days.

The full-grown larva is about 15 mm. long by 3-3.5 mm. wide at the widest part in the region of the 5th or 6th segment, circular in cross-section, or sometimes slightly flattened ventrally. In color it is a light yellowish green with a complicated dorsal pattern of dark grey spots and blotches on the second to tenth segments. Laterally there are two short parallel longitudinal dark lines of spots; below there is a dark spot on each of the second to 10th segments. The ventral surface is unmarked, as are the first and last segments. Both the head and siphon are unusually slender, and the anterior part of the body has great powers of extension, so that when extended in crawling the head and first two segments may make up ¾ of the total length. The locomotory protuberances include a narrow transverse dorsal pair, a rounded lateral protuberance on each side, and an oval ventral pair. Thus each segment from the 6th to the 10th inclusive bears 6 protuberances. The 5th segment lacks the ventral pair, and the dorsal pair are narrowed. These protuberances are extensile to some extent and bear dense short hairs. There are also a few long hairs in the head and anal regions, and at least a lateral pair on each segment, which are difficult to see. The anal region is less swollen than in other Tabanid larvæ I have seen, and does not appear to be used so much in locomotion. The apical part of the siphon is rather heavily chitinized and longitudinally striated, and bears near its apex four groups of three hairs each. The opening at the apex is a vertical slit fringed with minute hairs. In this slit, and lying between the ends of the two big tracheal trunks, is a heavily chitinized spear-like structure which seems to be capable of considerable extrusion and retraction. Hart (1895) mentions this structure as being present in all the Tabanid larvæ he examined, but noted that it was retractile, so that in many specimens it was not visible. He gives a figure of it in lateral view for *Tabanus nigrescers.* Stone (1930) also mentions this structure and uses it in his key, it being found in some species of *Chrysops* and *Tabanus* but not in others. Such a structure would seem quite well adapted to piercing the air spaces in the roots and leaves of such aquatic plants as *Pistia* and *Piaropus,* while allowing the larva to secure air from the water surface when such plants are not available. In any case, the larvæ live quite well under artificial conditions, apparently not needing aquatic vegetation from which to secure air.

The pupa is 10-14 mm. long, the abdomen relatively short, for the head and thoracic region are only slightly less than half the total length of the pupa. The head-capsule is smooth and rounded, lacking the bosses and rugosities often found in other species of the family. The thoracic spiracles are produced into relatively long conical trumpets, which are directed sidewise with their openings on the ventral side of the apex. These elongated thoracic trumpets have been found in only one other Tabanid, so far as I am aware. King (1926) records similar structures for *Tabanus fasciatus niloticus* Aust., a species which he found breeding in *Pistia* on the Nile. The 1st. to 4th. free abdominal segments bear long spines where the spiracles should occur. These at first sight appear to be breathing-tubes, but I cannot find that they are open at the apex. Each abdominal segment in addition bears a row of fine spines of variable length near its posterior margin, which are longer on the dorsal side. The female aster is shown in Fig. 5. The male aster is narrower, the lateral spines are relatively longer, and the ventral region of the last segment is considerably inflated. In color the pupa is light leaf green, becoming nearly black before emergence, when the colors of the adult can be clearly seen through the integument.

EXPLANATION OF PLATE II.

Fig. 1. Dorsal view of full grown larva of *Lepiselaga crassipes*, showing distribution of locomotory protuberances. Color markings omitted.

Fig. 2. Dorsal view of 7th segment, showing color pattern.

Fig. 3. Dorsal view of Siphon. a. tracheal trunks. b. apical slit. c. siphonal spear.

Fig. 4. Lateral view of ♂ pupa.

Fig. 5. Terminal view of last segment and aster of ♀ pupa.

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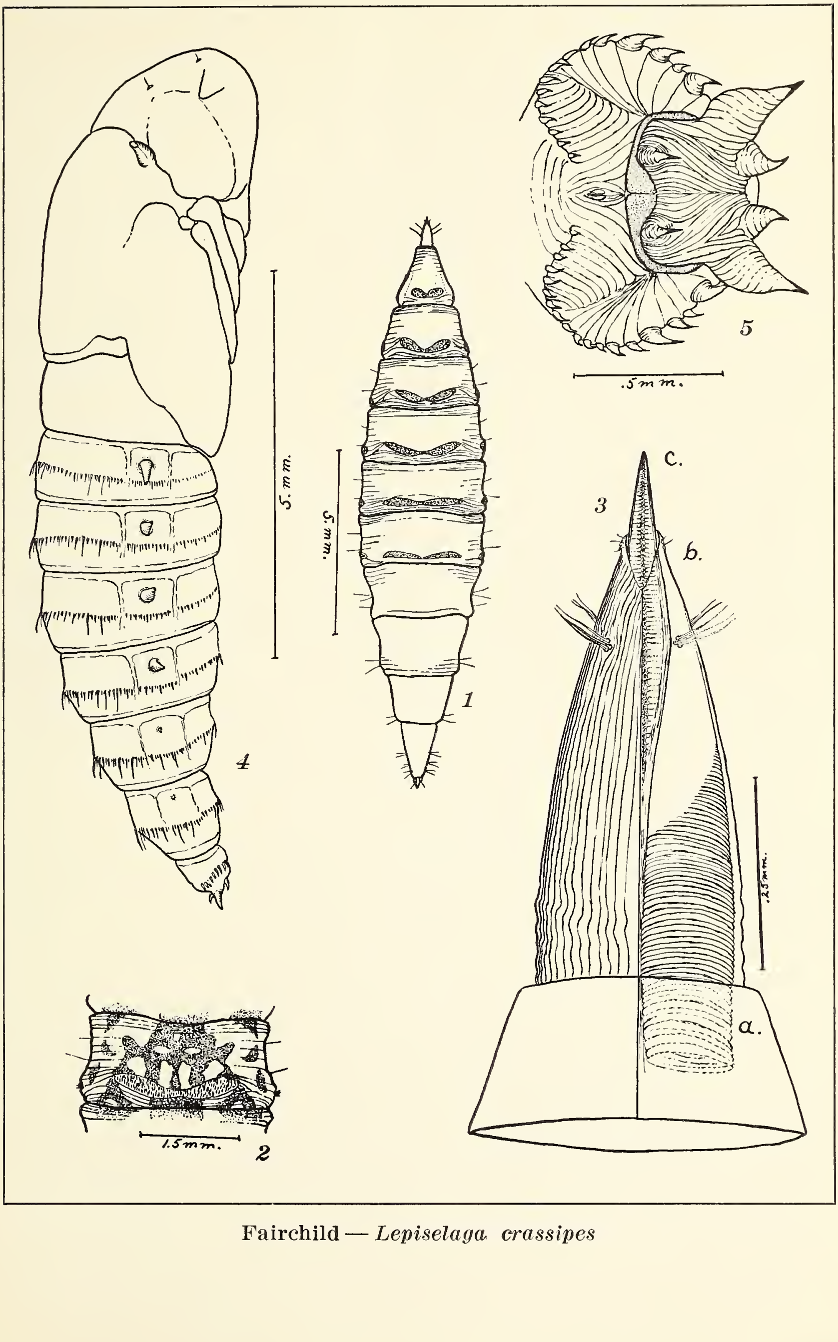

Fairchild — *Lepiselaga crassipes*

LIFE HISTORIES OF CUBAN LEPIDOPTERA

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Introduction

The life histories described in this paper are, for the most part, those of insects whose immature stages have hitherto been unknown. Also included are accounts which supplement the descriptions of species treated by earlier authors. Even the most meager notes are included here because it is felt that every fact however brief aids in the further study of a life history. For a list of previous studies of some of these species the reader is referred to Davenport and Dethier (1937). Color descriptions are based upon a comparison with Ridgway's (1920) color charts.

This work was made possible by a Harvard University Fellowship which enabled the author to pursue research at the Atkins Institution of the Arnold Arboretum in Soledad, Cuba.

Calisto herophile Hbn.

Egg

Ivory yellow to white when laid. Nearly spherical. Covered with a fine raised reticulation forming minute polygonal areas. A day or more after being laid the egg develops tawny-olive markings (Figs. 5, 6, and 8).

First Instar

Head height .6 mm.; head width .7 mm. General color of head bronze. Entire surface covered with a fine irregular dark brown raised reticulation. The background of the frontal areas is lighter than the rest of the head. Ocelli white. Edge of clypeus and mandibles dark brown. There are a few colorless tapering hairs and characteristic protuberances (Fig. 3). Body length 2 to 4 mm. Newly hatched larva ivory yellow striped with ochraceous-buff (Fig. 11). Anterior portion of body light ochraceous-salmon. After eating the anterior portion of the body becomes greenish. The mid-dorsal, para-dorsal, and suprastigmatal lines become brownish. The stigmatal and infrastigmatal lines become dark greenish. The background of the body is now whitish green. On segments one and two at the para-dorsal line there is a black splotch slightly more anterior in position than the dark brown spiracle. A few long colorless hairs with bulbous tips are scattered over the body. Those on the posterior segments are the longest. Those on the prothorax are longer than the ones on the remaining thoracic segments.

Second Instar

Head height .6 mm.; head width .7 mm. General color very light brown to gray. Surface granular. Three rather indistinct streaks composed of rather minute gray to fuscous dots extend over the head. They merge to a varying degree (Fig. 1). On the posterior part of the head in particular these three streaks are more or less continuations of the dorsal longitudinal lines of the body. The background is the color of parchment. There are numerous short colorless hairs arising from conspicuous black tubercles. Prominent on the sides of the head are two irregular black protuberances. Body length 4 to 5.5 mm. The wide dorsal, the thin paradorsal, and the wide suprastigmatal lines are sayal brown. On either side of the para-dorsals are irregularly marked light brown bands. The black splotch in the para-dorsal is largest on segment three. Between the suprastigmatal and stigmatal lines is a thin band of plumbago blue. The stigmatal line is outlined with darker brown and the infrastigmatal line is plumbago blue. Spiracles dark brown. Ventum dead grass yellow. Many short colorless tapering hairs cover the body.

Third Instar

Head height .9 mm.; head width 1.0 mm. Head differs but little from previous instar. It is lighter due to the smaller extent of dark streaks. Body 6 to 8.5 mm. long. Bands on body more distinct. On each segment in addition to the para-dorsal and suprastigmatal black splotches there is now a black spot on the border of the mid-dorsal line. Further changes in the body markings are shown in Fig. 9. The substigmatal line is white and very broad.

Fourth Instar

Head height 1.25 mm.; head width 1.25 mm. The only black now remaining on the head is an indistinct transverse band between the two prominent knobs, a short band extending posteriorly from each knob to the foramen magnum, and a slight black area near the ocelli. Body length 9 mm. Not much change. Markings intensified.

Eggs were laid May 6 and 7 and hatched May 13 and 17 six to eleven days having elapsed. The first instar required seven days all moults having been completed by May 24. The second instar occupied from twelve to fourteen days with moults on May 29 and June 2. The third instar was completed in eight days and the fourth in ten. Many different species of grass served as food plants, but lawn grass was preferred.

Metamorpha stelenes insularis (Holland)

Egg

Dark pea green. Height 1.2 mm. Greatest diameter .9 mm. There are fourteen raised white longitudinal ribs. At the apex of the egg the ribs present a few serrations when viewed in profile. Here also they join to form a stem-like projection on the summit of which is located the micropyle. The base of the egg, the surface applied to the food plant, is perfectly flat. It is divided into faint minute polygonal areas.

First Instar

Head height .5 mm.; head width .75 mm. Smooth shiny black with a few long black hairs. These are in part microscopically serrate. Body 3 mm. long. Clear transparent burnt yellow. Green from gut shows through. Few long black serrate hairs arising from very large tubercles. Spiracles brown.

Second Instar

Head height .9 mm.; head width 1.0 mm. Shiny black.

Bears two prominent dorsal spines. Each spine 1.4 mm. long. Club-shaped and bears long and short black hairs (Fig. 10). The long hairs are serrate. Body 6 mm. long. Shiny transparent, diamine brown. Anal segment frequently yellowish. Body later becomes dark shiny Danube green except for the last two segments. There are no conspicuous spines on segment one. Segments two and three have but one spine in the pleural region in addition to paradorsal spines. The mid-dorsal spines are lacking. The remaining segments bear mid-dorsal, para-dorsal, suprastigmatal, and infrastigmatal spines. The anal segment bears two mid-dorsal spines. All these spines are black.

Third Instar

Head height 1.3 mm.; head width 1.5 mm. Shiny black. Club-shaped dorsal spines 3 mm. long. Hairs longer and more numerous. Body length 10 to 13 mm. Body exceedingly dark chocolate to shiny black. Para-dorsal row of spines possesses large orange, fleshy bases (Fig. 2). Otherwise no change from preceding instar.

Fourth Instar

Head height 1.8 mm.; head width 2.0 mm. Dorsal spines now 6 mm. long. Body length 15 to 19 mm. No noticeable change from previous instar.

Eggs laid singly on the underside of leaves of *Blechum blechum* on May 4 emerged four days later on May 8. The butterfly oviposited only on seedlings. The young larvæ ate the entire egg shell and for the duration of the first instar ate the epidermal hairs of the food plant. The first instar was of three days' duration with moulting occurring May 11. The second instar required three days and the third, four days.

Anteos clorinde nivifera Fruhstorfer

Egg

Color varies from very light greenish to yellowish. It may be white. Length 1.5 mm. Greatest diameter .45 mm. There are on the average fourteen longitudinal ribs. Only every other one extends to the tip of the egg. All are joined by many parallel cross striations which at the apex of the egg form the micropyle rosette. The end of the egg bearing the micropyle is acute as compared with the base.

First Instar

Head height .4 mm.; head width .25 mm. Head entirely colorless and transparent except for the black pigment of the ocelli. Bears a few long transparent hairs. Surface microscopically rugose. Body 4 mm. long. Light greenish yellow. Green from gut clearly visible. Numerous long colorless hairs. Body surface microscopically rugose.

Second Instar

Head height .7 mm.; head width .5 mm. Body length 6 mm. Very similar to previous instar. Surface of head and body rougher. Hairs shorter and more numerous. Color same. Some individuals darker yellow.

Third Instar

Head height 1.0 mm.; head width .8 mm. Body 9 to 11 mm. long. Very similar to preceding instar. Hairs on head and body still shorter and more numerous.

Fourth Instar

Head height 2.0 mm.; head width 1.7 mm. Yellowish green. Surface rugose. Body length 12 to 20 mm. All parts of the body above the stigmatal line are pea green. There may or may not be many indistinct pink transverse lines. The whole dorsal area of the body is studded with minute black hairs arising from conspicuous tubercles. The proportion of black to yellowish tubercles varies considerably but in all specimens there are exceptionally large black and occasionally iridescent tubercles just above the stigmatal line. Stigmatal line and spiracles yellow. Substigmatal areas light yellow with yellowish to colorless hairs arising from tubercles of similar color. The hairs on the head arise from the same kind of tubercles.

Fifth Instar

Head height 3.5 mm.; head width 3.0 mm. Yellowish green. Covered with many tubercles of the same color from which arise concolorous hairs. Edges of mandibles fuscous. Black pigment of ocelli visible. Body 35 mm. long. Spiracles cream to white in color. Dorsal areas of body clear light pea green covered with microscopic blackish hairs arranged more or less in transverse rows on the tops of the transverse folds of each segment. Hairs arise from prominent tubercles. Lemon yellow interrupted suprastigmatal line very thin. Wide stigmatal line whitish green. Below the stigmatal line the body is lighter green. The numerous hairs are longer and more lightly colored. Just dorsal to the stigmatal line is an irregular line of black to iridescent tubercles of various sizes. They are most numerous on the thoracic segments, least numerous on the anal segments. Legs and prolegs light transparent green. Tips of claws on legs slightly fuscous.

Chrysalis

Length 32 mm. Very light green to yellow. The anterior end terminates in a long thin club-shaped tip. In color this is burnt sienna. From it extend two lateral lines of the same color. Each extends along the dorsal edge of the wing pad then continues as a suprastigmatal line. A mid-dorsal line of similar color passes from the first abdominal segment to the tip of the shallowly bifurcate cremaster. Edges of eyes same color. Body smooth with no prominent hairs or tubercles. The chrysalis is very stout-bodied in the thoracic region bulging considerably ventrally and slightly laterally. It is suspended in the manner characteristic of Pieridæ and Papilionidæ with a girdle around the thorax.

Oviposition is most frequent in the late forenoon and early afternoon. The butterflies circle around large bushes of *Cassia spectabilis,* deposit a single egg, then another a few feet away. One insect may lay as many as fifteen eggs on a single bush at one visit and repeat the performance at a subsequent visit. Each egg is laid singly on the edge of the leaf. It is fastened by its blunt base but reclines on its side. Eggs laid May 4 hatched four days later on May 8. Each instar requires on the average four days. One larva which pupated May 5 emerged May 14, nine days having passed.

Nathalis iole Bdv.

Egg

Characteristically pierid in shape. Length .6 mm. Greatest diameter .27 mm. Longitudinally ribbed. Often as many as thirty ribs. The ribs are connected by faint cross stripes approximately .03 mm. apart. Usually not parallel. The color of the egg at the time of oviposition varies considerably. In one case a freshly laid egg lemon yellow in color was followed fifteen minutes later by one in which the larva was clearly visible through the colorless transparent shell.

First Instar

Head height .2 mm.; head width .28 mm. Head smooth, shiny black with few short pale hairs. Body length 1.5 mm. deep turtle green. Few long fuscous spatulate hairs scattered over body. Arise from large rounded tubercles. Two para-dorsal, red, fleshy protuberances on prothoracic segment. Each crowned with a rounded shiny black spine.

Second Instar

Head height .8 mm.; head width .9 mm. Head black to dark brown. Bears many short tapering hairs, colorless to light fuscous. Body length 4 mm. Prothoracic protuberances now bear several short hairs on their sides. Spatulate hairs of body now much shorter. Tubercles from which they arise relatively larger. Each segment now bears in addition to the spatulate hairs a pair of blunt shiny black hairs paradorsally, laterally, and in the suprastigmatal position. All arise from prominent tubercles. Body dark greenish glaucous with dark green mid-dorsal line and light green to white stigmatal line.

Third Instar

Very little change from previous instar. Head light green.

Fourth Instar

Similar to third instar. Head green to greenish yellow.

Fifth Instar

Head height 1.2 mm.; head width 1.2 mm. Head light green to yellow. Otherwise not much change. Body length 17 mm. There is a wide variation in the coloring of the larva. The shade of green varies. Some larvæ were grass green while others were dark greenish glaucous. Some possess a darker green mid-dorsal line while others have a bright red interrupted line. The stigmatal line ranges from light green to white. Numerous colorless hairs arise from prominent warts. The body is microscopically mottled with the warts arising from dark green areas. Areas between are lighter green. The blunt shiny hairs of the second instar are much reduced and not easily distinguishable from the other hairs of the body. Short fuscous hairs on the head. Head surface finely granular.

Chrysalis

Length 6.5 to 10.8 mm. Typically pierid-shaped. Dark greenish glaucous. Mottled with light and dark green. Just prior to emergence the dark green mottling assumes a light fuscous appearance. On the wing pads this is in the form of dendritic more or less parallel lines in the same direction as the veins. Those on the tongue case are at right angles to the axis of the tongue. Fewer on abdominal segments; none in intersegmental areas. Absent on dorsal side of abdomen except for an irregular para-dorsal row of splotches. Markings increase laterally and ventrally. Surface smooth. Cremaster blunt. Spiracles rimmed with fuscous. Mouth-parts and especially antennæ are frequently outlined in fuscous.

Eggs were laid May 29 and 31. Some hatched two days later. The duration of the different stages of this species varies extremely. Color markings also show a wide variation. Each instar may require from three days to a week or ten days. The pupal stage requires an average of seven days. Females have never been observed ovipositing earlier than nine o'clock in the morning. Eggs are laid on very small seedlings of *Bidens leucantha.* Many false starts are made before an egg is actually laid. A female may visit several seedlings and at each one go through the motions of oviposition without extruding an egg. Then she may lay several eggs in rapid succession each on a different seedling.

Eurema lisa (Bdv. & LeC.)

First Instar

Head height .28 mm.; head width .3 mm. Head transparent and nearly colorless. Smooth with few hairs. Length of body 1.7 mm. Transparent yellow. Green in gut visible. Longitudinal rows of rather long fuscous tapering hairs.

Second Instar

Head height .58 mm.; head width .6 mm. Head same color. Smooth. Numerous short fuscous hairs over entire surface. Length of body 4 to 5 mm. Same color as before. Mid-dorsal line dark green. Stigmatal line light green. Numerous short black hairs arising from whitish tubercles. Those on anal segment longest.

Third Instar

Head height .9 mm.; head width 1.0 mm. Length of body 5 to 8 mm. Mid-dorsal line Danube green. Para-dorsal line shamrock green. Narrow stigmatal line light turtle green. Remainder of body clear fluorite green. Other characters same as above.

Fourth Instar

Head height 1.4 mm.; head width 1.5 mm. Head smooth. Fuscous hairs shorter and more numerous. Length of body 10 to 13 mm. Same as above.

Eggs laid May 31 hatched June 3 three days later. They were laid on the leaves of *Mimosa pudica.* The female deposited the eggs most often on the top side of the vein of the leaf. She was not disturbed by the action of the plant which closed its leaflets against her abdomen. Upon withdrawal of the abdomen the eggs were hidden from sight.

Papilio celadon Lucas

Egg

Greatest diameter 1.0 mm. Height .9 mm. Light green in color. Nearly spherical. Surface smooth except for a faint reticulation forming microscopic polygonal areas. Food plant not determined.

Papilio polydamas L.

First Instar

Head height 1 mm.; head width 1 mm. Head smooth, chocolate. Few short black hairs. Length of body 3 to 6 mm. Body light chocolate. Covered with minute whitish hairs simulating a pubescence. Larger black hairs on legs, anal segment, and slightly protruding substigmatal areas. Spiracles, legs, and thoracic shield dark chocolate. A row of para-dorsal fleshy protuberances. Those on segments one, seven, nine, and twelve, yellow to light orange. Covered with whitish pubescence. Others more darkly colored with chocolate. Prothoracic pair longest.

Second Instar

Head height 1.5 mm.; head width 1.8 to 1.9 mm. Little change from previous instar. Color similar. Fleshy processes longer and brighter yellow. Body length 12 mm.

Third Instar

Head height 2.5 mm.; head width 2.8 to 3 mm. Head darker chocolate than preceding instar. Body length 18 mm. Darker chocolate. Processes brighter orange. Those on segments one, two, and three are at the stigmatal line. That on segment four is at the suprastigmatal line; that on segment five, substigmatal. All segments, the first excepted, bear the usual para-dorsal processes. Small pale processes at the bases of all the legs. Those on segments ten and eleven most prominent. All are clothed with microscopic fuscous to black hairs.

Fourth Instar

Head height 3.7 mm.; head width 3.9 mm. Head light chocolate early in instar but later becomes shiny black. Body length 22 mm. Dorsal anterior side of prothoracic processes chocolate. Long and tapering. Tips of remaining processes clothed with black hairs. Body chocolate. Dorsal, and to smaller extent, ventral side striped transversely with narrow deep crimson bands.

Fifth Instar

Head height 4 mm.; head width 4.4 mm. Length of body 27 mm. Similar to preceding instar.

Each instar required from three to five days. The average life cycle required thirty days. Larvæ which hatched May 1 pupated May 21. The pupal stage lasted ten days. As food plant *Aristolochia argyreoneuron* was preferred, but the following species were eaten to a varying degree: *A. ringens, A. forckelii, A. redicula, A. saccata, A. tagala, A. fimbriata, A. brasiliensis, A. cymbifera, A. elegans, A. gigantea, A. grandiflora, A. glandulosa, A. hians, A. indica, A. Kaempferi, A. Roxburghiana, A. Ruiziana,* and *A. trilobata.*

Hemiargus filenus Poey

Egg

Pale dull glaucous-blue. Greatest diameter .4 mm. Height .15 mm. Top surface noticeably concave. Surface with macroscopic polygons formed by a greatly raised reticulation. Polygonal areas further divided into microscopic polygons raised but little above the general surface.

First Instar

Head height .1 mm.; head width .15 mm. Head smooth shiny black. Usually retracted. Length of body .9 mm. Clear light green. Long tapering colorless hairs on body. Para-dorsal and substigmatal rows longest. Hairs usually directed posteriorly.

Eggs laid on *Mimosa pudica* May 29, 31, and June 1 emerged June 3, 4, and 5. The duration of the egg stage was usually five days. Eggs were laid most frequently at the base of a bud. As with *N. iole* the female made many false starts. An egg would be laid every ten to fifteen trials.

Pyrgus syrichtus Fabr.

Egg

Cream color.

First Instar

Head height .4 mm.; head width .42 mm. Smooth shiny piceous, with few rather long whitish hairs. Length of body 1.5 mm. Body bears many colorless to fuscous hairs. Those on the prothoracic and anal segments are the longest and of the usual tapering type. Hairs forming the para-dorsal, lateral, and stigmatal lines are branched (Fig. 4). Those below the stigmatal line are of the usual tapering type. Body cream color.

Eggs laid May 22 emerged five days later May 27. Although *Sida* is listed as the food plant of these larvæ, several local species of *Sida* were refused by the larvæ which eventually died.

Cabares potrillo (Lucas)

Egg

Dark pea green. Greatest diameter .8 mm. Height .78 mm. Eleven prominent longitudinal ribs. These connected by low cross striations (Fig. 7). Eggs failed to hatch. Food plant unknown.

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EXPLANATION OF PLATE III.

Fig. 1. Second instar head capsule of *Calisto herophile* Hbn. Approximately x 50.

Fig. 2. Para-dorsal spine of third instar *Metamorpha stelenes insularis* (Holland). x 35.

Fig. 3. First instar head capsule of *C. herophile* Hbn. x 33.

Fig. 4. Branched hair of first instar *Pyrgus syrichtus* Fabr. Approximately x 200.

Fig. 5. Egg of *C. herophile* Hbn. Approximately x 18.

Fig. 6. Same.

Fig. 7. Micropyle rosette of egg of *Cabares potrillo* (Lucas). x 35.

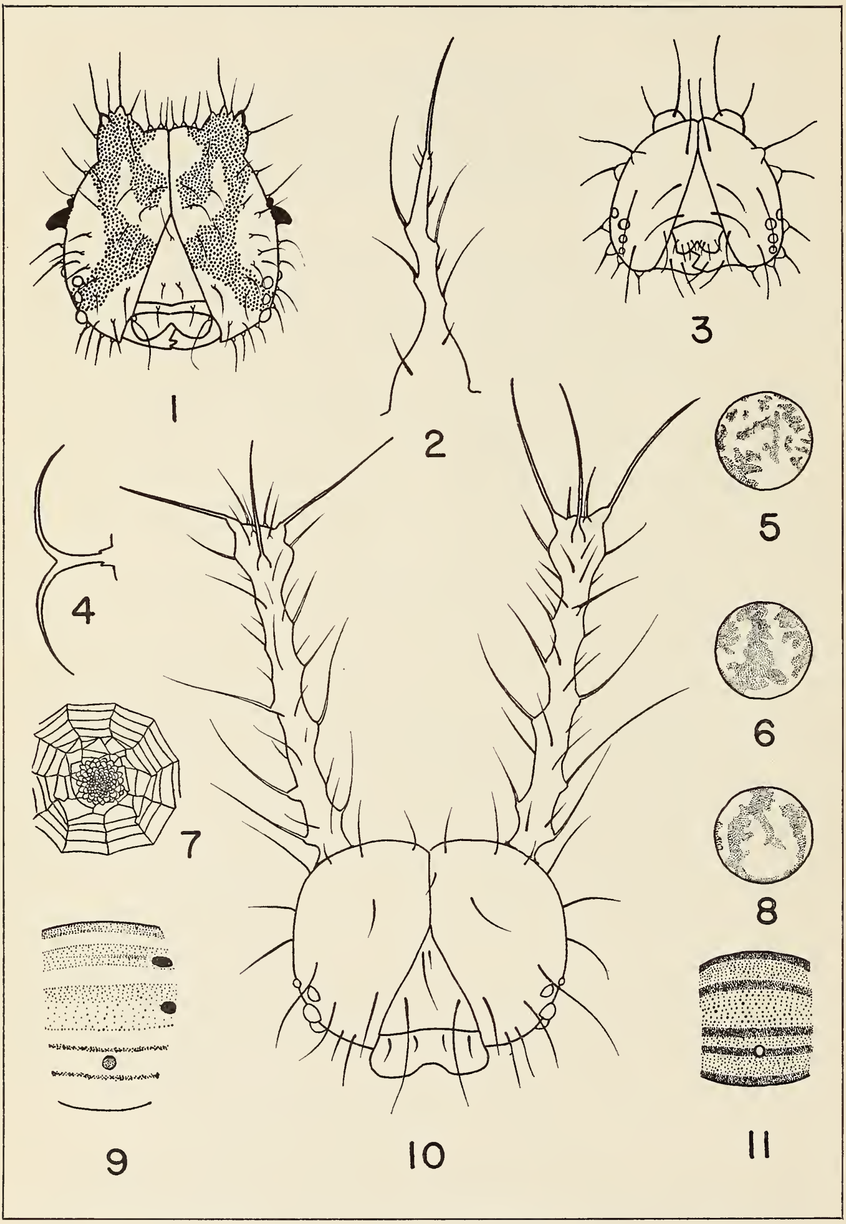
Fig. 8. Same as Figs. 5 and 6.

Fig. 9. Diagrammatic representation of the color pattern on an abdominal segment of the third instar larva of *C. herophile* Hbn. Approximately x 16.

Fig. 10. Second instar head capsule of *M. stelenes insularis* (Holland). x 35.

Fig. 11. Diagrammatic representation of the color pattern on an abdominal segment of the first instar larva of *C. herophile* Hbn. Approximately x 16.

Psyche, 1940 Vol. 47, Plate III.



Dethier — Cuban Lepidoptera

THE CONOPIDAE OF THE WEST INDIES AND BERMUDA (DIPTERA).

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No Conopidæ have been recorded from Bermuda and only three species from the West Indies. Of these three species, one is almost certainly incorrectly identified, and the second has always been placed as a synonym of the third. In this paper the synonymized name is resurrected and six species are described as new. Since the members of the Conopidæ are usually widely distributed, comparisons were made with the entire New World fauna.

The origins of the West Indian Conopidæ are obscured by the scarcity of data, since no representatives are yet known from Jamaica or the Lesser Antilles. Trinidad, from which Kröber has recorded *Physocephala testacea* v.d. Wulp (Argentina), is usually regarded as part of South America. The *Conops* herein described from Bermuda is so distinctive that nothing can be said concerning its relationships. No true *Conops* are yet known from the West Indies, but the Antillean *Physoconops* and *Zodion* show more or less definite affinities with Middle or South American forms. The unique *Physocephala* seems to be closely allied to a Costa Rican variety of a widely distributed South American species. The single *Occemyia* represents the first southern extension of the genus from the Nearctic region. The predominantly South American aspect of the West Indian Conopidæ is consistent with the fact that the Nearctic forms strongly indicate a Neotropical origin.

Conops Linnaeus

Linnaeus, 1758, Syst. Nat., p. 604, no. 226.

True *Conops* (*s. str.*) occurs generally throughout the

New World, but so far has not been found in the West Indies.

Conops bermudensis new species (Fig. 3)

Female: length 7 mm. Easily recognized by its dark color, entirely yellowish wings, and black spot in front of each eye. Front and vertex dark reddish brown; cheeks somewhat paler; face testaceous; a round, black, velvety spot in front of and contiguous with each eye at a level with the base of the antennæ. Fine silver pollen on face and cheeks and extending up to the black spot. Basal segments of antennæ dark brown, more than three times as long as wide; other segments missing. Proboscis dark brown, darker towards the apex, twice the length of the head. Thorax dark brown, obscurely covered with very fine silver pollen; mesonotum (except the humeri) black; scutellum dark brown; metanotum black. Legs dark brown; tibiæ becoming darker towards their apices; tarsi dark piceous; pulvilli and claws pale testaceous; tips of claws black. Coxæ covered with very fine silver pollen. Abdomen dark brown, covered with very fine silver pollen, particularly on the sixth and seventh segments. Ventral plate rather long, very convex and broad. Wings entirely uniformly pale yellowish brown.

Holotype (♀): Bermuda (Owen Bryant); in the Museum of Comparative Zoology.

The specimen is in rather poor condition, but is worth describing because it represents the first Conopid to be found in Bermuda. Most of the Nearctics species heretofore described under *Conops* really belong in *Physoconops*. But *bermudensis* is a true *Conops* and so distinctive that it cannot be confused with any other species.

Physoconops Szilady

Szilady, 1926, Annal. Mus. Nat. Hungar., 24: 588.

Physoconops cubanus new species (Figs. 6, 7)

Female: length without antennæ 10.5-11 mm. Front dark testaceous, vertex and median line, extending to the antennæ, piceous. Face and checks testaceous; anterior and posterior orbital margins covered with golden pollen. Proboscis dark piceous, apex black; less than twice the length of the head. Antennæ as figured, dark piceous, proximal segment paler. Thorax black; humeri brown with the inner side covered with golden pollen; also golden pollen on the mesonotum surrounding the humeri and on the mesopleuræ and sternopleuræ. Scutellum either black or with obscure golden pollen. Metanotum black, anterior half covered with golden pollen; most of metapleuræ covered with golden pollen. Halteres testaceous. Legs testaceous, tarsi black except at their proximal ends. Anterior surface of anterior coxæ and outer surfaces of fore and middle tibiæ covered with golden pollen. Pulvilli and claws testaceous, tips of claws black. Abdomen as figured; segments one and two black, with golden pollen on the posterior margins; the third segment with an obscure proximal yellow band; segments apical to two are dark rufous. Ventral plates of medium length and definitely narrowed at the tip, black on the posterior side. Wings hyaline with reddish brown band becoming fuscous at apical half. The dark band is paler in the costal cell; extends posteriorly to the first basal cell, to the vena spuria, and to a narrow hyaline margin in the distal half of the first posterior cell, but filling out the cell at its apex.

Male: length without antennæ 12 mm. Similar to the female but the golden pollen almost absent in the only specimen. The yellow band at the base of the third abdominal segment broader and more distinct than in the female.

Holotype (♀): Sept. 2, 1930, Guabairo about 4 miles north of Soledad, near Cienfuegos, Cuba (Richard Dow); allotype and paratype (♀) with same data as holotype; in the Museum of Comparative Zoology.

In Kröber's key (1939, Ann. Mag. N.H., 4: 467) *cubanus* runs to *fronto* Will. but differs in having a relatively longer third antennal segment, and differently colored thorax, front, occiput, and abdomen. In Van Duzee's key (1927, Proc. Calif. Ac. Sci., 16: 578) *cubanus* runs to *gracilis* Will., but *gracilis* is a true *Conops*.

Physoconops bahamensis new species (Figs. 8, 9)

Female: length without antennæ 13 mm. Vertex piceous with a black center; front testaceous becoming piceous or black at its upper margin. Face and cheeks pale testaceous; the facial depression and orbital margins with golden pollen. Antennæ as figured, piceous, the second segment thickly setaceous. Proboscis rufo-testaceous, tip piceous, less than twice as long as the head. Thorax black, a silver pollen spot on the inner side of each humerus and extending to the base of each wing. Anterior half of the scutellum, metanotum, and metapleuræ covered with silver pollen. A silver pollinate band on mesopleuræ and sternopleuræ. Anterior surface of prothoracic coxæ covered with golden pollen, the other coxæ with silver pollen. Femora bright rufo-testaceous; tibiæ pale testaceous, the proximal halves very pale; tersi black, paler at their proximal ends; pulvilli and claws pale yellow, tips of claws black. Halteres pale yellow. Abdomen as figured; first segment black, rest of the abdomen black. The posterior margins of the first, second, and third segments with silver pollen. The dorsal surface of the sixth segment covered with silver pollen. Fifth segment strongly constricted; the ventral plate very long. Wings with yellowish brown band in veins 1-5, except that the apical half of the second posterior cell is hyaline, and a narrow band along the posterior margin of the first posterior cell (except at the extremity) is hyaline. The brown band becomes fuscous at the apical third of the wing.

Holotype (♀): February 8, 1934, Eleuthera Island, Bahama Islands (Utowana Expedition) in the Museum of Comparative Zoology.

It is difficult to see what are the relationships of this species. In the key just published by Kröber (1939, Ann. Mag. N.H., 4: 466-467) *bahamensis* might run to *rufipennis* Macq. or *discalis* Will., depending on how one interprets the color of the wings. Macquart's species, however, has a differently colored head, scutellum, tarsi, and abdomen. Williston's *discalis* has a much shorter third antennal joint, black front, and other differences. Of the North American species, *bulbirostris* Loew is perhaps closest.

Physoconops ramondi (Bigot) (Figs. 1, 2)

Conops ramondi Bigot, 1857, in Ramond de la Sagra's Cuba, vol. 7, p. 808; pl. 20, fig. 6.

Conops pictus Fab. of authors, in error.

Female: length without antennæ 21 mm. Easily distinguished by its very large size and reddish brown color. Front, face, cheeks reddish brown. There is yellow pollen in the facial depression and extending along the facial and posterior orbits up to a little above the level of the base of the antennæ. In certain angles of light the pollen shows as a golden sheen. Proboscis reddish brown, evidently less than twice the length of the head (in the single female the apex is broken off). Antennæ as figured; reddish brown, style paler, second segment thickly covered with black setæ. Thorax reddish brown, a pair of obscure longitudinal piceous lines on anterior part of mesonotum and one near each margin of the mesonotum. Humeri without pollen, but an irregular golden pollen spot on the inside of each humerus and posterior from the humeri to the wing bases. An oblique golden pollen band on the mesopleuræ and sternopleuræ. Golden pollen hardly discernible on the reddish brown scutellum but forming a yellow band across the anterior half of the metanotum. Halteres dull yellow. Legs pale reddish brown, coxæ covered with a silvery yellow sheen; distal halves of the tibiæ covered with a yellow sheen, especially on the outer side; tarsi black, pale at each end; tips of claws black. Abdomen as figured; reddish brown; the posterior margins of the first and second segments with golden pollen, particularly on the sides; two obscure piceous stripes on the second segment; ventral plate very long, black on the posterior side. Wings hyaline, with a reddish brown streak from the first to the fourth veins, tending to be fuscous distally; posterior part of first posterior cell and most of the second posterior cell hyaline.

Male: length without antennæ 20.5 mm. Similar to the female but the style much longer and more attenuate; proboscis darker, with a black tip; first to third abdominal segments much thinner, and more pollen on the scutellum.

Described from a pair collected by C. T. Ramsden in 1910 (♂ May 31, ♀ June 21) on the Rio Seco, Quantanamo, Cuba in the C. W. Johnson collection of the Museum of Comparative Zoology.

Osten Sacken, in his catalogue (1878, p. 255), quotes Loew as stating *in litt.* that *ramondi* is the same as *pictus* Fab., and as a result of Loew's dictum *ramondi* has remained a synonym to this day. Since *ramondi* is twice the size of *pictus* and accurately figured in color by Bigot, it is inconceivable how Loew made such a statement. The specimens described above, however, were correctly named by Johnson.

Physoconops pictus (Fabricius)

Conops picta Fab., 1775, Syst. Ent., 4: 391 (West Indies).

Conops ramondi Bigot of authors, in error.

This species appears to be restricted to the West Indies. Macquart recorded it from the United States ("Carolina") and Weidemann from South America, but these references are almost certainly to other species. In the Museum of Comparative Zoology there are specimens from Cuba, Haiti, and Puerto Rico. The American Museum of Natural History also has specimens from Cuba and Puerto Rico. Kröber, 1939, records *pictus* from "S. Domingo".

Another species, for which good structural differences cannot at present be found, is represented in the Museum of Comparative Zoology by two specimens labelled "Cuba", one from "Havana, Cuba, Baker", and one from Buenos Aires, Trinidad Mts., Cuba, June 17-23, C. Parsons. This species differs from *pictus* in having a dark rufous abdomen, black scutellum, etc. It is perhaps intermediate between *pictus* and *cubanus*.

Physocephala Schiner

Physocephala Schiner, 1861, Wien. Ent. Monatssch., 5: 137.

Physocephala venusta new species (Figs. 12, 13)

Female: length without antennæ 9.5 mm. Face and front yellow except for a sinuous rufo-piceous transverse band contiguous with the vertex and extending medially down to the antennæ but not divaricating at the antennæ. Antennæ as figured, rufo-testaceous, the third segment and style somewhat paler, the distal end of the first and dorsal and lateral sides of the second segment covered with black setæ. Cheeks pale piceous with an obscure testaceous spot. Silvery white pollen extends along the eyes half way up the front. Proboscis dark piceous, about twice as long as the head. Mesonotum black, surrounded by a margin of gold pollen, except at the median third on the anterior margin. Sides of the thorax dark rufo-piceous with an irregular oblique band of golden pollen. Scutellum black; metanotum black with a large spot of golden pollen on each side. The halteres pale yellow. Coxæ dark rufo-piceous covered with coarse silvery pollen; trochanters and bases of the femurs pale testaceous; femora dark piceous except about the distal fourths, which are pale testaceous; tibiæ and tarsi pale testaceous, tips of claws black. Abdomen as figured, rufo-piceous tending to be darker dorsally and towards the base of each segment. Posterior margins of the segments with obscure golden pollen; except for a broad patch on each side of the distal end of the first segment and generally on the dorsal surface of the sixth segment. The ventral plate rufo-testaceous, black from behind, when seen from below angulate, forming an angle of 120°. Wings subhyaline, costal and subcostal cell testaceous; the usual brown stripe extends from the first vein to fifth, slightly beyond the apex of the second posterior cell, and does not fill up completely the first posterior cell.

Holotype (♀): Nov. 16-17, 1934, Mannville, Haiti (P. J. Darlington, Jr.) in the Museum of Comparative Zoology.

Of the Nearctic species *venusta* is clearly nearest to *sagittaria* Say. But *sagittaria* is larger, has a longer style, longer second antennal joint, the median black frontal line divaricating at the antennæ, larger and more rounded ventral plate, and color differences.

A Neotropical species which appears to be very closely related to *venusta* is *bimaculata* Kröber, described, from Argentina, Ecuador, and Colombia. According to Kröber's description (1915, Archiv. f. Naturgesch. Abt. A, H. 4, p. 140) *bimaculata* is much larger, has a shorter second antennal joint, scutellum reddish brown instead of black, abdomen black with much more yellow, and the ventral plate larger and rounded, not angulate. Kröber (Konowia, 5: 130) gives a supplementary description and figures of *bimaculata* from Costa Rica. The figures show that *venusta* is near but distinct from *bimaculata*.

Zodion Latreille

Zodion Latreille, 1796, Préc. des caract. gen. d. Ins., p. 162.

Zodion canescens new species (Figs. 4, 5)

Female: length 5 mm. Face yellow with the depressed central portion piceous; a few fine pale hairs on the cheeks, longer and darker hairs on front and vertex; front piceous, becoming darker towards the vertex; shining space around the ocelli broadly angular anteriorly. Face and cheeks covered with pale yellow pollen. Antennæ as figured, first and second segments piceous, the third rufo-testaceous. Proboscis twice as long as the head. Thorax piceous, covered with grey pollen except for three broad dorsal longitudinal piceous lines. The legs piceous but the femora, except at their distal ends, and tibiæ more or less feebly covered with grey pollen. Halteres yellow; calypteres white. Wings subhyaline, veins piceous, first posterior cell broadly closed. The abdomen as figured, segments one to four and all but the posterior margin of the fifth black, covered with grey pollen, except along two broad dorsal bands. The apical segments and ventral plate are rufo-testaceous.

Holotype (♀): April 12, 1926, Soledad, near Cienfuegos, Cuba in the American Museum of Natural History.

Among the North American species *canescens* is closely related to *fulvifrons* Say. But *fulvifrons* has a broad low ventral plate, longer proboscis, paler front, etc. Among the Neotropical species *canescens* is apparently very near to *americanum* Wied. According to Kröber, who examined the male type from Uruguay, *americanum* differs in having a pale front, proboscis more than twice the length of the head, two narrow black lines on the thorax, differently marked and colored abdominal segments. Kröber says that a female, without a head, next to the type is identical with *nanellum* Loew. If this is so, then the anal segment and ventral plate of *americanum* is very different from *canescens.*

Zodion species *vix* **americanum** Wied.

In the U. S. Nat. Museum is a Zodion from San Diego de Los Banos, Pinar del Rio, Cuba which is labelled *americanum* Wied. Unfortunately it is a male, but it seems to be much closer to *canescens* than to *americanum.* Roeder (1885, Stett. Ent. Zeit., 46: 343) records *americanum* from Puerto Rico, but very likely it is not true *americanum.*

Occemyia Robineau-Desvoidy

Thecophora Rondani, 1845, Nuovi Annali d. Sci. Nat., 3: 15

Occemyia Robineau-Desvoidy, 1853, Dipt. Eur. Paris, Myop., p. 50

Oncomyia Loew, 1866, Berlin ent. Zeit., 10: 41 (emend. of *Occemyia*)

Thecomyia Brues and Melander, 1932, Bull. M.C.Z., 73: 306 (*lapsus calami*).

All writers except Coquillett have overlooked the 1845 description of *Thecophora.* They cite the 1857 description, but even so Rondani's name is preoccupied by Charpentier's use of it for a subgenus of Odonata (1840). Since Charpentier's name was *Thecaphora* a strict application of the rules would necessitate the use of Rondani's *Thecophora.* It may be argued, however, that Rondani's name is invalid since he did not clearly indicate a species with the genus. *Thecomyia* (Tetanoceratidæ) was a slip for *Thecophora.*

Occemyia haitiensis new species (Figs. 10, 11)

Female: length 4 mm. Shining dark piceous, except the following parts which are more or less pale testaceous; face, cheeks, lower half of antennæ, basal half of inner side of third antennal joint, halteres, calypters, anterior surface of front coxæ, basal half of hind femora, narrow base of four anterior femora, distal tips of femora and bases of tibiæ, extreme tips of tibiæ and basal joints of tarsi. Front between vertex and base of antennæ rufo-testaceous. The shining space around the ocelli extends downward in an acute point. Front, occiput, thorax and abdomen with quite long black hair. Posterior lateral third of second abdominal segment and posterior margin of next two segments with silvery pollen. The hairs at the extremity of the abdomen somewhat pale. Each cheek with a group of about four very short black hairs and along each oral margin a row of black hairs which are about as long as the first antennal segment. Cheeks with silvery white pollen, which extends narrowly to top of eye on the frontal orbit and to the middle of the eye on posterior orbit. Antennæ as figured. Palpi small and piceous; proboscis with apical segment in the female a little shorter than the first, unknown in the male. Ventral plate of female narrow and rather long, shining piceous. Veins of wings uniformly piceous but becoming paler at the base.

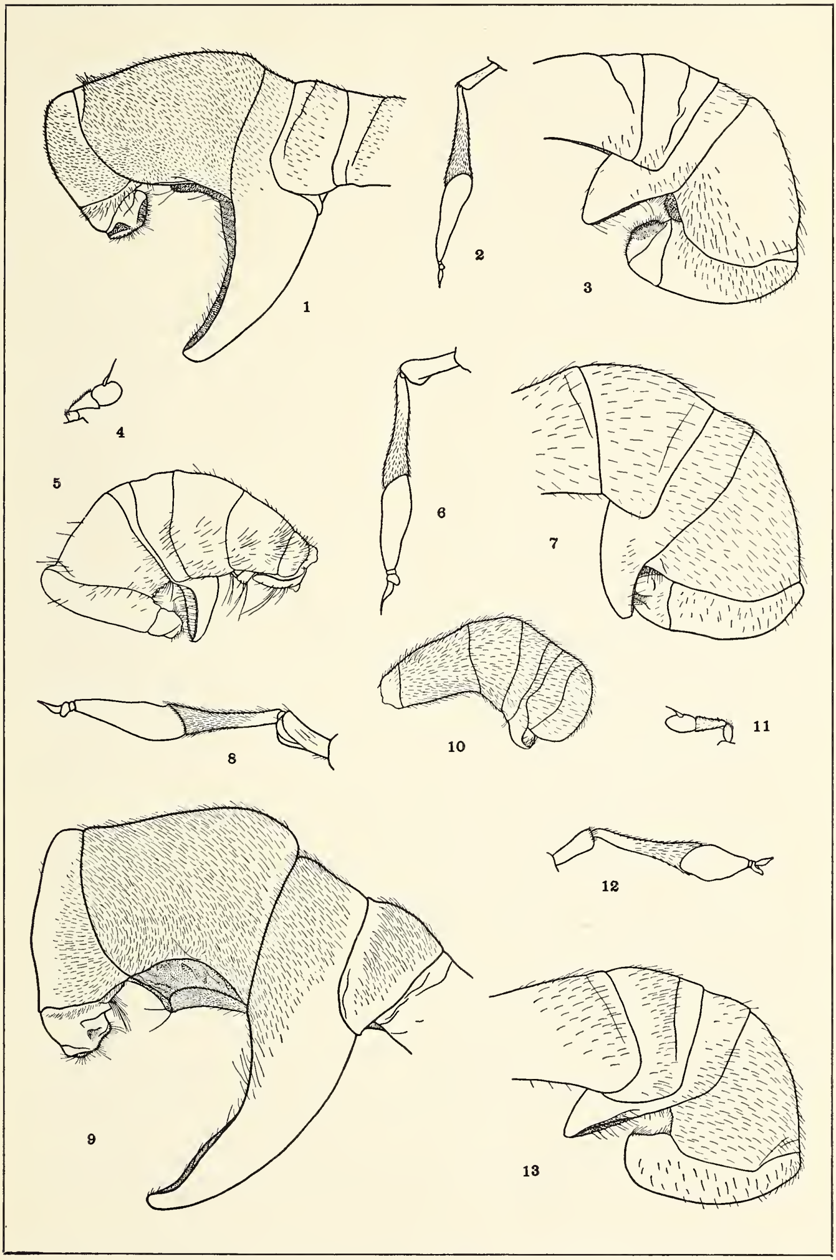
Holotype (♀): Port-au-Prince, Haiti (William Mann) in the Museum of Comparative Zoology.

In Van Duzee's key *haitiensis* runs to *nigra* Van Duzee from Oregon. But it differs from *nigra* in the shape and color of the antennæ, the pale hairs on the abdomen, darker front, the relative lengths of the first and second segments of the proboscis, etc. The new species is perhaps nearest to *loraria* Loew from eastern United States. But *loraria* has a shorter ventral plate, paler front, and dark hairs on the cheeks absent or very few and fine.

EXPLANATION OF PLATE IV.

Figs. 1-13: Antennæ and abdomens of female Conopidæ. All are enlarged the same amount, except *P. ramondi* which is enlarged half as much as the others. 1, 2: *Physoconops ramondi;* 3: *Conops bermudensis;* 4, 5: *Zodion canescens;* 6, 7: *Physoconops cubanus;* 8, 9: *Physoconops bahamensis;* 10, 11: *Occemyia haitiensis;* 12, 13: *Physocephala venusta.*

Psyche, 1940 VOL. 47, PLATE IV.



Parsons — Conopidæ

FOOD PREFERENCES OF THE COLORADO POTATO-BEETLE, *LEPTINOTARSA DECEMLINEATA* SAY.

By Charles T. Brues

Biological Laboratories, Harvard University

The experiments[1] here described were undertaken some years ago (1923-25), but no account of them was published at that time as a report on work of a somewhat similar nature by others appeared while my own was still in progress. More recently one or two additional papers relating to the choice of food-plants by the Colorado potato-beetle have been published and the whole question appears worthy of review with incorporation of the data secured by the present writer.

Aside from its importance as an insect pest of cultivated potatoes the Colorado potato-beetle is of particular interest on account of an apparent shift in its food-habits which occurred less than a century ago when it was first noted as feeding on the foliage of the potato. However, the food preferences of this beetle are not so clear as might appear from this statement and they have already furnished interesting material for study at the hands of several entomologists in this country and in France where the species has been naturalized since about 1920.

The potato-beetle was described by Thomas Say in 1824 from the western plains region and was regarded by him as native to the United States. There seems to be no reasonable doubt that this supposition was in error and that the original habitat was Mexico. At the time of its discovery by Say and for several decades later the beetle appears to have restricted its feeding to the foliage of a common weed of the Southwest, *Solanum* (*Androcera*) *rostratum*. This plant in turn is of Neotropical origin and is thought to have preceded the beetle, and to have become naturalized in the United

[1] I wish to express my gratitude to the Elizabeth Thompson Fund for a grant which made possible the construction of a series of large outdoor cages in which the breeding experiments were conducted.

States at a much earlier date. Its spread may have followed the trails of the early Spanish explorers aided by the bur-like fruit which is readily transported on the fur of animals or clothing of man. Later this plant became more sparingly naturalized further northward and eastward under locally arid conditions like those prevailing on waste land or rail-road ballast. That this plant may be actually native to the drier parts of our southwestern states is quite possible, but at any rate it appears to have been the preferred food-plant of the potato-beetle during the earlier half of the nineteenth century. There is also a native potato in this same region, *Solanum fendleri* Gray, *nec* Heurck & Muel. (*S. tuberosum boreale* Gray) which extends from Western Texas to Arizona and Mexico in moist transition areas but there are apparently no records that indicate whether or not this wild potato has ever served as a food-plant for the beetle. That it might do so is very likely since it is very similar to the cultivated form, although as the two plants (*S. fendleri* and *S. rostratum*) do not occur under similar ecological conditions passage from one to the other could not commonly occur.

Before 1860 the potato-beetle found a highly acceptable food-plant in the potatoes that were cultivated in the region where it then occurred and it was recognized as early as 1859 as an established pest in gardens. Thenceforth it spread into the eastern and southern states and later to the Pacific region. It has continued to prefer the potato to other species of the genus *Solanum* (*s. lat.*), although several other genera of Solanaceæ are sometimes attacked in a more sporadic way. Thus it is well known that the larvæ are frequently destructive to egg-plants (*Solanum melongena*) in gardens and that they appear occasionally on tomatoes (*Lycopersicum esculentum*), ground cherry (*Physalis* spp.) and on certain varieties of cultivated tobacco (*Nicotiana*) that develop a low nicotine content in the leaves.

The sporadic occurrence of the beetle on some of its less favored food-plants may indicate the presence of separate strains or genetically distinct types, especially as it cannot always be traced to the absence of the preferred potato food-plants in the immediate vicinity.

With this question in mind a series of 24 species of Solanum were secured as seed and plants were raised in the greenhouse. These were then set out in the open[2] at the time the first seasonal brood of beetles appeared and a number of adults (ten) were placed on the foliage of each plant. From these preliminary tests it was at once evident that there was a wide variation in the readiness with which the beetles fed upon the several species of Solanum that were offered to them. Omitting the potato which was suffering heavily from beetle feeding throughout the neighborhood at that time, several species were greedily accepted and voraciously fed upon. Among the species tested these were notably S. (*Androcera*) *rostratum*, *S. dulcamara*, *S. melongena* (garden egg-plant), wonderberry[3], *S. marginatum*, and *S. subinerme*.

Several were absolutely refused, including *S. nigrum*, *S. pseudocapsicum*, *S. barbisetum*, *S. granuloso-leprosum*, the garden tomato (*Lycopersicum esculentum*) and three unidentified Panamanian species.

Intermediate with reference to feeding were *S. pyracanthum*, *S. atropurpureum* and an unidentified Panamanian species.

As a result of these preliminary tests nine species were selected for further experimentation, as follows: "wonderberry", S. (*Androcera*) *rostratum*, *S. subinerme*, *S. marginatum*, *S. dulcamara*, *S. torvum*, *S. barbisetum*, *S. melongena* and *Lycopersicum esculentum*.

The last-mentioned species was added, although the beetles had previously refused to feed upon it, because of an infestation called to my attention by Professor W. E. Castle, who noticed the familiar beetles and larvæ destroying the

[2] On the grounds of the Bussey Institution at Forest Hills, Boston, Mass. where the entomological laboratories of Harvard University were located at that time.

[3] This plant was secured from a seedsman as Luther Burbank's "Wonderberry" which is according to botanists a form of *Solanum nigrum*. However, as noted below, the potato-beetle does not feed on the wild form of this species and cannot develop on it, a fact also attested by Trouvelot ('33) and his co-workers who attempted unsuccessfully to rear this insect in France on European plants of this cosmopolitan *Solanum*. The wonderberry is said to have originated as a hybrid between *S. villosum* and *S. guineense* (cf. Whitson & Williams, "Luther Burbank," vol. 6, pp. 105-133 (1914). The latter name has been applied to both *S. nigrum* and *S. aggregatum*, so the nativity of the wonderberry is hopelessly shrouded in doubt, but it appears that it is not identical with *S. nigrum* as has been assumed.

foliage of tomato plants in his garden in Belmont, near Cambridge, Mass. On account of this unusual occurrence it appeared that we might have chanced upon a mutation in choice of food and a part of the colony was transferred to one of the large screened cages[4] with a few healthy tomato-plants. They continued to feed and it appeared that some of the larger larvæ had entered the soil to pupate although the majority died before attaining full growth. However, no adults of a second generation appeared in the cage and the soil was left undisturbed until the following summer which likewise brought forth no beetles. This second year a similar infestation occurred in Professor Castle's garden, but we made no further transfers as it was evident that the beetles could not maintain themselves on tomato even though certain adults had developed a taste for it. In France Trouvelot and Thénard ('31) have similarly noted the disappearance of the larvæ from tomato plants and they attributed this to the difficulty experienced by the larvæ in maintaining their foothold while crawling on the coarsely hairy leaf stalks. This has been later questioned, however, by others working in the same region. Feytaud ('23) noted earlier that the adult beetles in France eat tomato foliage avidly, a statement that could certainly not be applied generally to the potato-beetle population in America. Quite recent studies in France substantiate this as they have shown that certain varieties of tomato are readily eaten while others are not.

Laboratory experiments by McIndoo ('35) showed that both adults and larvæ are to a surprising extent attracted to tomato leaves when permitted to choose between potato, horse-nettle (*Solanum carolinense*), *S. dulcamara* and tomato. Although showing much irregularity, a considerable number (±9.6-12%) of beetles and many larva (15%) came to rest on the tomato leaves. As the species is unable to survive on tomato it is clear that when tomato is as readily available as other acceptable species that there is a consistent weeding out in the general population of those beetles

[4] These cages were four feet square at the top and bottom with vertical sides eight feet high, covered completely with bronze window screening except on the bottom which was sunk to a depth of eight inches in the soil of the garden. They thus maintained the plants and insects under practically out-door condition throughout the year.

that are attracted to tomato. Even granting that the inability to mature on tomato is not absolute it is obvious that natural selection will completely prevent the development of any strain attracted to this plant for oviposition.

The relation of the potato-beetle to tomatoes is an extreme case of mistaken instinct, but the broods in our other cages showed that a similar less pronounced relationship prevails with at least some other species of *Solanum*. As mentioned in a preceding paragraph nine species on which the beetles fed readily were set out in separate breeding cages in the spring of 1923. Each cage was supplied with twenty beetles (ten of each sex). No further attention was paid to them except to note the progress of the experiment and to replace from a reserve stock any plants that suffered excessive defoliation. Replenishment was necessary especially in the case of *S. rostratum* as these plants were smaller and appeared to grow less vigorously.

Numerous larvæ developed in all of the nine cages and beetles of a second generation appeared in all of them. Plants were kept growing in the cages until the end of the season and outdoor conditions prevailed during the winter.

The following season (1924) the cages were again supplied with plants of the same species, but, of course, no further beetles were added. Beetles appeared in all but four of the nine cages. These four included *S. marginatum, S. barbisetum* and the two unidentified Panamanian species, indicating that the beetles had not survived the first year on these plants.

In the spring of the following season (1925) only the five remaining cages were planted as before and three of these failed to develop any adult beetles. These were "wonderberry", *S. torvum* and *S. dulcamara,* showing that under the conditions of the experiment the beetles had been unable to maintain themselves on these three species beyond the second season.

At this time (1925) only the two remaining cages produced beetles of the spring brood and the experiment was carried no further as it appeared clear that the beetles were able to continue on these plants. They were *S. rostratum,* the plant believed to be the original food-plant and *S. melongena,* the egg-plant. We know of course from innumerable observations that the beetles maintain themselves indefinitely on potato.

It thus appears that not only do the beetles evince a differential choice among various Solanums and other solanaceous plants as was first clearly shown by Trouvelot, *et al.* ('33a), but the choice of the beetles is not always compatible with the larval requirements in the way of food. Thus even if the beetles are unable to maintain themselves for more than a year or two on plants that they will quite willingly attack we may readily understand how the potato-beetle and similar insects fail to widen their range of food-plants even though the instincts of the adults may vary considerably in directions incompatible with larval food requirements. What happens in such cases is that a certain proportion of the population is doomed to extinction due to faulty instinct of the parents in selecting unsuitable food-plants. If the environmental resistance rates high or the "viscissitudes of life" are excessive, as is usually the case, this factor plays an important part in the economy of the insect, but in the case of pests of agricultural crops where this environmental resistance is lessened by an excessively increased food-supply it becomes of very minor importance.

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Book Review

A Laboratory Guide to the Study of the Evolution of the Wings of Insects, by J. Chester Bradley. 2nd ed. Ithaca, N. Y. Daw, Illston & Co. 160 pages, 70 plates. 1939.

This is a revision of a similar guide published in 1931. The first 15 pages deal with venational nomenclature, origin of wings, nature of veins, and the archetype venation. It is noteworthy that the concept of the anterior and posterior media and cubitus is used in the discussion of the latter topic. The remainder of the guide consists of a synopsis of the venation in the principal orders of insects, both recent and extinct. This part of the text is arranged systematically, with the more generalized groups considered first. The discussion under each group stresses the evolutionary significance of the wings concerned. The 70 plates at the end of the guide include drawings of wings of 83 insects; the lettering of the veins has been left for the student.

This guide should prove very useful in general courses in entomology, as well as those dealing with morphology and evolution. It contains much information otherwise available only in numerous journals. In a few instances, however, statements about the wings of fossil insects are somewhat out-of-date. On page 40, for example, reference is made to the fact that Permotipula is known from only a single wing, so that we have no means of ascertaining whether this insect had two or four wings. However, a complete Permotipulid, having four wings present, was described by Tillyard in 1937 (Nature, Jan. 9, p. 66). One obvious error has crept into the text: on page 26 and plates 10 and 12, the ordinal name Protoblattaria has been used for all fossil cockroaches. Professor Bradley tells me that this use of the term Protoblattaria was unintentional, and is the result of an oversight which probably occurred when the manuscript was being arranged.

F. M. Carpenter.

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A regular meeting of the Club is held on the second Tuesday of each month (July, August and September excepted) at 7.45 p.m. in Room B-455, Biological Laboratories of Harvard University, Divinity Ave., Cambridge. Entomologists visiting Boston are cordially invited to attend.

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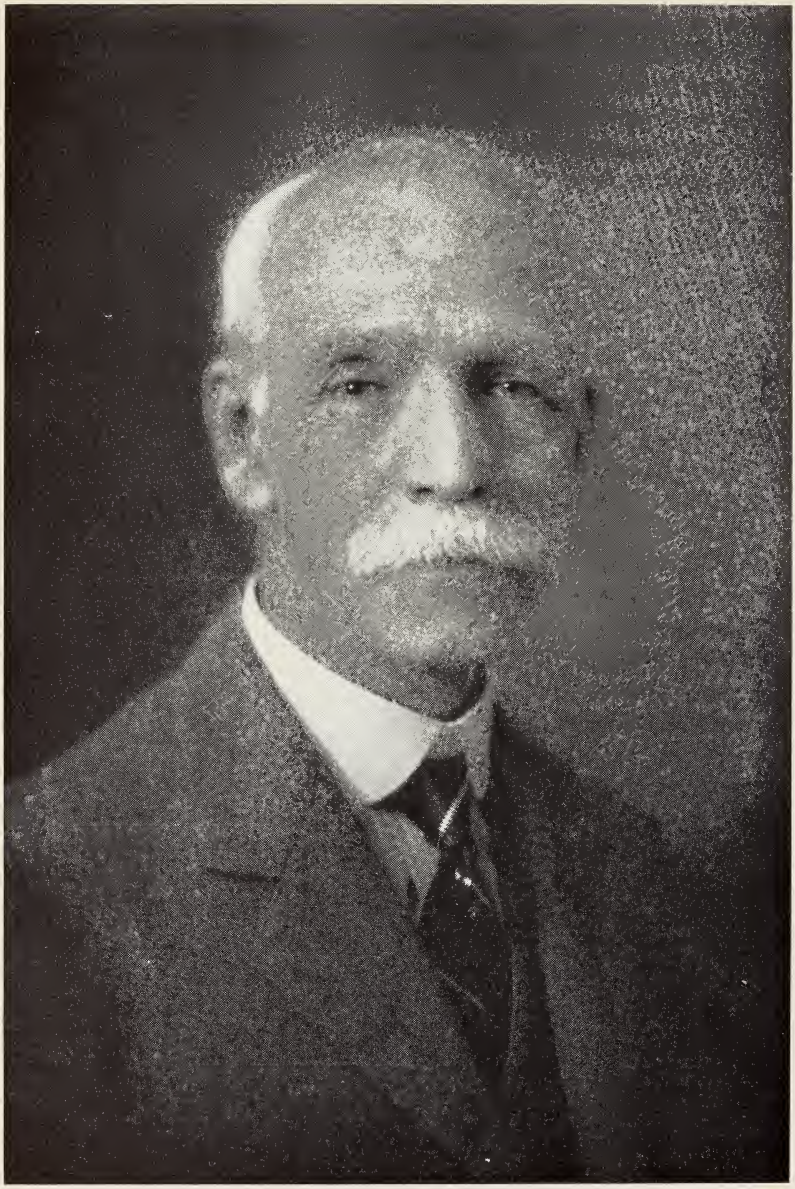

HENRY CLINTON FALL

PSYCHE

VOL. XLVII JUNE-SEPTEMBER, 1940 Nos. 2-3

HENRY CLINTON FALL (1862-1939)

Henry Clinton Fall was born December 25, 1862, at Farmington, New Hampshire. His father was Orin Tenney Fall, manufacturer, veteran of the Civil War, and member of the New Hampshire legislature. His mother was Mary Ann Hayes. Both were of good, old American stock.

Mr. Fall was educated in the public schools of Dover, New Hampshire, and at Dartmouth College, where he received the degree of B.S., at the head of his class, in 1884. Thereafter he taught physics and mathematics in Chicago, until, in 1889, his health became impaired. He went to California to recover and eventually resumed teaching there, first at Pomona and then at the Pasadena High school, where he taught physics and chemistry and was head of the science department for more than twenty years. He retired in 1917. After more than thirty years of notable work as a teacher, he returned to the East with his mother and made his home at Tyngsboro, Massachusetts with his sister, who had lately purchased the house in which his old friend and mentor, the coleopterist Frederick Blanchard, had lived. Mr. Fall continued his entomological work at Tyngsboro for more than twenty years. He died at home in the evening of November 14, 1939.

Mr. Fall had many interests. As a young man in college he excelled in baseball, and all his life he was keenly interested in baseball, tennis, and other athletic sports. He collected not only Coleoptera but Lepidoptera, stamps, postmarks, and old New England railway locomotive pictures. His valuable collection of these pictures is to be placed in the Railway and Locomotive Historical Society rooms in the Baker Library of the Harvard School of Business. But it was as a coleopterist that Mr. Fall made his scientific reputation.

His sister has mentioned an important incident in connection with his turning seriously to Coleoptera. It was at Wakefield, Massachusetts, in the summer of 1878, when he was fifteen years old. He was already interested in natural history, and needed only some special stimulus to start him along one line or another of scientific work. The stimulus was provided by the capture of a fine Cerambycid beetle, *Prionus pocularis,* on July 17. The specimen is preserved and labeled in the Fall Collection, of which it was the beginning.

Since July 17, 1878, the Fall Collection has grown to well over one hundred thousand specimens in the main series of North American beetles, plus nearly one hundred thousand more in the Charles Liebeck Collection, which came to Mr. Fall a few years ago, plus thousands of exotic beetles, Lepidoptera, and other insects. There are about a quarter of a million specimens in all. The collection contains between 14,000 and 15,000 distinct, identified species of beetles from America north of Mexico. It is likely that this is nearly 90% of the good, distinct species now known from the region, although nobody knows just how many species there really are. Mr. Fall described 1,484 of the species himself, practically all unquestionably good. The types of most of them are in his own collection. He kept them in four Schmitt boxes, crowded together for quick rescue in case of fire. His main North American series fills 292 additional Schmitts. Besides his own types, there are many co- and paratypes of other workers, and innumerable specimens which Mr. Fall compared with the types of Leconte, Horn, and Casey. Such specimens are carefully labeled, and there is an accurate system of cross references from the labels to Mr. Fall's notebooks, and to his working set of 59 bound volumes of papers on North American Coleoptera. The whole collection is beautifully prepared and arranged.

Mr. Fall has left his entire mounted insect collection, together with his correspondence, notebooks, and numbered volumes of technical papers, to the Museum of Comparative Zoölogy at Harvard College, Cambridge, Massachusetts. The arranged North America beetles are to be kept as a separate collection. The main series has already been installed in what has been the Leconte Room, now the Leconte-Fall Room. The collection will be kept as Mr. Fall left it, except that (as he wished) the types will be rearranged and, if practicable, put in the proper places in the main series, and some overflow material will be interpolated in additional boxes. The Leconte-Fall Room now contains an unexcelled collection of North American Coleoptera. In honor of Mr. Fall and in recognition of his work and of his collection a new department has been established in the Museum of Comparative Zoölogy, to be presided over by a Fall Curator of Coleoptera. The present writer has the privilege of being the first to bear this title.

The first paper published with the signature "H. C. Fall" appeared in *Entomological News* for September, 1893; the last, in the *Pan-Pacific Entomologist* for October, 1937. A complete bibliography is given below. There are 144 titles in all.

Mr. Fall's contributions to science include not only his splendid collection and his careful and extensive published work, but the influence which he had to the very last on coleopterists throughout the country. He was a friend and correspondent of practically every coleopterist from George Horn to graduate students of 1939. Frederick Blanchard and E. A. Schwarz were his first and closest entomological friends. It was a fortunate meeting with Mr. Fall that led Dr. Adalbert Fenyes to settle in California and to work on North American beetles. Charles Liebeck and John D. Sherman, Jr. are surviving friends of long association, and there are many others. The Sherman Dytiscidae formed the basis of much of Mr. Fall's work on water beetles, and Mr. Sherman has published a brief, intimate sketch of Mr. Fall's life in the *Journal of the New York Entomological Society* for March, 1940 (Vol. 48, pages 33-36). Mr. Liebeck retired from activity as a coleopterist on August 7, 1934, and, with generous appreciation of Mr. Fall's qualifications, he gave to Mr. Fall his large and beautiful collection. But perhaps even more important than his friendship with these and other well known coleopterists was Mr. Fall's tirelessness in encouraging and helping younger men, of whom the writer is one. His correspondence and identification work were enormous, and he kept them up quite literally to the last day of his life.

Among the traits which qualified Mr. Fall for his work was his excellent memory. It is stated on good authority that he knew the old Henshaw List of 11,000 numbered names so well that, with no conscious memorizing, he was able to give from memory the serial number of practically every species on the list, and the name which went with practically every number.

All in all, Mr. Fall knew the whole of the Coleoptera of America north of Mexico as few persons have known them, and as few will ever know them in this age of increasing specialization. His knowledge and his work entitle him to stand in the direct line of succession of First Coleopterists of America: Leconte, Horn, and Fall.

Of course, his worth did not go unrecognized. He was a fellow of the American Association for the Advancement of Science (1927) and a fellow of the American Academy of Arts and Sciences (1930). He was one of the sixteen United States entomologists made members of the Permanent Committee of the International Congress of Entomology at its first meeting, at Brussels, in 1910. He was one of the founders of the Pacific Coast Entomological Society, temporary president at its first meeting, and later vice-president. And he belonged to several other entomological societies. In 1929 he received the honorary degree of Doctor of Science from Dartmouth College. The degree was richly deserved, but at the same time was quite unnecessary to enhance his reputation. He was already known and respected throughout the entomological world as "Mr. Fall", and it is by that familiar name that I have called him here. Under that name he earned the titles given him by various persons since his death: "beloved teacher", "friend", and "our most eminent worker on North American Coleoptera".

Philip J. Darlington, Jr.

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HILARA GRANDITARSIS, A BALLOON-MAKER

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On July 31, 1935, while driving through the open forest near Moraine Lake, Alberta, I noticed some flies dancing a dozen feet above the ground in groups of four to eight among the spruce trees. The distinctive feature of this aerial dance was the white burden carried by some of the flies, which mysteriously glistened in the sunshine. Although the insects were flying out of reach of the net, now and then one would descend and in a short time some two dozen specimens were captured, all of them males. The species proves to be *Hilara granditarsis,* described by C. H. Curran in the Canadian Entomologist, 1926, page 248, from six specimens taken by Eric Hearle near Banff, Alberta, and recorded also as "swarming under trees". This habit of swarming in and out high up between the trees is rather unusual for Hilara, the numerous species of which are most commonly encountered dancing close to water.

The glistening oval bit of frothy matter carried by the flies is conspicuous in contrast with the blackish bodies of the insects hovering with it, and in bulk is even larger than the flies. When caught, the flies dropped the balloon, which is extremely delicate. On drying, the web collapsed and shrunk almost to nothing, and when put into alcohol quickly disintegrated.

In Europe, *Hilara sartor* has similar habits, which have been witnessed and commented upon by many entomologists. This species likewise is found in coniferous forests in the higher altitudes, the males fashioning a white frothy web which they carry in the aerial dance to attract the females.

There are some half-dozen other European species of Hilara which are known to build rudimentary webs around the small Diptera which they catch and carry for the nuptial dance, and it has been suggested that probably most species of the genus have the ability to produce viscous bubbles while they are engaged in quieting their prey by jabs with the sharp proboscis. This propensity has been elaborated into an instinctive courtship adaptation in *Hilara sartor.*

Professor Aldrich and his student, L. A. Turley, in 1889 recorded the balloon-making habit of the males of a species of Empis, which later I described as *Empis aerobatica.* In company with Professor Aldrich on Moscow Mountain, Idaho, I have watched the behavior of this species, and again on May 10, 1925, near the junction of the Salmon and Snake rivers in Idaho, I found a considerable gathering of the flies performing their balloon-juggling act some fifteen feet above ground.

The Empididæ are typically rapacious, predatory flies, and especially at the mating season are to be found malaxating their victims with repeated thrusts of the proboscis. Poulton and Hamm have suggested an evolutionary sequence in the development of this habit, possibly somewhat as follows:

1. The prey is devoured by both sexes independently of pairing.

2. The prey, caught by the male, is given to the female upon mating, as food to divert her attention from any cannibalistic tendency while she is astride him.

3. The prey is enveloped by the male in a froth secreted by the proboscis so that it becomes more enticing to the female. The prey need not be sucked by the female but acts as an aphrodisiac.

4. A web or balloon is formed of froth alone as the indispensible stimulus to copulation.

Hilara sartor in Europe and *Hilara granditarsis* in America represent the culminating stage in this sequence, probably independently developed, while *Empis aerobatica* has advanced the third stage until the frothy balloon is vastly larger than the microdipteron that formed its nucleus and even bigger than the Empis itself.

A NEW SPECIES OF HALIPLUS

By Edith W. Mank

Lawrence, Mass.

Some beetles, collected in July 1939 in Churchill, Manitoba by Mr. Albert L. Wilk, came into the hands of Dr. H. C. Fall and were mounted just before his death. He had examined them and noted among them two possible new species, one a *Hydroporus* and the other a *Haliplus*. He mentioned to me particularly the *Haliplus*. This, I herewith wish to describe and name for him in recognition of his unfailing inspiration and help.

Both Dr. P. J. Darlington, Jr. and Mr. J. B. Wallis have most generously given their time and assistance in preparing this description.

Haliplus falli n.sp.

Holotype ♀: Length 2.79 mm. Width 1.44 mm. In general form narrower and more parallel than *longulus* to which this species runs in the key to the Haliplids by Mr. Wallis.

Head: Brownish yellow with posterior part dusky; mouth parts and antennæ the same color as the front. Surface alutaceous, making it duller than in such species as *longulus*. A punctate triangular area with base of triangle anterior, between the antennæ; also punctured areas in crescent shape around the eyes; also on posterior darkened part of the head. Smooth area, shiny not alutaceous, between the clypeus which is punctured, and the punctured area on the front. Width between the eyes half the entire width of the head. Head wider, as compared with the base of the pronotum, than in *longulus*.

Pronotum: More yellowish than the head, with basal area dark. The dark area widest between the fairly long, deep, longitudinal plicae. Also darkened medially on the anterior edge. Surface very finely alutaceous. Lateral margin narrow. In the holotype and in all but one of the specimens examined, this margin is continuous with the edge of the elytra. In one ♂ the base of the pronotum is slightly wider than the base of the elytra. Relatively few rather large punctures in the widest part of the dark area at the base between the plicae; disc and lateral areas with a few shallow, scattered punctures. Disc more flattened than in *longulus*. Pronotum narrowed toward the apex but less so than in *longulus*, making the apex greater in width compared with the base than in *longulus*. The apex of the pronotum is also slightly wider than the widest part of the head.

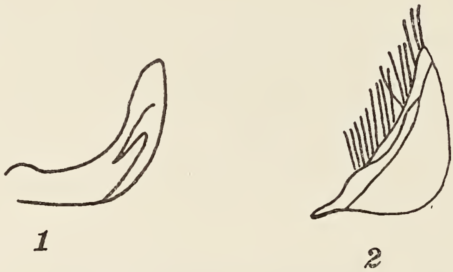

Fig. 1. *Haliplus falli* n. sp., ædeagus; Fig. 2, left paramere.

Elytra: Yellowish with black maculation consisting of a post medial sutural triangular blotch that reaches a point between the second and third striae; less definite dark markings in the form of darkened striae on the third and fourth striae posterior to the blotch; and also on the fifth and sixth striæ opposite the posterior part of the sutural blotch. Surface definitely alutaceous in the ♀. In the ♂ the surface is extremely minutely punctulate and alutaceous. Punctures forming striæ spaced well apart and on the whole about as deep as on the basal part of the pronotum. Apices of the elytra not sinuate. Body narrower than in *longulus* and more parallel, widest only a little in front of middle.

Prosternum: Prosternal process narrowest between the anterior part of the fore coxæ; sides margined; medial area not furrowed, slightly convex with relatively few large punctures; surface alutaceous.

Metasternum: Smooth at middle; margined with a very fine bead between the middle coxæ; on either side behind the middle coxæ, a group of more or less confluent large punctures, appearing at first glance to form a depression in the position of the furrows in *longulus.*

Abdomen: Ventral surface strongly alutaceous throughout.

Claws: Practically equal in length on the front tarsi.

Allotype ♂ : Post-medial sutural blotch somewhat larger than in the holotype. Also, as indicated above, surface of elytra extremely minutely punctulate and alutaceous. Front and middle tarsi with the usual pubescence on the underside of the first three tarsal segments. Claws of the anterior tarsi nearly equal, the anterior slightly shorter and more curved. Ventral surface of the abdomen alutaceous at sides except for the last segment which is alutaceous throughout.

The genitalia are as shown. The left paramere with hairs rather sparsely placed along nearly the entire length of the side. The ædeagus evenly curved, not narrowed apically as in *longulus.*

The ♀ holotype is in the Fall collection at the Museum of Comparative Zoology at Cambridge as well as one ♀ and one ♂ paratype. The ♂ allotype is in the collection of Mr. J. B. Wallis while three paratypes, two ♀ and one ♂ are in the author's collection.

Of the *Haliplidæ* with basal pronotal plicæ, this new species most closely resembles *H. longulus.* It is like *longulus* in the length of the plicæ, in the width of the side margins of the pronotum, in the fact that usually the edge of the pronotum is continuous with that of the elytra, and in the lack of a channel on the prosternal process.

It differs from *longulus,* in that the head is wider, the apex of the pronotum is wider compared with the base of the pronotum, the body is more narrow and parallel, the surface of the elytra is definitely alutaceous in the ♀ and extremely minutely punctulate and alutaceous in the ♂ and therefore not shiny, the metasternum has a fine marginal bead between the middle coxæ, and the claws of the front tarsi of the ♂ are less differentiate than in *longulus.*

All specimens examined were from Churchill, Manitoba.

NOTES ON *EPEIRA PENTAGONA* HENTZ.

By Elizabeth B. Bryant and Allan F. Archer.

Among the spiders described by Hentz from 1842 to 1850 are several that have never been recognized by later collectors. One of these is *Epeira ? pentagona.* This species, which the junior author has found rather common in the last summer in Alabama, proves to be identical with *Cyrtophora tuberculata* Keyserling [1] (1893) from Florida. The latter was wrongly placed generically and now becomes a synonym of *pentagona.* Related species recorded from the West Indies, Venezuela and Central America by Simon and O. P. Cambridge have been referred with *tuberculata* to the genus *Dolichognatha* Cambridge, the genotype of which is from Ceylon. According to Simon[2], this latter species spins a web in the form of a horizontal sheet, under which the spider stands in a manner similar to that of *Linyphia.* Since *pentagona* differs from the Ceylonese genotype in the form of web, as well as in several important structural characters, the following genus is erected for it here.

Nicholasia Gen. nov.

Cephalothorax short, cephalic portion very high; eyes, anterior row weakly recurved, eyes equidistant, a.m.e. largest of the eight, posterior row straight, p.m.e. smallest of the eight, touching and widely separated from p.l.e., lateral eyes on separate tubercles separated by a diameter of p.l.e.; mandibles two-thirds as long as cephalothorax in both sexes, no boss, narrow, slightly excavate on inner margin and the tips slightly widened, inferior margin of the fang groove with two teeth; labium much wider than long with tip truncate; abdomen short, very high at base,

[1] Die Spinnen Amerikas, 4, Epeiridae, p. 265, pl. 14, fig. 197.

[2] Histoire Naturelle des Araignées, 1894, 1, p. 743.

globose with two pairs of widely separated tubercles; in male on anterior femora a ventral basal median row of short spines.

Genotype: *Epeira ? pentagona* Hentz.

The genus is named in honor of Nicholas Marcellus Hentz, the founder of American araneology. *Nicholasia* is separated from *Dolichognatha* O. P. Cambridge by the very broad truncate tip of the labium, fewer teeth on the inferior margin of the mandibles and by the male palpus which has a dorsal apophysis on the basal third of the cymbium and a much simpler palpus. *Dolichognatha tigrina* Simon from Venezuela and St. Vincent probably belongs to this genus since it has a dorsal apophysis on the cymbium and a very similar palpus.

Nicholasia pentagona (Hentz)

Figure 1

Epeira ? pentagona Hentz, Journ. Boston Soc. Nat. Hist., 1850, 6, p. 18, pl. 3, fig. 1; reprint, p. 120, pl. 14, fig. 1. ♀

Cyrtophora tuberculata Keyserling, Die Spinnen Amerikas, 1893, 4, Epeiridæ, p. 265, pl. 14, fig. 197. ♀.

Female. Length, 3.0 mm., ceph. 1.5 mm., abd. 2.0 mm. long, 2.1 mm. high.

Cephalothorax pale yellow, cephalic portion dark, posterior lateral margins with a narrow dark line, cephalic portion very high, strongly arched, narrow, lateral margins parallel, no thoracic groove; eyes, anterior row weakly recurved, eyes equidistant, separated by more than a radius of a.m.e., a.m.e. largest of the eight, posterior row slightly shorter than anterior, straight, p.m.e. smallest of the eight, touching, p.l.e. slightly smaller than a.l.e., lateral eyes on separate tubercles, not connected and eyes separated by a diameter of p.l.e.; clypeus less than a diameter of a.m.e.; quadrangle of median eyes wider in front and higher than wide; mandibles brown, vertical, very long and narrow, two-thirds as long as cephalothorax, no boss, tips slightly divergent, inner margin near tip excavate, with a few hairs on front surface, fang groove slightly oblique, inferior margin with two teeth; labium much wider than long, tip truncate, rebordered; maxillæ more than twice as long as labium, slightly divergent, tips widened; sternum triangular, pale, mottled with dark gray; abdomen dark, very high at base, short and blobose with two pairs of widely separated conical angles, slightly chitinized, first pair fully two-thirds from base, venter dark with a few pale spots; legs, 1-2-4-3, anterior pairs longest, dark with pale rings at base and middle of tibiæ, posterior pairs with femora pale except for a dark ring at tip, spines slender and inconspicuous, I pair, femur, dorsal, 1 median, 3 prolateral, ventral, O, patella, 1 at tip, tibia, dorsal, 2, basal and median, prolateral, 2, retrolateral, 2, ventral, O, metatarsus, ventral, 1 prolateral at base, II pair, femur, O, patella, O, tibia, dorsal, 1 median, retrolateral, 2, ventral, O; epigynum a transverse elongate oval, fully three times as

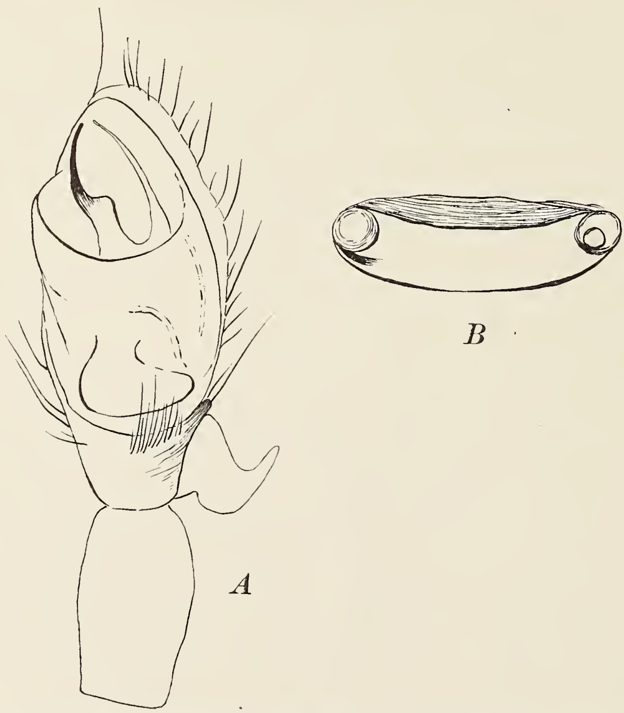

Fig. 1. *Nicholasia pentagona* (Hentz). *A*. Ventral view of left palpus (♂). *B*. Ventral view of epigynum (♀).

long as wide, margins heavily chitinized, with small dark dots in outer corners, area between convex and white.

Male. Length, 2.4 mm., ceph. 1.5 mm., abd., 1.2 mm.

Coloring same as in female, cephalic portion higher; eyes same as in female; mandibles longer and narrower, slightly excavate on inner margin and tips more divergent, front surface granular, no boss, fang groove oblique, one large blunt tooth probably on inner margin near median edge; labium, maxillæ and sternum same as in female; abdomen pale with dark gray blotches, short, globose with two pairs of widely separated conical angles more pronounced than in female and the tips plainly corneous; legs paler than in female and the pale rings wider, spines longer and more conspicuous, I coxa not modified, anterior femora with a ventral median row at base of 4 or 5 small, short, stout spines, each from a raised base; palpus pale, short and rather small, little longer than mandibles, a large dorsal lobe, semi-transparent, protruding from base of cymbium with prolateral margin rolled and ending in a hook, tibia longer than patella, cymbium dark, three times as long as wide, embolus and conductor confined to distal third, conductor black, curved and enlarged near origin, embolus colorless, straight and slender, placed between conductor and cymbium, basal third of bulb constricted.

The Hentz collection of spiders has disappeared and nothing remains but a few pins and labels.

Neoholotype ♀ Alabama; Tuscaloosa, 5 August 1939, (Archer).

Allotype ♂ Alabama; Tuscaloosa, 5 August 1939, (Archer).

The web of *Nicholasia pentagona* is difficult to observe in minute detail because of the poorly lighted locations in which it is found. It is a small web, barely 1½ inches in greatest diameter, and it is rather delicate. It is a horizontal orb-web, usually having four foundation lines and four radiating lines extending from a weakly defined hub. There are a varying number of spirals, usually less than a dozen. One foundation line connects terminally or centrally with a horizontal line outside of the web. The horizontal line extends between two walls of the shelter. From it hang two threads which become fused into a single thread, and from the thread hangs a silk-covered cord into which is incorporated the egg sacs. The cord is covered with debris consisting of fragments of bark, stems and leaves, as well as sand, humus, and small fæces. Occasionally the corpse of a victim is included in the mass. The male makes a cord that is an amorphous mass of debris. Its web is similar to that of the female, and is often located near that of the latter.

The spider ordinarily takes its station at the lower end of the cord, and is almost completely invisible against its background. When disturbed it draws the loose end of the cord together in a U-shaped loop, but seldom abandons it unless the cord is removed from place. Only once was the spider seen under the hub of the web, probably attracted there by its prey. Its food evidently consists of small Hemiptera and Diptera.

Seasonal records show that the females are adult from June to November. The males have been found only during the period extending from late July to early October. Spiderlings seem to appear in October.

Habitats: This spider is apparently confined to forest cover. Its habitats are largely limited areas within the vicinity of streams, both permanent and intermittent, near bodies of water, and in some cases in swamps that are not subject to high water. Its ecological situations are as follows: Steep slopes of narrow valleys and ravines; very shallow ravines having a negligible slope; bluffs of large creeks; generally distributed in woods having gradual or gentle slopes. It does not prosper in areas frequently burned over. It occurs in the following types of timber cover: Mixed mesophytic hardwoods; evergreen-deciduous hardwoods; oak-hickory; oak-pine on slopes; gum swamps; hammock woods, especially the type located on the summits of low bluffs above the Mobile Delta.

Nicholasia pentagona prefers no special species of tree, providing adequate shelter is present. Its habitat stations are as follows: webs located in scars at bases of trees (gums, magnolias, at least nine species of oaks, tulip poplar, sweetgum, pines); between the roots of beech trees; in hollows along the sides and at the ends of all sorts of rotting logs (*Passalus cornutus* stage); in undercuts of sandstone and conglomerate ledges; in undercuts of eroding stream banks. In one instance it was found on a low bank formed by transported silt collected at the base of an old wire fence in second-growth woods on a gradual slope (Andalusia, Ala.). Often associated with this spider are species of *Theridion* and sometimes *Theridiosoma radiosa* McCook.

Distribution

This spider occurs widely in Alabama having been taken near the four corner of the state. It seems to be confined to no special climatic complex or physiographic province, for it has been found in the Coastal Plain, Piedmont, and Appalachian Plateaus.

In the following records of distribution, unless otherwise indicated, specimens are females except where noted. All dates are recorded for 1939.

Baldwin Co.; Jackson Oak, Aug. 31; Bay Minette, Aug. 28. Butler Co.; Searcy, Sept. 1. Chilton Co.; Verbena, Oct. Covington Co.; Andalusia; Red Level, Aug. 27. Dallas Co.; Valley Creek State Park. Escambia Co.; Brewton, Aug. 29. Hale Co.; Moundsville. Houston Co.; Chattahooche State Park, Oct. 15. Jefferson Co.; Morris, ♂, Sept. 7; Cooley Creek, ♂, Oct. 2. Lawrence Co.; Black Warrior National Forest, June 11-15. Lee Co.; Chewacla State Park; Opelika. Madison Co.; Monte Sano, ♂, Sept. 29. Morgan Co.; Trinity Mountain. Shelby Co.; Calera. Tuscaloosa Co.; Tuscaloosa, ♂, Aug. 5; Yellow Creek. Winston Co.; Black Warrior National Forest.

ON SOME CHILOPODS FROM BARRO COLORADO ISLAND

By Ralph V. Chamberlin

University of Utah.

The humus dwelling chilopods listed in the present paper constitute a collection made by Mr. Eliot C. Williams, Jr., of Northwestern University, on Barro Colorado Id., Panama, in July and August, 1938, with the exception of *Taeniolinum panamicum,* the representative of which was taken in the Changuinola District by F. R. Swift. The types of the new forms are in the author's collection.

Cryptopidæ

Newportia rogersi Pocock

Newportia rogersi Pocock, Biol. Centr. Amer. Chilopoda, 1896, p. 33, pl. 3, figs. 6-6d.

Newportia rogersi, Chamberlin, Proc. U. S. Nat. Mus., 1922, vol. 60, art. 7, p. 5.

Twelve partly grown specimens of this species were taken at different dates in August. It was previously reported from Costa Rica at Volcan de Irazu (type locality), Cocos and San José.

Scutigeridæ

Pselliodes sp.

One young specimen was taken Aug. 9. It is possibly *P. nigrovittata* (Meinert), for which Panama is the type locality.

Schendylidæ

Schendylurus (Schendylotyn) integer Chamberlin

Schendylurus (*Schendylotyn*) *integer* Chamberlin, Proc. Biol. Soc. Wash., 1926, vol. 39, p. 10.

One specimen was taken on Sept. 3. Barro Colorado Id. is the type locality for this species, the holotype, a male, having been taken from a nest of the termite *Anoplotermes gracilis* Snyder by James Zetek, 30 Oct., 1924.

BALLOPHILIDÆ

Assuming that the inadequately known genotype of *Tæniolinum* belongs to the Ballophilidæ, as seems reasonably certain, and that it is congeneric with the form hereafter described as *T. panamicus*, the known genera of this family may be separated by means of the following key.

Key to Genera of Ballophilidæ

a. Ventral pores condensed, in one or two sharply limited and usually more or less elevated areas.
  b. Ventral pores in a single, undivided field.
    c. Antennae clavate.
      d. Prehensors lacking chitinous lines............*Ballophilus* Cook
      dd. Chitinous lines present on prosternum of prehensors.
        e. Coxae of last legs with a single pore on each side; tergites bisulcate.....................*Tanophilus* Chamberlin
        ee. Pores of last coxae two on each side; tergites not bisulcate.
          f. Field of ventral pores transversely elliptic. *Thalthybius* Attems
          ff. Field of ventral pores strictly circular. *Ityphilus* Cook
    cc. Antennae short, distally attenuated.....*Leptynophilus*, gen. nov.
  bb. Ventral pores in two circular areas on each sternite. *Diplethmus* Cook
aa. Ventral pores diffuse, in an indistinctly limited band over caudal boarder; joints broader than long. Antennae short and thick. *Tæniolinum* Pocock

Diplethmus dux, sp. nov.

The general color of the body is olivaceous, the integument above being brown with dense green pigment showing through from beneath, the integument of sides and venter paler. Legs green.

Differs from *D. ribauti*, sp. nov., in the conspicuously broader head, in the constantly smaller number of pairs of legs (69 as against 77-79), etc. The head is more nearly of the proportions represented for the head of *D. mexicanus*

Cook, the genotype. Head conspicuously convexly bulging at the sides, with anterior margin angled at middle and posterior margin straight.

The antennæ more definitely clavate than in *mexicanus*, the distal half being considerably thicker than the filiform proximal half of the organ; distinctly geniculate.

Prehensors when closed nearly even with anterior margin of head; claws slender; prosternum with chitinous lines distinct, the anterior border deeply angularly excavated at middle.

Porigerous areas of ventral plates circular, one close to each lateral margin and caudad of middle of plate, this elevated porigerous area relatively smaller than in *ribauti*, but clearly larger than represented for *mexicanus* and very much closer to the caudal margin of plate.

Dorsal plates densely coarsely granular, not sulcate. Last dorsal plate covering pleuræ from above, elongate shield-shaped.

Last ventral plate somewhat longer than wide, narrowed caudad, a longitudinal median depression. Pores of coxopleuræ typical.

Last legs strongly crassate, but narrowing distally.

Pairs of legs 69 in the three type specimens.

Length of holotype, about 45 mm.

Locality.—Panama: Barro Colorado Id. Three specimens of which the holotype, a male, was taken July 13, 1938.

Diplethmus ribauti, sp. nov.

Diplethmus mexicanus Ribaut (not of Cook), Mem. Soc. Neuchatel, vol. 5, p. 90, figs. 26-37.

Diplethmus mexicanus Chamberlin (not of Cook), Occ. Papers Mus. of Zool., Univ. of Michigan, 1921, p. 17.

Prof. Ribaut, in the place above cited, has given a detailed and fully illustrated account of this species. Cook's description of *mexicanus*, embraced in a key, is confined to the following: "Ventral pores in two areas; antennæ subfiliform; Genus *Diplethmus*, type D. *mexicanus*, sp. n. (Pl. V, fig. 2), Mexico." The figures given are the only means of identification. The differences these show in size of the porigerous area, in the shape of the head, and in the more elongate last sternite, would seem to make it impossible longer to consider the Colombian specimens as belonging to *mexicanus* since the characters mentioned are constant. Accordingly, a new name is here proposed for the Colombian species described by Ribaut.

Localities.—Colombia: Camelia, near Angelopolis; San Lorenzo. A male taken at the latter place from a bromeliad on a tree at 5,000 ft. elevation July 22, 1913, may be designated as the holotype. It is in the Museum of Comparative Zoology at Cambridge. A second male was taken at the latter locality under a log at 2,000 ft. elevation on July 25, 1913.

Taeniolinum panamicum, sp. nov.

In general characters much resembling *T. setosum* Pocock of St. Vincent; but the similarly short antennæ are slightly clavate instead of distinctly narrowing distad. The head appears to be more rounded anteriorly. The anal legs are similarly very thick proximally, narrowed distad, the last joint conical. The ventral pores are relatively sparse and are arranged across posterior border of the sternites, the poriferous area not sharply defined. Last ventral plate of moderate width, about as represented for *T. setosum,* similarly narrowing caudad. Two large coxal pores on each anal coxa, these partly covered by the last plate.

Pairs of legs, 45.

Length, 11 mm.

Locality.—Panama: Changuinola District, Boc Taso. One male taken by F. R. Swift. The only other known species of the genus is the genotype, *T. setosum* Pocock, described from St. Vincent and not since reported.

Leptynophilus, gen. nov.

Among the known genera of Ballophilidæ agreeing with *Ballophilus* and differing from all others in lacking chitinous lines on the prosternum of the prehensors. It may readily be distinguished from *Ballophilus,* as also from all the other genera excepting *Tæniolinum,* in having the antennæ attenuated instead of more or less clavately thickened. Tergites not bisulcate. Ventral pores in a large transversely elliptic area. Coxal pores of last segment two on each side.

Genotype.—*L. mundus* Chamberlin, sp. nov.

Leptynophilus mundus, sp. nov.

The type as at present, after preservation in alcohol, is fulvous and shows no dark pigmentation in the deeper tissues except in connection with the ventral glands.

Head small, widest behind and narrowed forward, anteriorly rounded. Antennæ short, attenuated beyond middle; first 5 or 6 joints longest, those beyond very short, the ultimate about equal in length to the two preceding taken together; a little curved at middle but not truly geniculate.

Claws of prehensors when closed not attaining the front margin of the head by a considerable distance. Chitinous lines absent. Anterior margin of prosternum gently incurved. Claws smooth.

Body constricted a little back of head as usual. Dorsal plates not bisulcate, clothed with numerous but not dense short setæ. Last dorsal plate anteriorly broad, strongly narrowing caudad.

Spiracles round, small, very gradually decreasing in size from the first caudad.

Ventral plates conspicuously setose. The ventral pores in a sharply defined, large, transversely elliptic area behind middle of sternite.

Last ventral plate broader than long, strongly narrowed caudad. Coxal pores large, two on each side.

Anal legs much swollen as usual in related genera, the ultimate article small, conically pointed.

Pairs of legs, 51.

Length, 23mm.

Locality.—Panama: Barro Colorado Id.

Differs from *Tæniolinum setosum* in the longer, more slender antennæ, in the relatively broader and shorter last sternite, and in the larger size, the length of *T. setosum* being given as 13 mm.

Pachymerinidæ

Polycricus fossor, sp. nov.

Color, pale yellow throughout.

Spiracles circular, the first much larger than the second which is intermediate in size.

Cephalic plate longer than wide, of nearly uniform width between the oblique corners; caudal margin straight. Frontal suture not evident. Antennæ short, filiform, uniformly setose, the ultimate article equalling or a little exceeding the two preceding taken together. Two very small, pale clypeal areas each bearing a single seta. Median division of labrum bearing 5 stout teeth, the lateral pieces conspicuously pectinate. Lappets of first maxillæ long and conspicuous. Coxæ of second maxillæ widely joined at middle; no coxopleural sutures evident.

Claws of prehensors when closed considerably surpassing the end of the first antennal joint. Claw at base and femur at distal end with a minute denticle, the other articles unarmed. Prosternum without chitinous lines.

Ventral pores in a band across caudal border of sternites.

Last ventral plate narrow. Coxopleural pores small and numerous as usual.

Pairs of legs, 71.

Length, about 15 mm.

Locality.—Panama: Barro, Colorado. Aug. 6, 1938. One specimen.

Differs from *P. stolli* (Pocock) in having two clypeal areas instead of one, in number of pairs of legs, etc.

Chilenophilidæ

Barrophilus, gen. nov.

A genus apparently most closely related to the African *Polygonarea.* With this genus it agrees in the structure of the second maxillæ the coxæ of which are connected only by a narrow membranous isthmus and are produced into a conspicuous conical process at the distomesal corner, the coxopleural suture running also as in that genus. Clypeal area present, single. Median dentate division of labrum widely separating the pectinate lateral pieces. Last coxæ with peculiar setose lobes much as in *Polygonarea.* It differs from *Polygonarea* in lacking external lappets on the first maxillæ, and in lacking ventral pores on the sternites. Anal legs with terminal claw.

Genotype.—*B. isolatus,* sp. n.

Barrophilus isolatus, sp. n.

Yellow throughout, the head scarcely darker.

Cephalic plate longer than wide in the usual ratio and of the typical general shape, being widest at caudal level of frontal region from where strongly narrowing cephalad and moderately caudad to the oblique caudal corners; posterior margin straight. A true frontal suture not present. Last two articles of antennæ equalling or a little surpassing the two preceding taken together. A median clypeal area far forward at anterior end, this bearing four setæ; setæ elsewhere absent from clypeus. Labrum distinctly tripartite, the lateral pieces pectinate; the median piece dentate, about half as long as each lateral piece.

First maxillæ without external lappets; outer branch much exceeding the inner branch. Coxa of second maxillæ strongly produced at disto-mesal angle into a conspicuous conical process; coxæ separated at middle, there being a narrow, membranous and glabrous isthmus; coxopleural suture long, running ectad of each pore as in Suturodes; claw of palpus wholly smooth.

Basal plate widely overlapped by the cephalic. Claws of prehensors when closed nearly attaining the distal end of the second antennal article. Claw article at base and femuroid armed within with an acute, conical black tooth, the intermediate articles not armed. Prosternum without chitinous lines; anterior margin with median excision, unarmed.

Spiracles small, circular.

Anterior sternites with a median longitudinal sulcus; no ventral pores detected.

Last ventral plate very wide with the posterior corners strongly rounded.

Coxopleuræ of the last legs with three glands on each side opening along border of last sternite. Adjacent to posterior end of sternite on each side and in relation to caudal gland a ventrally projecting small setose lobe which is farther forward on the joint and apparently less strongly developed than in species of *Polygonarea*.

Anal pores conspicuous.

Anal legs ending in well developed claws.

Number of pairs of legs 41 in all three types.

Length, 15 mm.

Locality.—Panama: Barro Colorado Id., July 25 and 26 and Aug. 7, 1938, one specimen on each date.

Nabocodes, gen. nov.

Clypeal area single, far forward. Lateral pieces of labrum relatively short and broad, pectinate, widely separated by the median piece. Telopodite of first maxillæ biarticulate, without external lappets. Coxæ of second maxillæ only narrowly and weakly joined at middle; the pleurosternal line long, running ectad of the mesally open pore. Prehensors long, exposed from above; claw and femoral joints armed within; no chitinous lines developed. Ventral plate absent. Last dorsal plate normally broad. Last ventral plate broad. Coxal pores small, typically few along and beneath ventral plate. Anal pores present. Anal legs without claw.

Genotype.—*Nabocodes mimellus* Chamberlin, sp. n.

This genus differs from the African *Brachygonarea* in lacking lappets on the first maxillæ and in having the anal legs clawless. It differs from *Barrophilus* in lacking the processes from meso-anterior corners of the coxæ of the second maxillæ, in lacking claws on the anal legs, and in the character of the coxal pores.

Nabocodes mimellus Chamberlin, sp. nov.

Pale yellow, with head and prehensors of slight chestnut cast.

The head of shape and proportions similar to that of the preceding species, but with anterior corners more obliquely rounded.

Claws of prehensors when closed attaining distal end of second antennal article. Claw armed at base with an acute tooth longer than in *fossor* and the tooth of femur also larger than in the latter species.

Spiracles round, the first largest. Sternites with a longitudinal sulcus which is widest and deepest at middle.

Anal sternite broad, the sides convex; with posterior corners rounded and middle portion of caudal margin straight. Coxal pores small and few, along and beneath edge of sternite, absent laterally and above.

Anal pores distinct.

Pairs of legs, in female holotype, 49.

Length, about 17 mm.

Locality.—Panama: Barro Colorado Id.

RARE PONERINE GENERA IN PANAMA AND BRITISH GUIANA (HYM.: FORMICIDÆ)

By Neal A. Weber
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The genus *Probolomyrmex* was erected by Mayr in 1901 (*Ann. k. naturhist. Hofmus.* Wien, 16:2) for a specimen of a strange ponerine ant from South Africa which had the clypeus fused with the frontal carinæ and produced as a peculiar lobe over the mandibles. He described this as *P. filiformis.* No other specimens were known until the report by Santschi in 1914 (*Bull. Lab. Zool. Gen. Agrar.* Portici, 8:312) of a second specimen of the species from French Guinea. In 1923 Dr. Mann (*Psyche,* 30: 16-18, Fig. 2) described a third specimen, a deälate female from Bolivia, as a new species, *P. boliviensis,* which was "the first case in its subfamily of a South African and South American relationship." In 1928 Dr. Wheeler (*Psyche,* 35: 7-9, Fig. 1) described a third species (*P. dammermani*) from Java. Described below is a fourth species, *P. petiolatus,* based on a worker that I took on Barro Colorado Island, Panama Canal Zone which adds Central America to the distribution of this rare genus.

The genus *Discothyrea* is another example of a rare and odd genus of minute ponerine ants but with a more extensive distribution which has been recently summarized and the New World species have been keyed (Weber, 1939). *D. isthmica,* described below, is an additional species from Barro Colorado Island taken by Mr. E. C. Williams, Jr. Two species are now known from this remarkably rich island since I found another species (*D. humilis*) in the month preceding Mr. Williams' discovery. In no other country in the New World is more than one species known.

The genus *Sysphincta* includes a few species of sluggish and seldom seen ants found in the Mediterranean region and Japan; one species occurs in South America, two in the United States and *S. cavernicola* Borgmeier is found in Panama. Mr. E. C. Williams, Jr., collected in Panama a worker of this species which has been known only by the female.

Alfaria so far is a strictly Neotropical genus of ponerine ants. Five species have been described from Colombia, Bolivia, Panama, Mexico and Costa Rica. Two new species are described below, one (*A. panamensis*) taken by Mr. E. C. Williams, Jr., on Barro Colorado Island and one (*A. carinata*) taken by myself in 1935 in British Guiana. The first biological notes on the genus, though very brief, were made on the Guiana species and are included below.

All specimens are in the author's collection.

Probolomyrmex petiolatus, sp. nov. (Fig. 1)

Worker. Length 1.6 mm. (thorax 0.61 mm.). Head in front view 1.4 times as long as broad, mandibles completely hidden from above, sides of head evenly convex, occipital margin feebly concave with angles evenly rounded; the

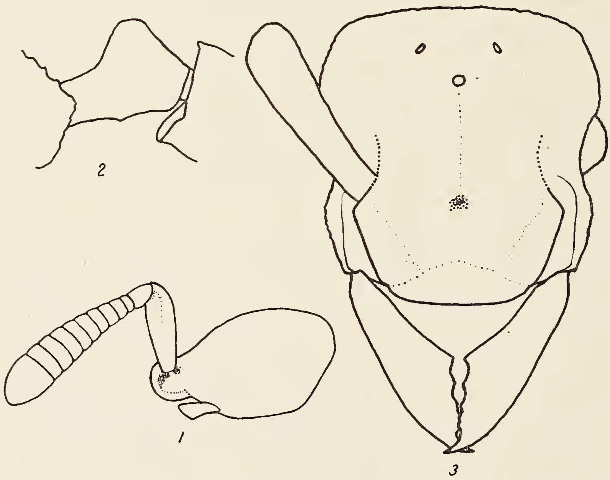

Fig. 1. *Probolomrymex petiolatus* sp. nov., head of worker in lateral view.

Fig. 2. *Sysphincta cavernicola* Borgm., petiole of worker in lateral view.

Fig. 3. *Alfaria carinata* sp. nov., head of female in frontal view.

maximum breadth of head is slightly posterior to middle; eyeless; in side view the antennal insertions are above the mandibles; antennal scapes curved, separated at their bases by a low lamina 0.27 mm. long, joints 2-10 of the funiculus strongly transverse, terminal joint conic, nearly as long as the preceding four joints taken together; mandibles very small, strongly curved, apical tooth much the longest and acute with a series of about six irregular, acute denticles on the cutting surface. Thorax in profile with pronotum convex anteriorly, with the entire dorsum of thorax plane and without trace of sutures, posterior epinotal border forming a distinct angle with the dorsum and on the declivity produced as a distinct but rounded obtuse angle. Thorax from above broadest at pronotum, with a short collar, pronotum rounded anteriorly and sides feebly impressed in meso-epinotal region. Petiole with a short anterior peduncle, high node and much longer and sub-cylindrical posterior peduncle, from above rectangular, 1¾ times longer than broad; the node convex anteriorly and feebly excavated behind; ventral lamina in side view well-developed, the anterior margin convex, the ventral margin plane and forming with the oblique posterior margin a slight hook. Anterior margin of first gastric segment impressed at petiolar junction, feebly convex dorsally, more sharply impressed but shorter ventrally; second gastric segment much longer than the first; remaining segments largely retracted; sting long and exserted. Legs moderately long and slender.

Sub-lucid, finely, evenly and shallowly punctate, the punctations partly large, partly small.

Pubescence a very fine, whitish appressed pubescence. Color an even ferruginous of moderate density.

Holotype: One worker taken by myself June 29, 1938 on Barro Colorado Island, Panama Canal Zone. The ant was among leaves and humus on the forest floor.

This species, first to be found in Central America, is easily distinguished from the single other New World species, *P. boliviensis* Mann of Bolivia, by the convex anterior margin of the head which is also broader, the greater number of teeth on the mandibles, the much more abruptly rising node of the petiole and its less excavated posterior surface, as well as the distinct peduncle behind. Though *boliviensis* is known only from the unique female the characters given above are probably common to both female and worker castes. The *boliviensis* female measured 2.8 mm. which may be longer than the unknown female of the Panamanian species. This species also differs from the two Old World species, *P. filiformis* Mayr of West and South Africa and *P. dammermani* Wheeler of Java, in having the petiole pedunculate behind. *P. filiformis* is much larger (3 mm.), has a much more massive node, longer antennal joints, etc. *P. dammermani* has a much more angulate epinotum and lacks a distinct petiolar node.

Discothyrea isthmica, sp. nov.

Female (*Deälate*). Length 1.2 mm. (of thorax 0.57 mm.) Head, excluding mandibles, about 1 1/6 times as long as broad back of eyes, evenly rounded behind, anterior margin produced as a convex lobe, slightly emarginate medially, which covers the mandibular bases, eyes large, convex, situated a distance of about one-half their diameters from the mandibular insertions, the three ocelli large and prominent; lamina between the antennal insertions large, rectangular with rounded angles, the anterior margin very slightly produced; antennæ 9-jointed, antennal scapes, bent, clavate, extending to a level with the posterior margin of the eyes and distinctly not reaching a level with the anterior ocellus; funicular joints 2-7 transverse, gradually increasing in length distally, terminal joint ovate, as long as all preceding joints; mandibles trigonal, strongly convex, edentate except for a long, acute apical tooth, the cutting surface concave. Pronotum produced anteriorly as a slight collar, inferior humeral angles obtuse, thorax evenly rounded at margins, epinotal angles marked as distinct, rounded tubercles. Node of petiole in side view an acute angle rounded apically, from above nearly twice as broad as long with feebly concave anterior margin and feebly convex lateral margins, petiole ventrally with a lamina projecting anteriorly between the hind coxæ and with a rounded, obtuse angle posteriorly. First gastric segment in side view with gently convex dorsum, anterior margin straight and forming an acute angle with the dorsum and an obtuse angle with the straight ventrum; second gastric segment more massive than first; terminal segments retracted, directed forward and downward; sting fine, exserted. Legs of moderate proportions, slender.

Integument opaque, even, covered with fine punctations between which are microscopic punctulations; punctations much shallower on the sub-lucid gaster.

Pilosity of a fine, whitish appressed pubescence. Color light reddish-brown.

Holotype: one dealate female taken July 25, 1938 by Mr. E. C. Williams, Jr., on Barro Colorado Island, Panama Canal Zone (No. 139 (447)).

This species runs to couplet 2 (*D. horni*) in my recent key (Weber, 1939) to the neotropical members of the genus. It is separated from *horni* by the distinctly tuberculate epinotum and in having the node not sharply angulate above. The other 9-jointed neotropical species, *D. testacea,* is much larger. It is interesting that this species should occur on the same island of six square miles as *D. humilis* which I found in the previous month. Aside from having 9- instead of 7-jointed antennæ this species is appreciably more massive, has a differently shaped petiole and is distinctly darker.

Sysphincta cavernicola Borgmeier (Fig. 2)

Worker (*Undescribed*). Length 2.4 mm. (thorax 0.78 mm.). Head in front view (excluding mandibles) less than one-tenth longer than wide, occipital border faintly emarginate medially, sides convex, anterior clypeal margin produced as a small pair of lobes with a minute tooth between; eyes very small, seemingly of one facet, situated in front of middle; insertions of antennal scapes projecting in front of frontal carinæ to anterior margin of clypeus, frontal carinæ small and short, almost vertical, fused together into a lobe over half as thick as high; antennal scapes short, stout and curved, extending barely a third their length beyond the eye level; funicular joints 2-10 strongly transverse, terminal joint slightly longer than the preceding four taken together; mandibles trigonal with four coarse teeth of which the apical is distinctly the largest. Thorax in profile without trace of sutures, the pronotum forming an evenly rounded right angle, the epinotum descending in an even convexity without teeth or tubercles; from above the thorax is seven-tenths longer than wide, being widest at the pronotum. Petiole distinctly pedunculate, the node in profile rounded-conic and from above transversely elliptical, being slightly wider than long, ventral surface of petiole with a feeble angular lamina medially, first gastric segment higher and broader than long, the anterior margin truncate, the sides convex, second segment longer than high, remaining gastric segments directed anteriorly. Legs of moderate proportions.

Sculpturing largely hidden by pilosity so that the ant seems dull except under intense light and moderately high magnification. Head, thorax, petiole and first gastric segment densely and deeply punctate. Pronotum, petiole and first gastric segment slightly punctate-vermiculate. Epinotal declivity on either side with a row of tiny tubercles. Second gastric segment sub-lucid, nearly smooth. Mandibles coarsely striate.

Pilosity of abundant short, fine, yellowish hairs, partly upright, mostly reclinate.

Dull brownish-red.

Allotype (Ergatotype): One worker taken by Mr. E. C. Williams, Jr., July 31, 1938 (No. 1410) on Barro Colorado Island, Panama Canal Zone. This worker agrees well with Borgmeier's recent (1937) description of a winged female from the Chilibrillo Caves in Panama except for the usual sexual differences. The female is 3 mm. long, has much larger eyes and the clypeal lamina is seemingly more projecting.

This species differs from the South American *S. micrommata,* according to Roger's original description, in smaller size, appendages being concolorous with the body, much denser pilosity, and in coarser sculpturing. It differs markedly from *S. pergandei* Emery of the United States especially in having the petiole clearly pedunculate.

Alfaria panamensis, sp. nov.

Female (*Deälate*). Length 3.2 mm. (thorax, including collar, 1.34 mm.) Head, excluding mandibles, distinctly longer than broad, broadest back of eyes, occipital margin straight or faintly concave, occipital corners rounded, head in side view with the posterior ventral angle of occiput produced as a distinct carinate lobe on each side of a short thoracic neck; anterior clypeal margin truncate, eyes moderately large, convex; frontal lobes large and convex, feebly angulate behind, extending to anterior clypeal margin when viewed from in front, and to a level posteriorly with the anterior one-fifth of the eyes; between the lobes is a deep, roughly circular impression; antennal scrobes laterally with a low but acute carina; antennal scapes slightly surpassing occipital margin, terminal funicular joint slightly longer than the preceding three taken together; mandibles coarsely striate, with six or seven acute teeth and a long, acute apical tooth. Thorax in profile flat, with evenly convex anterior pronotal margin descending to a sharply delimited collar mostly hidden by the posterior occipital tubercles; inferior humeral angles acute but rounded apically; epinotal declivity faintly concave, interrupted above the middle by a large, protuberant spiracle on each side. Petiole in side view convex above, concave below, distinctly higher than long, from above a little longer than broad with posterior margin convex. First gastric segment from above broader than long; second segment much larger, with remaining segments directed anteriorly. Legs of moderate proportions.

Opaque, body coarsely sculptured, head reticulate—vermiculate with depressions finely punctate, thorax irregularly vermiculate with the vermiculations above tending to run longitudinally; petiole coarsely reticulate, finely punctate in impressions, gaster reticulate, the reticulations becoming feeble posteriorly; appendages finely punctate, tibiæ finely striate.

Pilosity of moderately abundant, upright yellowish hairs. Dark, reddish-brown, appendages paler.

Worker. Length 2.8 mm. (thorax, including a slight collar, 1.2 mm.). Similar to the female with the usual sexual differences. The mandibles are as completely, though less coarsely, striate, the antennal scapes surpass the occiput. The thorax is without trace of sutures dorsally and the epinotal declivity bears two protuberant spiracles much higher than in *A. simulans*. The petiole is convex above, concave below with an anteriorly projecting ventral tubercle; from above the petiole is longer than broad while the first gastric segment is broader than long. The sting is massive and protuberant. Sculpturing similar except for a greater tendency towards longitudinal vermiculations instead of reticulations. Color a darker brown without a reddish cast except on the appendages.

Described from one deälate female and one worker, taken August 4 (No. 534) and July 29 (No. 358) 1938, respectively, on Barro Colorado Island, Panama Canal Zone by Mr. E. C. Williams, Jr.

This species appears close to *A. mus* Santschi also from Panama but comparing with Santschi's original description the following differences are marked: the groove extending back from the impression between the frontal lobes is entirely lacking in *panamensis,* the scapes surpass the occiput, the mandibles are entirely striate except on the cutting margin instead of striate only at the base, the petiole is distinctly longer than broad instead of as broad as long, the postpetiole is distinctly broader than long and the size is smaller. It is much smaller than *A. bufonis* Mann of Mexico and lacks a meso-epinotal impression. Both *simulans* Emery of Costa Rica and *emeryi* Forel of Colombia have the occiput concave and *simulans* has also a clypeus convex in profile, the mandibles more massive, the epinotal spiracles lower and less protuberant, the petiole dorso-posteriorly not produced, the eyes smaller; *simulans* is also much larger. *A. minuta* Emery of Bolivia is larger, has shorter antennal scapes, and the frontal impression is not noted in the original description.

Alfaria carinata, sp. nov. (Fig. 3)

Female (*Deälate*). Length 3.5 mm. (thorax, including a short collar, 1.4 mm.). Head, excluding mandibles, in front view broadest back of eyes, slightly longer than broad; occipital margin straight, corners slightly rounded, ventral angles produced as distinct carinate lobes on each side of the thoracic neck; anterior clypeal margin truncate; antennal scrobes in the form of a smooth, broad impression which is delimited laterally by a distinct, acute carina that curves medially in front of eyes; frontal lobes extending to the anterior clypeal margin in front view, with sinuate lateral margin which is obtusely angulate posteriorly and extends to a level with the anterior margin of the eyes; between the lobes is a distinct circular impression somewhat divided by a continuation of a median carina; antennal scapes stout, distinctly exceeding occipital margin, terminal funicular joint longer than the three preceding joints taken together but shorter than the preceding four; mandibles finely and completely striate, with a long, acute apical tooth and a cutting edge bearing 3-7 irregular feeble denticles of which only the basal tooth is constantly developed. Thorax with a short, reflexed collar from which the pronotum rises as an even convexity to the plane thoracic dorsum when viewed laterally; inferior humeral angle in the form of an acute tooth; epinotal declivity rounded with a large spiracle on each side only feebly projecting. Petiole longer than high, with evenly convex dorsum and concave ventrum terminating anteriorly as a distinct, rounded tooth, from above squarish with feebly convex posterior margin and sides and as broad as long. First gastric segment from above appreciably broader than long, sides convex, anterior and posterior margins truncate, antero-ventrally produced as a large lobe; second gastric segment longer than the first and much more massive; remaining segments capable of being entirely retracted except for a massive sting. Legs of moderate length and slender.

Opaque, coarsely sculptured; head vermiculate with a tendency of the sculpturing to become reticulate on the occipital region and back of eyes; pronotum reticulate, thorax above longitudinally vermiculate, petiole and gaster reticulate—vermiculate, becoming feebler on the second gastric segment; legs finely punctate, tibiæ lucid, finely striate.

Pilosity of moderately abundant, upright yellowish hairs.

Color dull reddish-brown, appendages lighter and richer in color.

Described from two deälate females which I took August 20, 1935 back of the Forest Settlement, Mazaruni River, British Guiana.

This species differs from *A. simulans, bufonis* and *emeryi* in having the occipital margin straight and not concave, from *minuta* in having longer antennal scapes, and from *mus* in having the mandibles entirely striate, the antennal scapes longer, and the first gastric segment broader. The female of *bufonis* is probably much larger. The *panamensis* female is smaller, has the mandibles more coarsely striate and more distinctly dentate, the lateral carina of the antennal scrobes less distinct, the epinotal tubercles much more protuberant, and the petiole longer than broad. *A. carinata* is named from the very distinct lateral carinæ of the antennal scrobes.

These ants were found in swamp rain forest back of the settlement. On a huge fallen log supported by its branches and buttress roots these two females, dealate females of *Myrmicocrypta spinosa* Weber and *Cyphomyrmex rimosus* Spinola, and a nest of *C. bigibbosus* ssp. *faunulus* Wheeler occurred in a small area of a few square centimeters. The *Alfaria* were under the harder shell of the log among debris left by wood-boring beetles and other insects in the softer internal wood. They moved about slowly as do dacetonine ants and were not discommoded by the strongly reflexed gaster, whose terminal segments were carried beneath the body. When I handled the ants they turned the terminal gastric segments from side to side, the large two basal segments remaining rigid, and protruded the long sting in exactly the fashion of wasps. The sting of these small ants could not penetrate the skin. One was kept for a time in a small container and by August 27 had laid a white egg which was elliptical in shape but impressed on one side so as to be somewhat kidney-shaped. On a following day the egg was eaten. Unfortunately no other biological observations have been made on these archaic ants.

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NOTES ON HIPPOBOSCIDÆ.
14. THE GENUS ECHESTYPUS SPEISER

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Echestypus Speiser

Echestypus Speiser, 1907, Wiss. Ergebn. Schwed. Zool. Exped. Kilimandjaro, II, pt. 10, p. 3; 1908, Denkschr. Med.-Naturw. Ges. Jena, XIII, pt. 1, p. 176.

Speiser described the genus as new in two different publications; but it should be dated from the first appearance in 1907, where it included only two species, *Lipoptena sepiacea* Speiser (1905) and *Echestypus parvipalpis* Speiser (1907). One of these must be the genotype and I select herewith as such the older species, *Lipoptena sepiacea.* In 1908, Speiser included *Lipoptena sepiacea* and *Echestypus binoculus* Speiser (1908); but not *E. parvipalpis.* Aldrich (1923, Insecutor Inscitiæ Menstr., XI, p. 77) selected "*E. binoculatus* Speiser" (misspelling of *binoculus*) as genotype; but, that species not being mentioned with the 1907 description, Aldrich's type designation is invalid.

Echestypus agrees with *Lipoptena* in all essential characters, save two, the absence of ocelli and the short or vestigial palpi. Neither of these characters is of particular phylogenetic importance in Hippoboscidæ, and I am inclined to regard *Echestypus* merely as a subgenus of *Lipoptena.* Within the limits of the latter genus, the length of the palpi varies considerably, being very short in some species.

The three species which I recognize in *Echestypus* agree also in the following characters, all of which, however, are found in one species or other of *Lipoptena.* Head and thorax dorsally with few, spaced setæ: one to six frontal bristles, none of them behind the eyes; one pair of vertical bristles; mesonotum on each side with a conspicuous curved row of four to six short, dorsocentral setæ; three humeral bristles (two anterior, one posterior); two rows of notopleural setæ (before base of wing), those of the posterior row very long; two presutural bristles (one short and one long) close to the notopleurals; on each side two to five prescutellar bristles, the external ones placed close to the base of the wing, the single internal one very long, far from the others and seemingly in line with the dorsocentrals; scutellum with one or two pairs of apical setæ. Abdomen with sclerotized tergal plates as follows: a short basal plate, more or less fused with the first pleurite on each side (though generally much darker) and excised in the middle by a broad triangle, the apex of which extends as a narrow notch; hind margin of basal plate with a row of three to eight long setæ on each half, the disk either bare or with a few setæ mostly in a transverse post-median row; second to fourth tergites each with a more strongly sclerotized transverse plate near the hind margin, variable in size, the plate bearing a pair of distant setæ or a medially interrupted row of three to six setæ; most of fifth and sixth tergites strongly sclerotized, short, bearing one or two pairs of long setæ near the apex; the tergal area occupies about the median half of the dorsal surface, the remainder being covered by four partly sclerotized pleurites, which are even more developed ventrally than dorsally and bear scattered setæ (more numerous ventrally). Ventrally the abdomen has a strongly sclerotized basal crescent-shaped sternite, the disk partly covered with short, thick, almost spine-like setæ (two of these much longer in each apical corner); remainder of median ventral area not sclerotized, but soft and fairly uniformly covered with scattered short setæ. Setæ of sternum short, spine-like, few in number and placed more or less in transverse rows. Claws of all tarsi robust and slightly asymmetrical; apical spur of fore and mid tibia stout; fore coxa dorsally without retrograde spur, but with a long seta. As in *Lipoptena*, the wings break off apicad of the base, shortly after the adult hatches. I have seen the complete wing of *E. sepiaceus* (Fig. 2) and *E. paradoxus*. It is shaped as in *Lipoptena cervi* and has the same type of venation: only three well-developed longitudinal veins, apparently the first (R_1), third (R_{4+5}) and fifth (M_3+C_1); the sixth (2d An) is incomplete; other veins are indicated by depressed (concave) lines; only one cross-vein, between the supposed third and fifth longitudinals, therefore probably a fusion of anterior basal cross-vein (M_3), anterior cross-vein (r-m) and portion of fourth longitudinal (M_{1+2}); the third longitudinal ends in the tip of the costa at an acute angle and without knob-like swelling; the costa is thickened only at the extreme base and between the tips of the first and third longitudinals. The alula is rudimentary; the halter well developed and shaped as in *Lipoptena.* The membrane bears uniformly scattered, exceedingly minute microtrichia.

It may be noted that the external morphology is extremely similar to that of the European *Lipoptena cervi* (Linnaeus) and the Cingalese *L. efovea* (Speiser), particularly in the arrangement of the sclerites of the abdomen and in the venation of the wing.

Echestypus is known at present only from the Ethiopian portion of the African continent (south of the Tropic of Cancer), where it occurs on various antelopes, *viz.,* on bushbuck and nyala (*Tragelaphus*), reedbuck (*Redunca*), oribi (*Ourebia*), waterbuck (*Kobus*), duiker (*Cephalophus* and *Sylvicapra*), steinbok (*Raphicerus*), springbok (*Antidorcas*) and kudu (*Strepsiceros*). The host relationships are more fully discussed under each species.[1]

To some extent *Echestypus* is the Ethiopian representative of *Lipoptena,* although I have seen a true species of *Lipoptena* (with well-developed ocelli) off bushbuck and duiker in Uganda and the eastern Belgian Congo.

Four "species" of *Echestypus* have been described; but, after studying some 600 specimens, from 90 different lots and off more than a dozen hosts, collected throughout tropical and South Africa, I am able to recognize three species only. These are, moreover, very similar, as will be seen from the subjoined key. As I was unable to examine the types of the four described forms and as the original descriptions are scattered and inaccessible to the average entomologist, I have reproduced them in full.

[1] Throughout this paper the nomenclature of the hosts is that of Glover M. Allen's recent "Checklist of African Mammals" (1939, Bull. Mus. Comp. Zoöl., LXXXIII).

KEY TO SPECIES

1. Palpi vestigial, not or barely visible from above beyond the anterior margin of the fronto-clypeus. Mediovertex nearly as long as or slightly longer than wide; inner orbits narrower than the eye; postvertex as long as or slightly shorter than mediovertex. Scutellum with two pairs of apical bristles. .... *E. paradoxus.*
   Palpi short, but distinctly protruding beyond the anterior margin of the fronto-clypeus on the head seen from above, nearly half as long as the fronto-clypeus. .... 2.
2. Mediovertex as wide as long or slightly wider; inner orbits narrower than the eye; postvertex nearly as long as or slightly shorter than mediovertex. Scutellum with two pairs of apical bristles. .. *E. sepiaceus.*
   Mediovertex longer than wide; inner orbits as broad as or broader than the eye; postvertex about half the length of mediovertex. Scutellum with one pair of apical bristles. .... *E. binoculus.*

1. **Echestypus paradoxus** (Newstead). Fig. 1.

Lipoptena paradoxa Newstead, 1907 (February), Ann. Trop. Med. Paras., I, p. 91, figs. 19-20 (♀; Kasongo, Belgian Congo; off *Tragelaphus scriptus*). Austen, 1909, Illustr. African Blood-Suck. Flies, p. 209. Bezzi, 1916, Natura, Riv. Sc. Nat., VII, p. 178.

Echestypus paradoxus D. Bruce, Hamerton, Mackie and Lady Bruce, 1911, Rept. Sleeping Sickn. Comm. Roy. Soc., XI, p. 228. C. W. Howard, 1912, Bull. Ent. Res., III, p. 218. S. A. Neave, 1912, Bull. Ent. Res., III, pp. 311, 314, 315, 320 and 322. Mason, 1916, Ann. Rept. Dept. Agric. Nyasaland for 1915-16, p. 19. Anderson, 1924, Kenya Med. Jl., Suppl. No. 1, p. 9, and Suppl. No. 2, p. 4. Bedford, 1927, 11th and 12th Repts. Dir. Vet. Res. South Africa, I, pp. 300 and 782. Ferris, 1930, Parasitology, XXII, pt. 3, p. 278, figs. 3 and 4 A-C (♀ ♂). Bedford, 1932, 18th Rept. Dir. Vet. Serv. An. Ind. South Africa, p. 421. Cuthbertson, 1937, Proc. Trans. Rhodesia Scientif. Assoc., XXXV, pt. 1, p. 33.

Eschestypus paradoxus Curson, 1928, South Afric. Jl. Nat. Hist., VI, pt. 3, p. 182.

Echestypus parvipalpis Speiser, 1907, Wiss. Ergebn. Schwed. Zool. Exped. Kilimandjaro, II, pt. 10, pp. 3 and 5 (♀ ♂; Mt. Kilimanjaro, Tanganyika Territory; off *Tragelaphus scriptus roualeyni*). Austen, 1909, Illustr. African Blood-Suck. Flies, p. 202. S. A. Neave, 1912, Bull. Ent. Res., III, p. 317. Morstatt, 1913, Der Pflanzer, IX, p. 509. Bezzi, 1916, Natura, Riv. Sc. Nat., VII, p. 178. Falcoz, 1930, Encyclop. Entom., B, Diptera, V (1929), p. 52 (♀ ♂).

Previous Records. — Belgian Congo: Kasongo, types, off *Tragelaphus scriptus;* Newstead described the species from an "antelope", but stated that "the same host also harboured a number of ticks. (*q. v.*)." These ticks, from Kasongo, are listed in his paper (p. 100) as *Rhipicephalus nitens* from *Tragelaphus scriptus.* — Uganda: Singo, off *Tragelaphus scriptus* (Bruce *et al.*, 1911). — Kenya Colony: Makindu, off *Strepsiceros imberbis* (Neave, 1911). — Tanganyika Territory: Mt. Kilimanjaro, types of *E. parvipalpis,* off "*Tragelaphus roualeyni*"; this name is now used for the South African race of *T. scriptus*; the type host of *E. parvipalpis* was probably the East African race *T. scriptus massaicus* Neumann (Syn.: *T. sylvaticus meruensis* Lönnberg) (Speiser, 1907). — Northern Rhodesia: Msoro's, 50 miles W. of Ft. Jameson, off *Tragelaphus scriptus* (Neave, 1912); 35 miles E. of Ft. Jameson, off *Strepsiceros strepsiceros* (Neave, 1912). — Southern Rhodesia: Gatooma, Hartley District, off *Sylvicapra grimmia;* Inyati, Matabeleland, off *Sylvicapra grimmia* (both Cuthbertson, 1937). — Nyasaland: Near Kota-Kota, off *Tragelaphus scriptus* (Neave, 1912); off bushbuck [=*Tragelaphus scriptus*] and warthog, without more definite locality (Mason, 1916); the warthog appears very questionable as a host. — Bechuanaland Protectorate: Sekukuniland, off *Tragelaphus scriptus sylvaticus* (Bedford, 1927 and 1932). — Transvaal: Pietersburg District, off *Strepsiceros strepsiceros* (Bedford, 1927 and 1932). — Zululand: Ubombo Flats, off *Tragelaphus angasii;* Ntambanana, off *Tragelaphus scriptus sylvaticus* (erroneously recorded in 1927 as off *Redunca fulvorufula*); Emakosini, off *Redunca arundinum*; Umfolosi, off *Sylvicapra grimmia*; without more definite locality, off *Strepsiceros strepsiceros* (all from Bedford, 1927 and 1932). — Portuguese East Africa: Pongwe Valley; tendos [?dembos] of Urema, Gorongoza Province; forest of Inhaconde, 350 m., Gorongoza Province (all without host, from Falcoz, 1930); C. W. Howard's (1912) record off an owl is open to question and probably due to an error in labelling.[1]

[1] Two specimens, collected in Portuguese East Africa by C. W. Howard, are at the U. S. National Museum, labelled "from *Sylvicapra grimmia.*"

Fig. 1. *Echestypus paradoxus* (Newstead). Female, Elisabethville, Belgian Congo. Dorsal (right) and ventral (left) view.

Specimens Examined. — Belgian Congo: Luofu, Kivu District, off *Tragelaphus scriptus* (J. P. Chapin); Rutshuru, Kivu District, off *Tragelaphus scriptus* (J. Bequaert); Katofio, Katanga, off *Sylvicapra grimmia* (B. Bennett); Elisabethville, Katanga, off *Sylvicapra grimmia* (J. De Riemaecker; L. Van den Berghe); Kasepa River near Elisabethville, off *Sylvicapra grimmia* (J. De Riemaecker); Malenda River (a tributary of the Bushibila River), near Elisabethville, off *Sylvicapra grimmia* (J. De Riemaecker); Kilwa, on Lake Moero, off *Sylvicapra grimmia* (L. Van den Berghe); Kapiri, Katanga, without host (Congo Mus.); Kibombo, Manyema, off *Tragelaphus scriptus* (J. Bequaert); Doruma, Uele, off an antelope (C. Henrard); Nyanza, Urundi (H. C. Raven). — Uganda: Entebbe, off *Tragelaphus scriptus* (R. W. M. Mettan); Stogem, off *Tragelaphus scriptus* (C. R. S. Pitman); West Nile, off *Tragelaphus scriptus* (C. R. Pitman); without more definite locality, off *Tragelaphus scriptus* (J. O. Shircore); Toro, without host (Congo Mus.); Matuba Island, Lake Victoria (G. H. E. Hopkins).—Ethiopia: Addis Abeba, off *Tragelaphus scriptus*.—Kenya Colony: Zuwani, without host (L. Bayer); Guaso Nyiro, off *Strepsiceros imberbis* (W. L. Smith).—Tanganyika Territory: Kilossa, off *Tragelaphus scriptus* and *Sylvicapra grimmia* (A. Loveridge; these specimens were erroneously recorded as *Hippobosca capensis* in Proc. Zool. Soc. London for 1923, p. 734).—Angola: 80 miles from the coast, off *Strepsiceros strepsiceros* (Brit. Mus.).—Southern Rhodesia: Matetsi, Wankie District, off *Strepsiceros strepsiceros* (R. H. R. Stevenson). — Nyasaland: Maperera Stream, Lower Shire River, off *Tragelaphus scriptus* (P. le Touzel Chapman); Henga River, and Kayuni, N. Nyasa, off "gawpi" (T. B. Davey); Karonga, without host (W. Hood-Dye); Tangazi River, Namulambo, Ruo District, off *Taurotragus oryx pattersonianus* and *Strepsiceros strepsiceros* (Rodney C. Wood); Chikonje, Ruo District, off *Strepsiceros strepsiceros* and *Tragelaphus scriptus* (Rodney C. Wood); Ruo District, off *Aepyceros melampus, Sylvicapra grimmia,* and *Tragelaphus angasii* (Rodney C. Wood). — Transvaal: without more definite locality, off *Tragelaphus scriptus*; Guernsey, District Pilgrim's Rest, off *Strepsiceros strepsiceros* (R. du Toit). — Zululand: Ubombo Flats, off *Tragel-*

aphus scriptus sylvaticus (H. H. Curson) and off *Tragelaphus angasii*; Umfolosi, off *Sylvicapra grimmia*; White Umfolosi River, off *Tragelaphus scriptus sylvaticus* and *Kobus ellipsiprymnus* (H. H. Curson); Lower Umfolosi River, off *Tragelaphus angasii*, and *T. scriptus sylvaticus* (H. H. Curson); Umkuzi River, off *Tragelaphus scriptus sylvaticus* (H. H. Curson). — Cape Province: Port Elizabeth, without host (Brit. Mus.); if the locality label is to be trusted, this specimen was possibly taken from some animal in captivity.

Host Relationships. — There are now reliable records of *E. paradoxus* from nine distinct antelope hosts. The bushbuck, *Tragelaphus scriptus* (Pallas), is by far the most common host. It is found over practically the whole of Africa south of the Sahara, in several races. G. M. Allen (1939) recognizes 27 valid races and lists many more synonyms. The nyala, *Tragelaphus angasii* Gray, is restricted to southeastern Africa. The kudus are closely related to the foregoing, from which some authors do not separate them generically. The lesser kudu, *Strepsiceros imberbis* Blyth, is restricted to Northeast Africa. The greater kudu, *Strepsiceros strepsiceros* (Pallas), occurs throughout the savanna areas of Africa south of the Sahara. Both are frequent hosts of *E. paradoxus*. The duiker, *Sylvicapra grimmia* (Linnaeus), also a common host, has about the same distribution as the greater kudu. The following four hosts are perhaps more accidental: the reedbuck, *Redunca arundinum* (Boddaert); the eland, *Taurotragus oryx pattersonianus* Lydekker; the impalla, *Aepyceros melampus* (Lichtenstein); and the waterbuck, *Kobus ellipsiprymnus* (Ogilby). These antelopes are found in the savannas of South, Central and East Africa. The two anomalous records of warthog and owl seem wholly unreliable.

Distribution. — *E. paradoxus* is reliably known in the wild state from Ethiopia, Uganda, the eastern and southeastern Belgian Congo, Kenya Colony, Tanganyika Territory, Nyasaland, Northern Rhodesia, Southern Rhodesia, Angola, Bechuanaland, Transvaal, Portuguese East Africa and Zululand. It is definitely an insect of the savanna and plains country of East, Central and South Africa, avoiding the Rain Forest of the Congo Basin, as well as West Africa proper.

Synonymy. — The types of *E. paradoxus* are at the Liverpool School of Tropical Medicine. Although I have not seen them, there can be no doubt that the species here called *paradoxus* is the one described and figured by Newstead and later figured by Ferris (1930) under the same name.

Speiser evidently could not have been acquainted with Newstead's *paradoxus,* when he erected his genus *Echestypus.* There seems to be no reason why the three species he knew should not be the same as those recognized in the present paper. Both his *E. sepiaceus* and *E. binoculus* may, I believe, be recognized with certainty from the descriptions, as shown in the sequel. Hence, *a priori,* Speiser's third species, *E. parvipalpis,* may be Newstead's *paradoxus,* particularly in view of the fact that this is the most common and most widely distributed of the three. The types of *E. parvipalpis* are at the Stockholm Museum and I have not seen them. The statement about the unusually short palpi clearly applies only to *E. paradoxus* and the remainder of the description also fits this species better than either of the others.

The descriptions of *E. paradoxus* and *E. parvipalpis* were published the same year, but that of *paradoxus* certainly appeared first. The issue of the Ann. Trop. Med. Paras., containing the description, was dated February 1st. The paper on the Diptera Pupipara of the Kilimanjaro Expedition, by Speiser, was first recorded at the meeting of April 10, 1907, of the Stockholm Academy of Sciences (Kungl. Svenska Vetenskapsakad. Årsbok for 1908, p. 33).

Characters. — In addition to the features mentioned in the key, *E. paradoxus* is characterized by the slightly more developed chetotaxy; there is usually one more dorsocentral and the disk of the basal tergal plate bears a number of setæ, mostly in one oblique row. The second to fourth tergal sclerotized plates of the abdomen are rather smaller in the female than in the other species, although their anterior limits are poorly defined; moreover, in the male there are only four sclerotized tergal plates (II to V) behind the basal plate (I). The hind margin of the crescent-shaped basal sternite of the abdomen forms a shallow, semi-elliptical curve. The wing, which I have seen in a male from Ruo, Nyasaland, does not differ from that of *E. sepiaceus*.

Original description of *E. paradoxus*: "Female. — Specimens preserved in Canada balsam and alcohol are red-brown inclining to orange-brown at the sides of the abdomen; claws black; base of abdomen with a bilateral patch of darker chitin, the median area of the remaining segments also with darker markings, but these are both irregular and inconstant in the preserved examples. Head as wide as the anterior part of the thorax; ocelli absent. Mouth parts rudimentary. Outer margin of eyes with a double series of spinose hairs. Thorax narrower in front than behind, with a submedian series of about nine long spinose hairs forming a curved line, and a short submarginal series of usually four similar ones terminating opposite the insertion of the mid legs; posterior margins with four long spinose hairs on either side of the scutellum; the last-named organ is also furnished with four similar hairs. Abdomen short ovate, almost sub-circular, with numerous spinose hairs arranged as shown in the figure. Venter with numerous short spinose hairs; median convex area with numerous minute equidistant tubercles bearing slender spinose hairs, the spaces between the tubercles finely but strongly rugose. Legs short, stout, sparsely clothed with hairs of varying lengths and varying degrees of thickness; the posterior pair not extending beyond the tip of the abdomen; tibial spine to anterior and mid legs stout; tibial spine to posterior legs long, slender; pulvillus broadly dilated from the middle outwards, finely spinose; feather-bristle strongly spinose; the upper surface with only one series of spines, the inner with two or three; ungues very faintly and irregularly toothed on the inner margin. Length 4 mm.; width of abdomen 2 mm. The absence of ocelli in the female is rather remarkable. There is also an almost entire absence of external mouth parts, including the labial sheath; the only indication of these organs being a minute truncated cone, the exact nature of which could not be determined in the limited supply of material."

Original description of *E. parvipalpis*: "Länge 4-5 mm., Mundrand-Scutellum 1.6 mm. Farbe braun in verschiedener Schattierung, am Hinterleib die weichhäutigen Teile weisslich gelb. — Kopf breiter als lang, der Clypeus etwas länger als das vordere Drittel, die matte Stirnstrieme länger als breit, die Augen gross, auf den Orbiten je 2 Borsten, eine stärkere nahe dem oberen Ende, neben dem Scheiteldreieck, eine kürzere in der Mitte etwas nach auswärts von der grössten Konvexität der Orbita. Fühler ohne Besonderheiten, die aus den zusammenliegenden Maxillartastern gebildete Rüsselscheide ganz auffallend kurz, nur mit den kurzen Börstchen, mit denen sie besetzt ist, über den Vorderrand des Clypeus hinausragend, kaum länger als an der Basis breit. Thorax in der allgemeinen Konfiguration wie bei *Lipoptena* und *Echestypus* sonst. Die mit 3 kräftigen Borsten besetzte Schulterschwiele ist nicht durch eine so deutliche Naht abgegrenzt wie bei *Echestypus* spec. typic., jederseits der Längsnaht stehen 5 Borsten in etwa hyperbolisch gekrümmter Reihe, auf den kurzen Scutum mesonoti jederseits 4, auf den Pleuren vor der Flügelwurzel 2 Reihen von je 4 Borsten, die vorderen kürzer, die hinteren länger. Scutellum mit 4 Borsten, zu denen bisweilen noch eine überzählige fünfte an einer Seite der Vierergruppe kommt. Flügelstumpfe mit kaum mehr erkennbaren Rest von Geäder, Halteren weisslich gelb, gross und voll entwickelt. Abdomen in der allgemeinen Konfiguration mit *Echestypus* spec. typ. übereinstimmend. Das erste Tergit als ein Paar dunkelbrauner Platten auf den weicheren zweiten liegend, jederseits nahe dem Hinterrande mit 4 dünnen kurzen Börstchen. Die Hinterrand des zweiten in der Mitte tief und spitz eingebuchtet, in dieser Bucht jederseits 5 lange ziemlich kräftige Borsten, die Seiten weitläufig mit kürzeren bedeckt. Dahinter liegen 4 derber chitinige Tergite, denen 3 weichere, deutlich abgegrenzte Pleurite entsprechen. Die Tergite sind noch eigentümlich konfiguriert: III ist fast ganz, mit Ausnahme einer ganz weisslich häutigen Partie, die den spitzen Winkel im II Tergit ausfüllt, derb chitinig, quergerunzelt und dunkelbraun, am Hinterrande in der Mitte liegt aber eine etwa halbelliptische heller braune Platte, an deren Hinterrande wieder jederseits 2 schwache Börstchen stehen. Sonst stehen Börstchen nur noch an den Seiten des Tergits, jederseits 3 am Hinterrande und 2 etwa auf der halben Länge davor. Die beiden folgenden sind ähnlich, die dunkle Chitinisierung ist aber mehr auf die Seiten beschränkt, das helle besonders herausgehobene Feld ist bei IV schon etwas, bei V noch wieder breiter, trägt bei IV jederseits 2, bei V jederseits 1 Börstchen, auf den Seiten bei IV nur noch 3, bei V keine Börstchen mehr. Tergit VI, dem kein eigentliches Pleurit mehr entspricht, ist eine quere Platte, die nahe ihren Hinterecken jederseits 3 Borsten trägt, und auf ihrer Fläche zwei dunkler chitinige Seitenflecken erkennen lässt. Das nun folgende Analsegment, durch den Besitz von 2 Stigmenpaaren als VII + VIII gekennzeichnet, ist nackt mit Ausnahme eines Kranzes von Borsten um die Analöffnung. Die dem III Tergit entsprechende Pleuritplatte ist gleichmässig weitläufig kurz beborstet, die dem IV Tergit entsprechende nur in der vorderen Hälfte, die dem V entsprechende nackt mit Ausnahme von 2 Borsten am Rande. Diese Angaben über die Pleuritplatten beziehen sich auf die Ansicht a tergo; auf der Bauchseite sind sie alle ebenso wie die nicht segmentarisch abgeteilte Ventralfläche gleichmässig kurz beborstet. Das dunkelbraune Basalsternit kann man etwa als ein gleichseitiges Dreieck beschreiben, dessen hintere Ecken als halbrunde (sie sind in sich etwas gewölbt) Zapfen soweit nach hinten vorgezogen sind, dass am Hinterrande ein halbkreisförmiger Ausschnitt entsteht. Der Hinterrand ist ganz mit dornartig kurzen Borsten besetzt, ebenso die Zapfen selber und ihr Seitenrand, während die Basishälfte nur wenige schwache Borsten aufweist. — Diese bisher beschriebenen Verhältnisse sind bei ♂ und ♀ ganz gleich, Abweichungen ergibt nur die Genitalregion. Hier wird beim ♂ die Genitalöffnung von zwei sanften, mit den gewöhnlichen Börstchen der Ventralfläche besetzten Höckerchen flankiert während beim ♀ vor der Genitalöffnung eine breite fingernagelförmige, etwas derber chitinige Platte liegt, die sehr dicht mit ziemlich feinen Börstchen, in etwa 3-4 Reihen vor ihrem Hinterrande besetzt ist. Vor dieser Platte liegt noch eine kleinere, die offenbar dem Hinterrande eines (VI?) Sternites entspricht, dunkel gelbbraun und mit 3-4 Borsten besetzt, vor dieser eine unregelmässig verdoppelte Reihe Borsten, die keiner Segmentgrenze entsprechen. Die Beine sind kräftig, die Hüften stark beborstet, die Vorder- und Mittelschenkel etwas verdickt, auf den Hinterschenkeln steht auf der Vorderseite am Anfang des letzten Drittels eine kräftige auffallende Borste. Die Tibien sämtlich auf der Oberseite (dorsal) fast kahl und nur ventral mit kräftigen Borsten besetzt." ♂ ♀.

2. **Echestypus sepiaceus** (Speiser). Figs. 2 and 3.

Lipoptena sepiacea Speiser, 1905, Zeitschr. Syst. Hym. Dipt., V, p. 353 (♀; Caffraria; and Witu, Lamu and Wangi, Kenya Colony; no host). Bezzi, 1908, Bull. Soc. Ent. Italiana, XXXIX, (1907), p. 198.

Echestypus sepiaceus Speiser, 1907, Wiss. Ergebn. Schwed. Zool. Exped. Kilimandjaro, II, pt. 10, p. 3; 1908, Denkschr. Med.-Naturw. Ges. Jena, XIII, pt. 1, pp. 176 and 178. Austen, 1909, Illustr. African Blood-Suck. Flies, pp. 187 and 196. H. H. King, 1911, 4th Rept. Wellcome Res. Lab. Khartoum, vol. B, p. 126, Pl. VI, fig. 5 (♀). S. A. Neave, 1912, Bull. Ent. Res., III, p. 320. Bezzi, 1916, Natura, Riv. Sc. Nat., VII, p. 178. W. B. Johnson, 1918, Nigeria, Ann. Med. Sanit. Rept. N. T. Prov. for 1917, p. 165. Davey and Newstead, 1921, Ann. Trop. Med. Paras., XV, p. 461. Anderson, 1924, Kenya Med. Jl., Suppl. No. 1, p. 9. Bedford, 1927, 11th and 12th Repts. Dir. Vet. Res. South Africa, I, p. 782; 1932, 18th Rept. Dir. Vet. Serv. An. Ind. South Africa, p. 421.

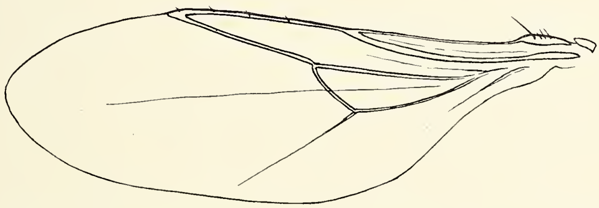

Fig. 2. Wing of *Echestypus sepiaceus* (Speiser), female, Bulukatoni, Uganda.

Eschetypus sp. J. J. Simpson, 1914, Bull. Ent. Res., V, pp. 24, 25, 30 and 35.

Previous Records. — Gold Coast: Sawla, off duiker (*Cephalophus* sp.); Banda N'Kwanta, off "red-flanked duiker", *Cephalophus rufilatus*; Bandowa, off "oribi", *Ourebia ourebi*; all three localities in the savanna country north of the Volta River (Simpson, 1914; as *Eschestypus* sp.; I have seen these specimens). — Anglo-Egyptian Sudan: Kio, without host

(King, 1911). — Kenya Colony: Witu, Lamu and Wangi, without host, cotype.—Nyasaland: Upper Shire River, south of Lake Malombe, off *Strepsiceros strepsiceros* (Davey and Newstead, 1921). — Cape Province: Caffraria, without host, cotype.

Specimens Examined. — Gold Coast: Sawla, off *Cephalophus* sp.; Banda N'Kwanta, off *Cephalophus rufilatus*; Bandewa, off *Ourebia ourebi quadriscopa*; Guripe, off *Cephalophus* sp. (all J. J. Simpson). — Anglo-Egyptian Sudan: Darraba, Dinder River, off *Ourebia ourebi montana* (G. M. Allen); Bongo, River Nile, Equatoria, off Abyssinian blue duiker, a race of *Cephalophus caerulus* (Neal Weber). — Uganda: Bulukatoni, West Nile, off *Tragelaphus scriptus* (C. R. S. Pitman).

Host Relationships. — *E. sepiaceus* has been definitely recorded from five distinct antelope hosts. The red-flanked duiker, *Cephalophus rufilatus* Gray, is strictly West African (Upper Guinea to northeastern Belgian Congo). The blue duiker, *Cephalophus caerulus* (Ham. Smith), occurs in several races in South and East Africa, as far north as the eastern Sudan. The distribution of the bushbuck, *Tragelaphus scriptus* (Pallas) and of the greater kudu, *Strepsiceros strepsiceros*, are discussed under *E. paradoxus*, as these antelopes harbor both species of *Echestypus*. The ouribi, *Ourebia ourebi* (Zimmermann), occurs in several races in the savannas of most of Africa south of the Sahara.

Distribution. — *E. sepiaceus* is now known with certainty from the Gold Coast, the Anglo-Egyptian Sudan, Uganda, Kenya Colony and Nyasaland. The only record for South Africa proper is based on the old specimen from "Caffraria", which Speiser included among the types. Perhaps it might be well to examine this fly more carefully, to see whether it is strictly cospecific with the cotype from Kenya Colony.[1] Like *E. paradoxus, E. sepiaceus* is evidently an insect of the savanna and plains country of Central and East Africa, but it extends much farther west, across the Sudan. It should be looked for in French Guinea and Senegambia.

Synonymy. — *E. sepiaceus* was originally based upon two

[1] In case the Caffraria specimen was of a different species, I herewith restrict the name *sepiaceus* to the form represented by the type from Witu, Lamu and Wangi.

Fig. 3. *Echestypus sepiaceus* (Speiser). Female, Bulukatoni, Uganda. Dorsal (right) and ventral (left) view.

females at the Berlin Museum, one dry, labelled "Caffraria, Drège"; the other in alcohol, labelled "Witu, Lamu u. Wangi 23/8, 95, Denhardt." I have not seen the types. That Speiser's and my *sepiaceus* are the same is shown by the following statements in the original description: "Stirnstrieme etwas breiter als lang. . . . Maxillarpalpen kurz." It is further confirmed by the comparison drawn by Speiser (1907), in a key, between *E. sepiaceus* and his *E. parvipalpis* (= *paradoxus* Newstead).

Characters. — In addition to those given in the key, the chetotaxy is somewhat less developed than in *E. paradoxus*, there being usually one dorsocentral less, while there is no transverse row of setae on the disk of the basal tergal plate. The second to fourth tergal sclerotized plates of the female are larger than in *E. paradoxus*. The hind margin of the crescent-shaped basal sternite of the abdomen forms a deep semi-circular curve. The claspers (or parameres) of the male genitalia are stronger than in *E. paradoxus*.

Original description of *E. sepiaceus*: "♀. Länge 3.8-4.2 mm.; Mundrand-Scutellum 2.2 mm. Russbraun mit etwas helleren Vorderbeinen und Schenkelwurzeln und graubraunem Abdomen. Kopf rundlich mit grossen Augen, die wenig schmäler als hoch sind. Stirnstrieme etwas breiter als lang, Lunula ohne Grübchen, heller lederbraun abgesetzt. Clypeus am Vorderrande ebenfalls heller braun, mit einer feinen Mittellinie. Maxillarpalpen kurz. Thorax auf seinem vorderen Abschnitte etwas heller braun als hinten. Skulptur und Beborstung wie gewöhnlich. Metasternum halb so lang als Mesosternum. Beine mehr oder weniger hell kastanienbraun mit dunkeln Knien und Tarsengliedern. Abdomen ähnlich dem von *L. cervi* L. Das erste Tergit wie gewöhnlich nur in der Form zweier derberer Platten zu beiden Seiten der Hinterleibswurzel auf dem zweiten darauf liegend. Dieses ist weniger derb als bei *L. cervi* L., mit geschwungenem Hinterrande, in der Mitte eingezogen. Das dritte Tergit ist länger als bei *L. cervi* L. Es ist an seinem Vorderrande, der sich an den Ausschnitt des Basalsegments 1 und 2 anlegt, nur schwach, am Hinterrande in einem rechteckigen queren Stück derb chitinisiert und dieses Rechteck entspricht den ebenso gestalteten, dahinter liegenden 3 folgenden Tergiten. Das Basalsternit ist an seinem

Hinterrande so tief ausgebuchtet, dass es nur aus zwei zungenförmigen, vorne in ihrer eigenen Breite zusammenhängenden, divergierenden Lappen besteht. Sonst ist die Ventralfläche gleichmässig beborstet und nur vor der Genitalöffnung ein wenig derber bräunlich chitinisiert."

3. **Echestypus binoculus** Speiser. Fig. 4.

Echestypus binoculus Speiser, 1908, Denkschr. Med.-Naturw. Ges. Jena, XIII, pt. 1, p. 176, fig. (♀ ♂ ; Kalahari; off *Raphicerus campestris*). Bezzi, 1916, Natura, Riv. Sc. Nat., VII, p. 178. Bedford, 1932, 18th Rept. Div. Vet. Serv. An. Ind. South Africa, p. 420.

Echestypus binoculatus "Speiser" Aldrich, 1923, Insecutor Inscit. Menstr., XI, p. 77 (error for *binoculus*).

Previous Records. — Kalahari: Without more definite locality, off *Raphicerus campestris,* types. — Cape Province: Middelburg, off *Antidorcas marsupialis* (Bedford, 1932).

Specimen Examined. — Orange Free State: Hoopstad District, one female, off *Raphicerus campestris* (R. du Toit).

Host Relationships. — The few specimens known were taken from steinbok, *Raphicerus campestris* (Thunberg) and springbok, *Antidorcas marsupialis* (Zimmermann), both small South African antelopes. *Antidorcas* reaches southern Angola, while *Raphicerus* extends farther north in East Africa, to northern Tanganyika Territory.

Distribution. — This rare species is known only from the Kalahari, the western Orange Free State and the west-central part of Cape Province. When steinbok and springbok are more carefully examined, the range of the parasite will no doubt be extended.

Synonymy. — *E. binoculus* was described from two males and five females, from the Kalahari. I have not seen the types and I do not know where they have been deposited. The species is, however, easily recognized from the original description and figure.

Characters. — I have only seen one female, received through the kindness of Dr. R. du Toit. The characters given in the key are taken from this specimen. In addition, it may be noted that the chetotaxy is more reduced than in either of the other species: there is only one pair of apical

Fig. 4. *Echestypus binoculus* Speiser. Female, Hoopstad District, Orange Free State. Dorsal (right) and ventral (left) view.

scutellar bristles and the second to fourth median tergal plates bear only one bristle on each side. These tergal plates are, moreover, larger than usual.

Original description of *E. binoculus*: "Länge 3.5-4.5 mm., Mundrand-Hinterrand des Scutellum 2 mm. Kastanienbraun mit einigen helleren Teilen am Kopf, an der Basis der Schenkel und den Schulterecken, die weichhäutigen Teile des Abdomens hell-umberbraun. Kopf rundlich, mit nur wenig verschmälerten Augen, die etwa 1½ mal so hoch wie breit sind. Orbiten sehr breit, fast so breit wie die Augen. Stirnstrieme etwas länger als breit. Lunula ohne Grübchen. Clypeus heller als der übrige Kopf, mit einzelnen braunen Querlinien und einer noch etwas helleren vertieften Mittellinie, die hinten, mitten zwischen den Fühlern, in einem Grübchen endet. Maxillarpalpen, die die Rüsselscheide bilden, kurz. Thorax dorsal wie ventral in Bau und Beborstung sich fast ganz an *Lipoptena* anschliessend. Scutellum mit einem Paar Borsten. An den Beinen fallen die Knie durch etwas dunkleres Braun auf. Ueber Flügelstummel und Halteren siehe die Gattungsbeschreibung. Abdomen bei ♂ und ♀ fast ganz gleich konfiguriert, nur dass beim ♂ die Segmentgrenzen auch ventral ziemlich deutlich sind, während sie beim ♀ hier verwischt sind. Das 1. Tergit ist nur durch 2 derbere Chitinplatten in dem 2. Tergit markiert. Dieses 2. Tergit ist nicht so derb wie bei *Lipoptena*, der Hinterrand bogenförmig, median aber ist er noch bis fast auf seine halbe Länge von hinten her durch eine schmale Kerbe gespalten. Dahinter folgen, den Hinterrändern der Tergite 3-6 entsprechend, 4 unter sich nach Länge und Breite fast ganz gleich gestaltete Chitinplatten; bei den 3 ersten davon ist der vordere Rand nicht gerade, sondern in der Mitte zipfel- oder zahnartig nach vorn vorgezogen. Diese 3 Platten tragen nahe ihrem Hinterrande jederseits eine Borste, die 4., vorn geradrandige bisweilen jederseits 2. Hinter ihr folgt ein Paar am Hinterrande mit vielen Borsten besetzter, fast quadratischer Platten, die zusammen das 7. Tergit repräsentieren; dahinter das weiche Analsegment. Ventral ist ausser dem Basalsegment keinerlei derbere Chitinisierung zu bemerken. Das Basalsternit ist schmal, besteht, (ähnlich wie bei *Echestypus sepiaceus* m.), fast nur aus 2 schmalen, zungenförmigen divergierenden Lappen, die median an ihrer Vereinigungsstelle sich so weit verbreitern, dass das Segment median beim ♀ etwa 1½ mal, beim ♂ fast zweimal so breit (recte lang!) ist wie an den Seiten. Die übrigen Sternite kennzeichnen sich durch etwas dunkleres Chitin und die Stellung der Borsten. Beim ♂ steht jederseits der Genitalöffnung eine kleine, kaum erhabene, mit dünnen Borsten besetzte Warze." ♀ ♂.

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AN EXPERIMENTAL STUDY ON CASTE DETERMINATION IN ANTS

BY LAURENCE G. WESSON, JR.

Boston, Mass.

There are two theories concerning the method of determination of the castes of the female sex in ants. The blastogenic theory maintains that the caste of the individual worker or queen is determined in the egg. The trophogenic theory maintains that the castes are determined by influences upon the egg or resulting larvæ after the egg has been laid. Between these two theories lies an ill-defined zone in which on the one hand environmental influences may be presumed to be transmitted through the reproductive female to the egg to alter the character of the nutritive material laid down for the larvæ, or even to alter the genetic pattern. On the other hand, it is possible that an inborn tendency to become one caste or the other may be only partial, to be altered under environmental stress. Definite proof of the blastogenic theory would appear to be a difficult task, and would probably require careful genetic and chromosomal studies. Certain proof of the trophogenic theory, on the contrary, appears much simpler and would consist in the demonstration that any arbitrarily chosen female egg can be caused at will to develop into either queen or worker through control of environmental factors. It is important to note here that failure to prove the trophogenic theory does not disprove it, for some potent environmental factor may still be uncontrolled.

Although no discussion of the arguments on both sides[1] will be attempted, it should be noted that no amount of experimental manipulation of environmental conditions has succeeded in producing morphological intergrades between queen and worker—only smaller queens and larger workers. Species do vary considerably, however, in the degree of variation transitional between the two castes, but always there is a distinct hiatus. Under natural conditions, each species normally has a certain season of the year, usually Spring or Fall, during which a portion of the female brood develops into queens. Further, it has been noted by numerous observers that the proportion of queens and workers produced at such times varies widely and shows a strong correlation with the economic conditions of the colony: the weaker and less well-nourished the colony, the smaller the proportion of queens and males produced. Obviously, there is some method by which the colony controls the time of appearance, number and proportion of the different castes.

In the past, practically every approach to the problem has consisted in marshalling general truths, analogies, bits of evidence in the way of field observations and anomalous specimens, and logical sequences by the proponents of one side or the other in support of their theory. For example, in the most recent of such engagements, Wheeler (1937), after careful study of a remarkable series of what were apparently queen-worker mosaics of the ant *Acromyrmex octospinosus*, came to the conclusion that the female castes are determined blastogenetically. Whiting, (1938), reviewing Wheeler's book, showed that these same mosaics could be intercastes and explained equally well on a trophogenic basis. Thus the solution is left as inconclusive as before, and it is apparent that only controlled methods of approach can decide. The only previous experimental approach to the problem which I have been able to find appears to be that of Ezhikov (1934) who writes: "When we subjected to hunger the larvæ of ants destined to be females (Camponotus, Myrmica) at different moments of their development, we never were able to obtain forms transitional between the queen ant and the worker, but either real fertile females,

[1] Dr. Wheeler's book (1937) contains something of the various arguments, together with an extensive bibliography on the subject.

perhaps somewhat reduced in size, or else typical working individuals." In none of Ezhikov's publications which I have been able to examine have I found any further description of his experiments than is suggested in the above quotation.

It is the purpose of the present paper to describe an experiment designed to test whether the castes of the female sex of *Leptothorax curvispinosus* are determined blastogenetically or trophogenetically.

Experimental.

The procedure consisted in subjecting two groups of larvæ, as nearly identical as possible, to controlled conditions differing between the two groups only in the amount of food supplied. During the summer, a quantity of larvæ (about 250) was collected from several nests of *Leptothorax curvispinosus.* These larvæ were thoroughly mixed, then introduced into a colony of *Leptothorax longispinosus* from which queen and brood had been removed. This was done to insure that no further *curvispinosus* larvæ would be produced. The resulting mixed colony remained about two weeks at summer temperature, during which time about 80 of the larvæ disappeared, presumably as a result of a certain amount of resistance to adopting them on the part of the *longispinosus.* The remainder grew a little. The nest was then placed in a cold room (2° C.) to hibernate. Five months later (March), the colony was removed from hibernation and immediately divided into two practically equal portions. In order to secure an impartial division of the larvæ, the smaller and shriveled specimens were discarded, the remainder gathered into a pile, thoroughly mixed together, then the pile was divided into halves through the center. At this time, the larvæ were 1/10-1/6 of pupation size. These two divisions may be designated colonies A and B, composed as follows:

Colony A—27 longispinosus workers; 44 larvæ.

Colony B—30 longispinosus workers; 44 larvæ.

Both colonies were maintained simultaneously under conditions as nearly identical as possible as to nest size and construction, feeding space, moisture, temperature and illumination, but differed in the amount of food administered.

Colony A was given a superabundance of food comprising egg yolk, sugar syrup, and grasshopper legs. Colony B was given the same kind of food, but just enough to allow the larvæ to grow. The precise amount of food to give to B was difficult to determine since too much would obviously defeat the plan of the experiment, while too little might cause the workers to devour some of their larvæ. As soon as each larva had pupated, it was removed and identified.

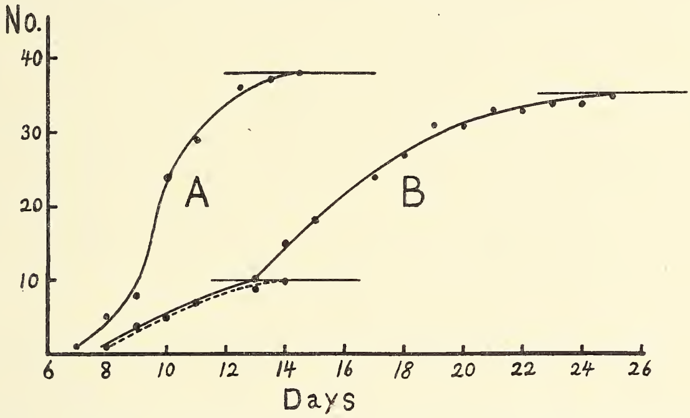
Results.

The results obtained from each group of larvæ are tabulated below:

	A	B
Larvæ initially present	44	44
Larvæ died during experiment	6	9
Larvæ surviving to maturity	38	35
males	3	2
females	35	33
queens	32	10
workers	3	23

In colony A, 94% of the total surviving female brood comprised queens, as compared with 30% in B. If it then be assumed that the six larvæ which died in colony A would have been workers, while the nine larvæ which died in colony B would have been queens and were preferentially destroyed by the workers, then 78% of a total female brood of 41 in A would have been queens as compared with a corresponding figure of 45% in B. Such a possibility of preferential destruction must be considered even though highly unlikely. Colony A, especially, had more than ample food and therefore no reason to destroy any larvæ. It would seem probable that the dead larvæ represent enfeebled or injured individuals, approximately equally divided between the two colonies, which would have been disposed of under any circumstances.

The difference between the figures 78% and 45% could conceivably be explained on the basis of chance assortment, but this is highly unlikely. If we assume on the basis of the blastogenic theory that of the original 88 larvæ 83 are female, and of the 83, 51 are predetermined as queens and 32 predetermined as workers, then the chances of obtaining 9 workers, 32 queens (colony A: 78%) plus 23 workers, 19 queens (colony B: 45%) are less than 1:100 the chances of obtaining an equal division of 16 workers, 25-26 queens in each colony. Unfortunately, I will be unable to undertake corroborative experiments which should be performed before these results may be considered conclusive.



Fig, 1. Number of larvæ pupated at a given time plotted against days after beginning of experiment. A, colony A; B, colony B. Solid lines, pupation curves of total brood; broken line, pupation curve of queens alone of colony B. It may be noted that in B, workers and males did not start pupating until the 13th day, or one day before all the queen larvæ had finished pupating.

The two colonies responded very differently in the rate of maturation of the larvæ. From figure 1, it will be noted that during the period when the entire brood of colony A is pupating, the queen larvæ alone, for the most part, are pupating in colony B. Even though the latter colony is getting much less food, the queen larvæ have matured at the same time as the larvæ in the well-fed colony, while the maturation time for the rest of the brood lags considerably behind that of the queen larvæ.

Conclusions.

It may be affirmed that, in all probability, with the ant *Leptothorax curvispinosus* only one type of female egg is laid, and that these eggs become queens or workers respectively according to the nature of at least one environmental factor acting upon them after being laid. The present experiment goes even farther than this, for in it the determination of queens and workers was effected at a comparatively advanced stage in larval growth, indicating that final determination may be considerably postponed. Exactly what environmental factors are involved is not evident. Quantity of food is one factor, from the nature of the experiment; but that is not all, for attempts to produce queens from *L. curvispinosus* larvæ during the summer by overfeeding met with no success. Larvæ on emergence from hibernation, therefore, differ from larvæ during the rest of the year in being, somehow, peculiarly susceptible to a "gynegenic" influence of quantity of food. This influence may be direct or may be transmitted to the larvæ secondarily through the workers. Perhaps it is the action of factors arising from various seasonal changes which produces this different responsiveness on the part of overwintered larvæ.

Now we can trace a possible pattern of events. As Winter approaches, there remains in the nest a variable number of larvæ of varying size whose growth has been brought to a standstill by the decline in food and increase in cold weather, possibly other factors. These larvæ emerge in the Spring somewhat reduced in size, but with their physiology so altered that under the influence of an abundant available food supply they can start development toward the queen form. All the larvæ are not the same in their susceptibility, however, so that when the food supply is small, only the most susceptible are affected; and there may be some, perhaps small or feeble larvæ, which are not affected at all. The larger the food supply, the more less susceptible larvæ are affected. This period of susceptibility lasts only a short time (indicated by the fact that the pupation curve of the queens in colony B is quite short and is simultaneous with the curve for A), after which the larvæ become resistant to the gynegenic action of food and become workers no matter how much food is offered them. While the queen larvæ are developing, the largest proportion of the available food goes to them, the rest of the larvæ taking comparatively little (indicated by the separation of queen and worker pupating curves of colony B). Thus the queen larvæ are enabled to grow to normal size at normal rate even though the colony is on reduced rations. A similar pattern, in reverse, could hold for those species in which the queens are produced in late Summer or Fall.

Summary

An experiment is described which indicates that the female castes of *Leptothorax curvispinosus* are determined trophogenetically and not blastogenetically.

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THE HISTOLOGY OF THE WING PADS OF THE EARLY INSTARS OF *PTERONARCYS PROTEUS* NEWPORT (PLECOPTERA)

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Several very thorough papers have been published on the wing development of holometabolous insects. The differentiation of the wing, however, is so rapid that investigators are by no means unanimous as to the mode of formation of the blood lacunæ about which the adult wing veins subsequently form. Marshall (1913), studying *Platyphlax designatus* Walker, a trichopteran, stated that lacunæ develop in the wing Anlage of the last nymphal stage and that tracheæ do not enter until the wing has everted. Hundermark (1935) investigated *Tenebrio molitor* and reported that tracheæ grew into the newly everted wing disc and that later lacunæ formed about them. Kuntze (1935) in his exhaustive studies of *Philosamia cynthia* Drury (Lep.) claimed that lacuna formation preceded the entrance of the tracheæ and that lacunæ developed inward from the margin. Waddington (1939) speaks of the formation of vein lacunæ in Drosophila wings as being the fusion of small local lacunæ along the site of the presumptive adult vein. He does not refer to the method of formation of the small lacunæ nor are wing tracheæ mentioned in his paper.

From these studies and other investigations on holometabolous insects, it is not possible to determine the ancestral mode of lacuna formation. To elucidate the problems of lacuna formation and differentiation of wing epithelium one would logically turn first to the Heterometabola, but no histological investigation of any scope has been undertaken. Tower (1902) sectioned a first stage nymph of *Anasa tristis* De Geer (Hem.) and saw disc-like hypodermal thickenings in the dorso-pleural region on the wing bearing segments. At the time of the first moult the discs evert to form wing pads. Formation of a disc and its subsequent eversion also occurs in holometabolous forms. Regarding *Microcentrum latifolium* (Orthoptera), Tower reported that the first instar has well developed wing pads, which everted in the embryo but do not become external until the first nymphal moult. He does not note first occurrence of lacunæ.

Sulc (1911) sectioned the early instars of *Philaneus lineatus* (Hom.) in order to reconstruct the tracheal system. He found that in the first instar tracheæ do not extend to the site of the wing pad, which is later invaded by two tracheæ in the second instar. He found four longitudinal tracheæ in the wing pad of the third instar, a pattern which is elaborated in the fourth and fifth stages. Curiously enough, he did not describe or figure lacunæ, although they have been illustrated in non-histological works on wings of Homoptera.

Beck (1920) discussed the development of the wing vein in *Phyllodromia* (*Blatta*) *germanica;* this was not histological, but was concerned with the development of the wing's tracheal system throughout the life of the roach. Neither the advent nor the differentiation of lacunæ is mentioned.

In order to investigate the differentiation and growth of wing epithelia and to ascertain the relationship between the development of lacuna and trachea, *Pteronarcys proteus* Newport was chosen. This insect is a primitive plecopteran with at least fourteen nymphal stages. The writer was fortunate in obtaining several early instars which were studied exclusively by serial sections, since whole mounts of entire individuals or of wing pads do not show lacunæ. Specimens were fixed in Kahle's fluid (two hours), sectioned in paraffin at 6μ without difficulty or loss of sections and stained with Mallory's triple connective tissue stain.

The length of the specimens is not given as it is an unreliable index of a particular instar. Body length varies among fixed specimens: some are caused to telescope by the action of the fixative, others are relaxed at full length. Head width, however, enables one more definitely to determine the stadium to which a specimen belongs.

First Instar

Head width, .408 mm. A single specimen was obtained and sectioned. The wing anlage is not a disc of cells developed in the embryo and everted upon eclosion. The only external indication of wing buds in the first instar is a small flange where the pleurum and the tergum join. This flange can well be regarded as a lateral expansion of the tergum. Hypodermal cells on the tergal portion of the thoracic expansion grade from pavement epithelium to tall columnar cells, as one proceeds laterally. Lacunæ are not yet developed, nor are tracheæ associated with the anlage.

Second Instar

Head width .54 mm. Two specimens of this stage were studied: one, in the inter-moult phase; the other, just prior to its moult to the third instar. In the inter-moult specimen both meso- and metathoracic analgen have attained the same degree of development. A well marked sinusoid runs along the outer margin of each wing expansion, and is incomplete in that it does not communicate with the hæmocœle either anteriorly or posteriorly. In the left rear wing the sinusoid is 9μ in length and is occluded in one place by hypodermal cells suspended in it. In the other metathoracic expansion the sinusoid is evidenced by 20μ and 30μ lengths, separated by an occlusion.

Histological examination shows the sinusoid to be the result of attenuated cell ends not going directly to the basement membrane of the hypodermis. Instead the processes merge with the ends of neighboring cells to leave a space. Precisely the same sort of sinusoid is found in the prothoracic expansion. It follows, therefore, that the sinusoid is not the costal lacuna. It may be termed the precostal sinusoid, for it occurs peripherad of costa in all nymphal stages. It is a false lacuna situated at the base of large bristles and may be the site of trichogen cells. In nymphs about to moult the precostal sinusoid is obliterated by large trichogen cells.

Prior to the second moult the costal lacuna is developed. It is a space between the basement membrane of the wing epithelia and is readily distinguishable from the precostal sinusoid which is an intercellular space. In the late second instar costa is a marginal lacuna which communicates anteriorly and posteriorly with the hæmocœle. Although a few blood cells are present in the posterior portion of the lacuna it is not certain that blood can circulate because the anterior opening is very small. The costal lacunæ of the right fore, right hind, left fore and left hind wing pads measure 168μ, 162μ, 160μ and 140μ respectively.

With the exception of the right hind wing, the single trachea to the wing disappears in the dorsal epithelium of the bud, and does not approach costa or form a lacuna. In the right metathoracic flange, however, the trachea is worthy of note for its exceptional behavior. The trachea travels into the costa of this wing, the only instance where it does so in twenty-eight wing pads of early instars studied by serial section. 60μ from the site of apposition of the trachea to the dorsal wing epithelium, and 18μ past the anterior end of costa, the trachea enters the lacuna. In the next 42μ, the trachea moves across the lacuna into the ventral epithelium where it may be followed for 22μ to its end. As the trachea enters costa 18μ away from the lacunal opening it is obvious that the lacuna is not caused by a boring in of the trachea, nor does the diameter of the lacuna taper to conform to the tapering trachea.

In each segment of the pterothorax a nerve leaves the interganglionic connective at a point immediately anterior to the ganglion. The nerve associates itself with the wing trachea and enters with it into the dorsal wing epithelium. The nerve could not be traced further.

Because tracheæ are often considered to be inductors of lacunæ, it is well to digress upon the anatomy of the tracheal system. In the second instar a trachea extends to the wing for the first time. (It is the more anterior of the two branches which supply the wing of older nymphs. The posterior branch does not appear during the late third instar.) A large longitudinal trachea runs laterad of the alimentary tract, and in the wing bearing segments the longitudinal trachea receives perpendicularly an equally large branch from the anterior gill. From the junction of these large tracheæ to the corresponding junction in the succeeding segment runs a smaller trachea which arches out peripherally from the main longitudinal trachea. From the peripheral arch branches extend to the wing, leg, and posterior gill. In the late third instar a trachea extends for the first time to the posterior portion of the wing flange. This is the state of pterothoracic main tracheæ during the second, third, and fourth instars.

Third Instar

Head width, .68 mm. Killed early in period of cell division and growth preceding fourth instar. The old endocuticula is partly resorbed and the new integument is partly secreted.

The apposition of nerve and trachea is the same as that of the preceding instar. Costa communicates anteriorly and posteriorly with the hæmocœle and does not contain a trachea. Subcosta appears for the first time in the life history of *Pteronarcys proteus* during the period of hypodermal cell division in the last phase of the third stadium. Subcosta is open at the anterior end and opens posteriorly into costa at a point near to where the latter empties posteriorly.

In the right forewing 48μ posterior to the entry of the trachea onto the wing epithelium, one observes the opening of subcosta, and 30μ posterior to that opening is the point of entry of the trachea into the lacuna. The trachea is therefore associated with the wing epithelium for 78μ without having created an intercellular space, much less a lacuna. Once within the subcosta, the trachea travels for 48μ and moves from the dorsal to the ventral epithelium. The trachea ends outside of the lacuna 6μ before subcosta ends. With minor variations the behavior of the trachea in each of the three subcostas is the same. A small cross vein has already developed 60μ anterior to the distal end of subcosta.

Because the entry of the trachea into subcosta is so far removed from the anterior opening of the lacuna, subcosta could not possibly have been induced by the mechanical boring in of the trachea. Subcosta is not centered with respect to the trachea once it does enter. The lacuna does not taper, whereas the trachea tapers to nothing. Evidently the trachea does not induce the lacuna.

Head width, .79 mm. Killed late in period of cell division and growth prior to the moult to the fourth instar. Examination of the integument showed the old integument to be almost completely resorbed and the integument of the fourth instar in great part to be laid down.

The structure of the wing in this specimen differs from the early growth phase third instar. At the anterior margin of the wing a large trachea becomes applied to the dorsal wing epithelium. 24μ posterior to the point of application a lacuna appears but is not associated with the trachea. The lacuna is divided into three smaller lacunæ by cell processes forming partions. As the wing flange broadens posteriorly, the three lacunæ become separated in space by added cell processes which form a typical middle membrane. 48μ posterior to the first appearance of the lacuna, the trachea becomes associated with the most mesal lacuna. Posterior to this point the innermost lacuna bifurcates. 120μ from the opening of costa and 120μ from the posterior margin of the wing pad, the trachea goes deeply into the ventral epithelium and tapers to an end.

If one numbers the lacunæ inward from the margin, number three appears to be the new structure, and is therefore probably radius. The subcosta in the early growth phase third instar runs midway between costa and the hæmocœle, and sends a short branch to the anterior margin of the wing near its apex. The second lacuna in the late growth phase third instar has the same position and structure as it did in the early growth phase, whereas the new (third) lacuna runs next to the hæmocœle and forks at mid-length of the wing. The left metathoracic wing has the same anatomy with minor differences. The two remaining wings were compressed locally when they were sectioned so that one cannot follow the trachea. The three lacunæ, however, are readily identified. Four additional lacunæ, each about 50μ in length, make their initial appearance at the apex of the wing pad. Further study is necessary to determine their identity.

Fourth Instar

Head width, .88 mm. Four specimens were sectioned serially and examined. The anatomy of the wing pad is the same as that of the late growth phase third instar.

General Consideration and Conclusions: Before one is able to characterize vein lacunæ, one has to study blood lacunæ in the prothorax. When the costa is formed in the second instar, a blood lacuna develops in the prothoracic flange and like the costa runs in an arc to communicate anteriorly and posteriorly with the hæmocœle. Similarly, at the time of differentiation of subcosta, the prothoracic flange adds another lacuna which is entad of and parallels the first. (Later instars show that several more lacunæ are added.) Prothoracic flange epithelia do not oppose their basement membranes to form a middle membrane. Prothoracic lacunæ therefore differ histologically from vein lacunæ in having a diameter from 2½ to 4 times as great, and are not middle membrane structures.

From a study of the early instars of *Pteronarcys proteus* one concludes that: (1) the sole histological distinction of vein lacunæ is their middle membrane structure. One cannot say that vein lacunæ are also distinguished by tracheæ because costa rarely contains one, and costa in the early instars does not differ from subcosta or radius. (Costa, always an ambient structure, did contain a trachea in one of about 60 examined specimens of all ages. The other longitudinal lacunæ of older instars invariably contain both tracheæ and nerves. Costa never contains a nerve.)

(2) Lacunæ are not induced by tracheæ.

The writer is particularly grateful to Dr. Albert Miller of the University of Arkansas who supplied specimens of the first and second instars, and to Dr. F. M. Carpenter and Dr. A. B. Dawson who read and criticized this paper.

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Description of Plate VI.

Transverse Sections of *Pteronarcys proteus* Newport.

I. Metathoracic flange, x294, first instar, right side. The site of the wing disc is marked by the transition of pavement epithelium to tall columnar cells.

II. Mesothoracic wing pad, x294, second instar, left side. Precostal sinusoid and a middle membrane present. No lacuna or trachea developed.

III. Prothoracic flange, x294, second instar, left side. False lacuna present but a middle membrane not developed.

IV. Mesothoracic wing pad, x294, late growth phase second instar, left side. Costal lacuna is present.

V. Prothoracic flange, x294, same specimen as no. IV, left side. Blood sinusoid present.

VI. Prothoracic flange, x294, early growth phase third instar, right side. Two blood sinusoids are present. Middle membrane is not developed.

VII. Mesothoracic wing pad, x206, same specimen as no. VI, right side. Subcosta has formed.

VIII. Mesothoracic wing pad, x290, fourth instar, left side. Three lacunæ are visible.

Key to Abbreviations

BC .... Blood cells
C .... Costa
FL .... False lacuna
I2, I3, I4 .... Integument second instar, etc.
M .... Middle membrane
P .... Precostal sinusoid
SC .... Subcosta
R .... Radius
T .... Trachea
WD .... Wing disc

PSYCHE, 1940 VOL. 47, PLATE VI.

HOLDSWORTH — WING PADS OF PTERONARCYS

A SYNOPSIS OF THE GENUS ACERATASPIS (HYMENOPTERA, ICHNEUMONIDÆ)

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The genus *Acerataspis* was originally described from Japan. A second species has been found in Formosa, and in this paper a third is described from southern China. A redescription of the genus is here given, since the original characterization proves to be inadequate in the light of the species discovered since its publication.

Acerataspis Uchida

Acerataspis Uchida, 1934, Ins. Matsumurana, **9**: 23
Cushman, 1937, Arb. u. morph. u. tax. Ent. Berlin-Dahlem, **4**: 290

Cerataspis Uchida (nec Gray), 1934, Trans. Sapporo Nat. Hist. Soc., **13**: 275

Moderate sized, coarsely punctate, black, with yellow facial markings and abdominal fasciæ. *Head* not broader than thorax; face longer than broad, evenly convex below the antennæ, without a facial shield; epistomal suture absent; antennal sockets close together, separated by a strong longitudinal keel, the lower end of which is continuous with the elevated, convex, lower part of the face; mandibles bidentate at apices; hypostomal carinæ not very high; no palpal segments swollen as in *Metopius;* eyes seen from the side broadest below the middle (at least in *sinensis*). *Thorax* short and high; sides of pronotum shining and impunctate, with longitudinal grooves; mesoscutum without parapsidal furrows; mesoscutellum with a basal, median, impunctate, longitudinally carinate, transverse, depressed area, behind which is an elevated area, the sides of which are margined, and the posterior lateral angles of which are produced posteriorly, as in *Metopius*. Propodeum short, its spiracles short oval, its surface incompletely but strongly areolated. Wings with numerous, rather long hairs (at least in *sinensis*); areolet of fore wing large, briefly petiolate or costal margin short; recurrent vein with a single fenestra, which is near its costal end. Legs rather slender, claws strongly pectinate, middle tibiæ with two apical spurs. *Abdomen* not petiolate, apical segments swollen and turned downward; spiracles of first segment round, slightly anterior to the middle of the segment, the dorsal profile of which is strongly angulate about the middle; first three or four abdominal terga with two or three conspicuous, longitudinal, middorsal, parallel or nearly parallel carinæ; segments two, three, and four broader than long; sixth tergite very large, bulbous, forming the rounded apex of the abdomen; ovipositor slightly exerted.

Genotype: *Cerataspis clavata* Uchida, by original designation.

Key to the species of Acerataspis

1. First three abdominal tergites with *two*, parallel, longitudinal, dorsal carinæ. .... *sinensis*
   First three tergites, and sometimes the base of the fourth as well, with *three* parallel, longitudinal, dorsal carinæ. 2
2. Fourth abdominal tergite with longitudinal, dorsal carinæ on basal half; first tergite with apical angles yellow, and tergites two, three, and five in large part yellow. .... *formosana*
   Fourth abdominal tergite without longitudinal carinæ; fourth abdominal tergite in large part yellow, fifth yellow on posterior margin, others black. .... *clavata*

Acerataspis clavata (Uchida)

Cerataspis clavata Uchida, 1934, Trans. Sapporo Nat. Hist. Soc., **13**: 276

Acerataspis clavata Uchida, 1934, Ins. Matsumurana, **9**: 23

Type from Hikosan, Kiushu, Japan, in the Entomological Institute of the Hokkaido Imperial University. The species is also known from Tosa, Shikoku, Japan.

Acerataspis formosana Cushman

Acerataspis formosana Cushman, 1937, Arb. u. morph. u. tax. Ent. Berlin-Dahlem, **4**: 291

Type from Suisharyo, Formosa, in the Deutsches Entomologisches Institut.

Aceratapsis sinensis Michener, n.sp.

Female: Length 9 mm. (with the apex of the abdomen turned down). *Head* rather small, black, pubescence dull white, upper three-fourths of area between anterior margin of clypeus and antennal sockets yellow, lower margin of this yellow area arcuate concave, inner ocular orbits narrowly brown, more broadly black toward upper part of yellow area, so that yellow does not reach ocular margins; keel between antennal sockets yellow. Face below antennal sockets coarsely and confluently punctured; rest of head with smaller punctures, for the most part separated by less than their diameters; ocelli large, distance between posterior pair greater than an ocellar diameter, slightly less than distance to eye margin; genæ convex, about one-half as wide as eye. Antennæ dark brown, lighter beneath than above; mandibles dark brown medially; palpi dark brown. *Thorax* black, pubescence dull white, a minute dull yellow spot below each tegula, inner margins of scutellar processes brown, tegulæ dark brown. Thorax largely coarsely and closely punctate, lower lateral portions of pronotum impunctate, with about six longitudinal ridges; sternauli with punctures sparser than elsewhere on mesepisterna; posterior margins of mesepisterna and entire metapleura shining and nearly impunctate, the latter sclerite with a few small, scattered punctures above; basal depression of scutellum with three longitudinal carinæ; posterior processes of scutellum connected by a carina, the short median section of which is along the posterior margin of the scutellum; metanotum with a small, elevated, median area, margined on each side by an angulate carina; propodeum with a rather small basal median area, posterior to which is a broad area (see figure), completely separated from lateral apical areas. Fore legs dark brown, apices and anterior surfaces of femora yellow, and bases and anterior surfaces of tibiæ yellow; middle legs dark brown; hind legs black. Wings grayish as a result of numerous long hairs inserted on the nearly hyaline membrane; wing veins and stigma very dark brown; areolet not petiolate, but costally directed side very short. *Abdomen* with sterna yellow; terga one to three black, four orange yellow, the base black, the apical margin dark brown, five black with a subapical transverse, orange yellow band, six black. Pubescence of tergites one to four dull white, of following tergites black. Punctures of first three abdominal tergites coarse and approximate, of following tergites finer and more widely separated; third tergite nearly twice as broad as long, fourth slightly more than twice as broad as long; first three abdominal tergites with a pair of longitudinal, dorsal carinæ, parallel on first two tergites, slightly converging posteriorly on the third.

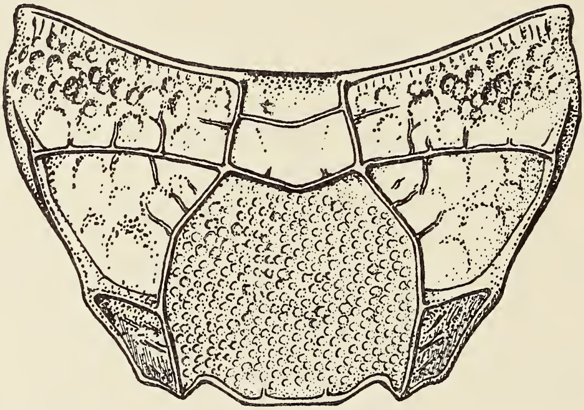

Fig. 1. Posterior dorsal view of propodeum of *Acerataspis sinensis* Michener.

Holotype female: Yim Na San, east Kwantung, south China, June 14, 1936 collected by Mr. J. Linsley Gressitt, on loan deposit to the California Academy of Sciences.

This species is easily distinguished from both of the previously described species of the genus by the presence of two instead of three longitudinal carinæ on the first three abdominal tergites. It differs further from *A. formosana* by the acarinate fourth tergite, the entirely black first three abdominal tergites, the largely yellow fourth, and the primarily black fifth tergite, and the black scutellum. It differs from *A. clavata,* in addition to the first character given, by the markedly different areolation of the propodeum and the nonpetiolate areolet. The color pattern is remarkably similar to that of *clavata.* The basal median portion of the propodeum is asymetrical in the holotype, as shown in the figure.

THE MATING HABITS OF THE WINTER MECOPTERON, *BOREUS BRUMALIS* FITCH.

By G. C. Crampton, Ph.D.

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The family Boreidæ contains the small winter scorpion-flies which differ from the bulk of their allies in that they are active during the winter, running about on the snow when most adult insects are dormant from the cold.

The life histories of the American species of *Boreus* have not been worked out in detail, but since their larvæ may be found in the moss about the roots of trees in cemeteries, or along the sides of wooded roads, at almost any time of the year, it is extremely probable that there is more than one generation a year. Pupæ found in the same situations, in the neighborhood of Amherst, emerged in late October; and it is probable that adults are to be found at that time, although they were not taken in the open until later in the year. The pupæ are not immobile, but wriggle about actively when they are removed from their pupal cavities in the earth about the moss roots.

Adult specimens of *Boreus* found on the snow in December and February [1] when brought indoors and placed in jars containing moss, in the hopes that they might oviposit in the moss, were too greatly excited by their unusual surroundings to oviposit, and spent most of the time climbing to the tips of the moss stems and jumping off like fleas toward the light of the windows in which the jars were placed. This leaping toward the source of light was not observed in any other Mecoptera; and the leaping habit exhibited by *Boreus* lends some weight to Tillyard's suggestion that *Boreus* is related to the ancestors of the fleas.

[1] The writer is deeply indebted to Dr. Inez Williams, formerly a student of the Massachusetts State College, for her assistance in collecting much of the material upon which these observations were made, during the winter of 1933.

As the females walked about over the moss in the jars, the males mated with them readily. As described by Withycomb, 1926, (Entomological Monthly Magazine, vol. 62, pp. 81-83) for the English species of *Boreus,* when mating takes place, a male runs up beside a female, and hooking his slender curved wings over her back, extends the end of his abdomen beneath her, and endeavors to lift her off her feet. If she does not struggle too strenuously, he usually succeeds in lifting her across his back, and grasping the parts with his genital forceps, he forces down the projecting valves of the eighth sternite of the female and inserts the intromittent organ into the genital aperture thus exposed.

As the female becomes quiescent, the male shifts her body along his back to the position shown in Figure 1, in which it may be seen that the male now holds the female by grasping her fore legs near the bases of her front femora by means of his wings; and her beak extends downward between his wings in the manner shown in the figure. The female is held in position at the terminal end by means of the male's genital forceps, or forcipate parameres, which grasp the terminalia of the female near the bases of the valves of her eighth sternite, the tip of the male's abdomen being turned up over his back in order to hold the intromittent organ within the aperture of the female above him, as is shown in the accompanying plate. In this position, the valves of the female's eighth sternite project ventro-caudad below the tip of the male's upturned abdomen, while the terminal segments of the female project posteriorly over the upturned hypandrium, or ninth sternite of the male, as is shown in the figure.[1]

The male carries the female about on his back in this manner for some time; and the muscles operating the genital forceps become so set during the process that a copulating pair may be lifted up on a piece of paper without becoming separated; and in several instances the writer succeeded in dumping them into hot fixing fluid without their becoming separated—as was the case with the pair from which the accompanying figure was made.

Egg laying probably occurs shortly after mating, although the writer did not succeed in observing the process. According to Withycomb, the eggs are deposited in moss.

[1] The writer is deeply indebted to Mr. Hagar, a former student of the Massachusetts State College, for making the accompanying figures.

The subgenital valves of the female are unique among the Mecoptera, and are borne on the eighth sternite like those of female Tipulidæ, although the female Diptera have sternal structures of the ninth sternite not present in the females of *Boreus*. It is possible that the valves of the eighth sternite of *Boreus* may represent the ventral valves of the ovipositor of female Orthoptera, but the exact homologies of these parts in female Diptera, *Boreus*, etc., have not been definitely determined.

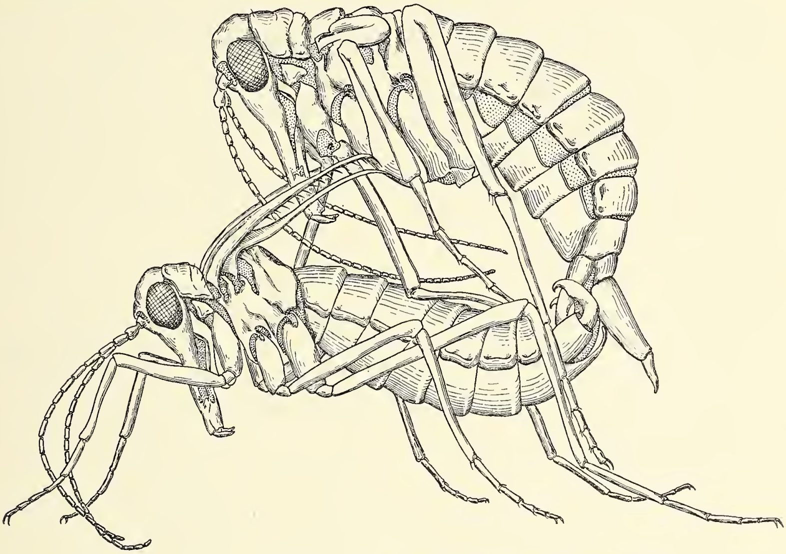

Fig. 1. Mating Position of *Boreus brumalis*.

Since female Tipulidæ use the slender flanged rigid cerci, which are shaped exactly like those of *Boreus*, to form the dorso-terminal portions of the egg-laying apparatus, it is probable that a female *Boreus* uses her terminalia in a similar manner to deposit her eggs in moss.

The terminal segments of the genital forceps of the male of *Boreus*, etc., represent the parameres of male Hymenoptera, etc., while the basal sclerites represent the parameral plates, as was pointed out by the writer in several publications. Recent morphologists, however, do not accept this interpretation, and homologize the segments of the forcipate genitalia of male Mecoptera, Diptera, Trichoptera, etc., with the coxites and styli of such primitive insects as *Machilis*, etc., despite the fact that the forcilate genitalia of male Hymenoptera (and Coleoptera) are clearly homologous with the forcipate genitalia of male Mecoptera, Diptera, Trichoptera, etc., and if the forcipate genitalia of male Hymenoptera and Coleoptera represent parameres, then the forcipate genitalia of all Holometabola represent parameres throughout the series of closely related insects.

There are marked sexual differences in the shape and structure of the vestigial wings of the two sexes of *Boreus*. As is shown in the accompanying figure, the wings of the male are slender curved tapering structures, and the front wings of the male are lined along both the anterior and posterior borders by a row of stout bristles to aid in holding the female in copula. The wings of the female, on the other hand, are flat lobe-like structures, having no apparent functional significance.

NEW CHRYSOPIDÆ FROM AUSTRALIA

By Nathan Banks

In Psyche vol. XVII, pp. 99 to 104, 1910, I described twelve new species of Australian Chrysopidæ, nine belonging to the genus Chrysopa as it has been used (though wrongly) for many years. I now add five new species, and give a new synoptic table for them.

Of those I have not seen are two that I consider distinct, *extranea* E. Petersen which I can place in the key from his figure of the wings, and *personata* Navas which, according to his figure, has quite different facial marks from any seen by me.

Three of the Navasian species, *deutera, reaumeri,* and *notosticta* have been placed by E. Petersen as synonyms of *Ch. ramburi,* and I believe correctly.

Ch. assimilata does not appear, from description, to differ from *Ch. innotata.*

The species described by Tillyard from Norfolk Island cannot be placed from his figures and descriptions until one has fresh material from that island; *C. leai* goes in the section of *edwardsi* and *extranea,* possibly also *C. arancariæ.* It would not be unusual if some of them occur in Australia, but I cannot fit any of the five new species described below to any of them. *Ch. olatatis* Bks. is possibly a male of *Ch. latotalis,* but of the many males of *latotalis* I have seen none that have the pale, slightly yellowish stripe from back of head along middle of thorax; the outward appearance of the genitalia is the same, but in *olatatis* (seen from behind) there is a plate above the edge of the last ventral segment with a straight upper margin, I do not see this in *latotalis; olatatis* is from Port Darwin, all the *latotalis* I have seen are from middle and north Queensland. *Ch. latotalis* is very similar to *Ch. basalis,* but without the dark mark on basal antennal joint; the external genitalia and the stigma appear the same.

SYNOPSIS OF SPECIES

1. More than seven cubital cross-veins beyond end of the divisory veinlet; palpi and pronotum marked with black. ....2.
   Normally but six or seven cubital cross-veins beyond the end of the divisory veinlet. ....3.
2. Divisory cell twice as long as broad; a dark spot at inner base of basal joint of antennæ. ....*edwardsi*
   Divisory cell about as broad as long; no such spot; a dark line between antennæ. ....*extranea*
3. Hind tibia but little more than three times as long as the tarsus, not swollen; usually two dark marks below antennæ, a dark line across pronotum, and two short marks each side, basal joint of antennæ usually with an upper and an outer dark mark and two lines on vertex. ....*ramburi.*
   Hind tibia more or less plainly swollen, and four times as long as tarsus, or longer, rarely the above marks on face and pronotum........4.
4. Basal antennal joint with dark mark on outer or inner side; antennæ always pale........5
   No dark marks on basal joint of antennæ, unless the antennæ are black, beyond second joint........7.
5. Gradates bordered with dark or yellowish. ....6.
   Gradates not bordered; a black mark between the antennæ at base; dark stripe on basal joint on both outer and inner sides........*signata.*
6. Veins bordered with yellowish; radial sector very sinuous; basal antennal joint with but one dark line; gradates pale........*irregularis.*
   Gradates dark and bordered with dark, also some other veins; basal joint of antennæ with two dark lines........*regularis.*
7. The divisory veinlet ends plainly before the cross-vein above; veins nearly all greenish; head, antennæ, and palpi pale, unmarked; gradates mostly remote from each other........*otalatis.*
   The divisory veinlet ends at or beyond the cross-vein above, at least normally. ....8.
8. A dark spot at base of the stigma; gradates bordered, pronotum and mesonotum with a dark spot each side. ....*jocaste.*
   No distinct dark spot at base of the stigma........9.
9. A distinct dark spot on radial sector more than half way to tip, and extending back on two veins; gradates faintly bordered; a dark spot under each eye; palpi marked with dark; a faint reddish stripe each side on pronotum........*signatipennis*
   Not as above ....10.
10. Many cross-veins as well as gradates bordered with dark; antennæ pale, a reddish mark under each eye........*traviata.*
    Cross-veins not plainly bordered........11.
11. Antennæ plainly dark beyond the second or third joints; head usually with red on vertex or face........12
    Antennæ not plainly dark; head without red marks on vertex........14.
12. Stigmal area between costa and subcosta practically without cross-veins, or only one near tip........13.

Stigmal area between costa and subcosta with several cross-veins and others broken in middle; base of divisory cell not thickened and but little oblique; the branches of radial sector but little bent at inner gradates; a large red spot just above base of each antennæ; antennæ dark from second joint out; seven cubital cross-veins beyond divisory. .... *darwini.*

13. The branches of radial sector at the inner gradates are scarcely bent; pronotum long; the antennæ are dark from beyond third joint; the base of divisory cell very oblique and very plainly thickened. .... *atalotis.*

The branches of radial sector at the inner gradates are strongly bent, so the continuation of each branch appears to come from the middle of the end of preceding cell; antennæ black beyond second joint; pronotum not so long; hairs on veins longer; base of divisory cell only slightly oblique and not thickened. .... *satilota.*

14. Cubitus dark; veinlets behind base of radial sector partly dark; outer gradates dark; seven cubital cross-veins beyond divisory cell; dark spots above base of wings. .... *alcines.*

Cubitus not darkened, gradates and various other cross-veins plainly dark; often a dot under each eye. .... *innotata.*

Neither cubitus nor gradates plainly dark .... 15.

15. Costal stigmal area with a few cross-veins and beyond are four cross-veins before end of subcosta (not clearly marked). .... *ramburi.*

Costal stigmal area tapering to tip and without cross-veins, except possibly one near tip. .... 16.

16. Base of divisory cell very oblique and thickened; pronotum as long or longer than broad; face not marked with reddish. .... *italotis.*

Base of divisory cell scarcely oblique and not thickened; divisory veinlet often ending at cross-vein above or just beyond; pronotum broader than long; in female sometimes two reddish spots above clypeus; in male the stigma is solid yellowish, much like *basalis.* .... *latotalis.*

Chrysopa edwardsi, sp. nov.

Face pale, a dark streak under each eye, and the lateral margins of clypeus dark; palpi pale, slightly marked with dark; antennæ pale, basal joint with an oblong brown spot on the upper inner side near base; pronotum green, with a median yellowish stripe, each side is a sinuous dark line, part way from middle to side, sometimes it is broken into two or three spots; near the posterior corner of pronotum is a dark brown spot; on each side of the anterior lobe of mesonotum is a dark spot; sometimes a dark line on each lateral lobe of the mesonotum; abdomen brownish, with a more or less plain dark streak each side. The fore wing has one or two dark dots at extreme base; nearly all cross-veins partly dark, usually at ends; the gradates, anals, and sometimes other veins near base wholly dark.

In hind wings the costals and many radial cross-veins dark, stigma not very distinct. The wings are fairly broad, almost acute at tips; the hairs on veins quite long; the gradates are in parallel series, the outer about seven, the inner usually ten, extending much basally; there are eight or nine cubital cross-veins beyond the divisory cell, the latter ends much beyond the cross-vein above, the cell being fully twice as long as broad; the post-cubital area is much wider than the costal, the second cubital cell scarcely longer than the third. In the costal stigmal area there are no cross-veins, but beyond are two or three, the branches of radial sector scarcely bent at inner gradates. In the hind wings the inner gradate series also extends basally; the triangular cell is quite long, and basal part of medius bends down in a gradual curve.

The pronotum is about as broad behind as long in middle, the sides sloping forward; the hind tibia not swollen.

Length of fore wing 16.5 mm., width 6 mm.

Two from "Australia, Edwards" (in M.C.Z.) and two from "Victoria, Australia, Edwards coll.", probably H. Edwards, in the Amer. Mus. Nat. Hist. Type M.C.Z. no. 25452.

Chrysopa edwardsi puncticollis n. var.

In general similar to the typical form, but the palpi are more heavily dark; on the pronotum besides the sinuous line each side, and the spot near posterior angle, there are three other spots on each side: one toward the front, one below it on the lower margin, and one behind the latter, visible only from below; the spot on basal joint of antennæ is rather reddish, and there are two short parallel reddish lines on middle of vertex.

Size as the type.

One from Tasmania. Type M.C.Z. no. 25453.

Chrysopa traviata sp. nov.

Pale yellowish green; a reddish spot under each eye, and usually a red line inward of it; last joint of palpi partly black; antennæ pale, unmarked, not very long. In fore wings the gradates are dark, and many cross-veins at ends;

the gradates, veins along hind margin, and most of the cross-veins, except costals and radials, bordered with pale brown; in hind wing the costals mostly dark. The wings are rather slender, almost acute at tip; the hairs on veins moderately long. In fore wing the gradates are in parallel series, but the inner further from outer than from the radial sector, about five gradates in each series, the branches of radial sector but little bent at inner gradates; six cubital cross-veins beyond the divisory cell, latter small, over twice as long as broad, ending at or beyond the cross-vein above, its base faintly thickened; second cubital cell but little if any shorter than the third; costal area no broader than post-cubital area, the latter but little broader than the cubital area; the costal stigmal area without cross-veins, but two or three beyond.

In hind wings the gradates, about four in each row, rather far apart; the triangular cell small, the union of radial sector and medius long, the basal part of medius quite suddenly bent down. Pronotum broader than long, sides nearly parallel, narrowed near front; hind tibia plainly swollen.

Length of fore wing 11 mm., width 4 mm.

Several specimens from Redlynch, North Queensland, 20 August to 14 October (Wind. coll.). Type M.C.Z. no. 25454.

Chrysopa jocaste sp. nov.

Head and thorax nearly white, abdomen yellowish, a small brown spot under each eye, palpi pale, unmarked, antennæ pale, becoming darker toward tip, pronotum with a large brown spot near each anterior corner, and a similar spot over base of fore wings. Wings with pale greenish venation, gradates and some other cross-veins more or less dark, the gradates and many other cross-veins and the marginal forks bordered or clouded with dark, the triangle below third cubital cell wholly clouded, a larger darker cloud over the radial sector just before stigma and extending back over the bases of two branches behind, these branches are nearer to each other at base than the others; at base of stigma is another brown spot over three brown cross-veins.

In hind wings the veins are pale, unclouded, but a dark dot at base of stigma. Wings moderately broad, acute at tips, hairs on veins rather short toward wing-base, plainly longer near tip.

In fore wing the gradates are parallel and nearer to each other than the outer row to the hind margin, about six in each row, those near base widely separated; six (or seven) cross-veins beyond the divisory, the latter ends at or just beyond the cross-vein above, the divisory cell twice as long as broad; branches of radial sector little bent at inner gradates; the costal space about as broad as the post-cubital, the latter much broader than the cubital area; costal stigma area without cross-veins, but one or two beyond.

In hind wing but two inner and five outer gradates, the triangular cell is slender and the free part of medius slopes down gradually.

Pronotum short, much broader than long, the sides slightly convex; hind tibia much swollen.

Length of fore wing 13.5 mm., width 5 mm.

One from Lankelly Creek, McIlwaith Range, Cape York, North Queensland, 8 June (Darlington). Type M.C.Z. no. 25455.

Chrysopa alcines sp. nov.

Body pale; the clypeus is plainly reddish; palpi and antennæ pale, unmarked, pronotum also; a dark spot above base of each wing; venation largely green, but in fore wings the cubitus from second cubital cell out is plainly brown; the outer gradates also brown, and the radials and some costals dark in middle; stigma indistinct.

The wings are moderately slender, tips rounded, the hairs on veins rather long; in fore wings the costal and post-cubital areas about equal in width, the post-cubital about a third broader than the cubital area; seven cross-veins beyond end of divisory cell, latter twice as long as broad, ending beyond the cross-vein above, second cubital plainly shorter than third; the gradates in nearly parallel series, about five or six in each row, inner row extending somewhat basally and is generally nearer to radial sector than to outer row; the branches of radial sector scarcely bent at inner gradates; costal stigmal area without cross-veins. In hind wing three inner gradates, one quite far basad, and five outer; the triangular cell is small, and the free base of medius curves strongly down.

Pronotum nearly as long as broad, sides parallel; hind tibia plainly swollen.

Length of fore wing 13.5 mm., width 4.5 mm.

From Middle Queensland (Perkins). Type M.C.Z. no. 25456.

Chrysopa darwini, sp. nov.

Body pale yellowish, tip of abdomen darker; palpi pale, unmarked, antennæ from second joint out dark, but fading before middle, above each antenna is a large deep red spot in the depression, the basal joint of antennæ also slightly reddish above; the pronotum shows faintly some reddish on each side-margin; veins and cross-veins green in both front and hind wings, stigma not conspicuous. The wings are moderately slender, not acute at tips, hairs on veins fairly long. In fore wings the gradates are parallel, the outer as near inner as to hind margin, the outer of seven, the inner of six veinlets, but the basal one is far before the others, the branches of radial sector only a little bent at inner gradates; seven cubital cross-veins beyond the divisory, the latter ending only a little beyond the cross-vein above, the cell more than twice as long as broad, the base of cell only a little oblique and not plainly thickened, the second cubital cell is much shorter than the third; the costal area hardly broader than the post-cubital area, latter only a little wider than the cubital area; the costal stigmal area has no cross-veins, but two or three beyond. In the hind wings the triangular cell is fairly long and the free base of medius curved gently; there are four inner and five outer gradates, about parallel and the outer row about as near inner row as to outer margin.

The pronotum is about as long in middle as broad behind, narrowed near front; the hind tibiæ are plainly swollen.

Length of fore wing 14 mm., width 5 mm.

One from Port Darwin (Dodd coll.). Type M.C.Z. no. 25457.

NEW SPECIES OF NORTH AMERICAN DIPLOTAXIS (COLEOPTERA; SCARABÆIDÆ)

By Mont A. Cazier

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The new species presented in this paper were found among material submitted for determination by various friends. The writer would like to express his sincere thanks and appreciation to O. L. Cartwright and R. H. Baker for making available the Mexican material which is so closely allied to the Texas and Arizona fauna. Thanks are also due L. W. Saylor, W. F. Barr, R. G. Dahl, K. S. Hagen and J. C. von Bloeker for material loaned during the course of these studies.

The descriptions are arranged so that the diagnostic portion includes the main characters used by Fall [1] (1909) in his key. This will enable the reader to refer directly to the most closely allied species.

Diplotaxis arta Cazier, new species

Small, black; upper surface glabrous; labrum broadly, arcuately emarginate; mentum horizontal, slightly convex behind, strongly declivous at anterior third, the declivity margined by an acute arcuate raised line and a row of erect setæ; pronotal angles not impressed, sides not bisinuate; front of head without convexity; metasternum normally long, elytra not connate; ungual tooth short, nearly perpendicular to claw, median in position; clypeus rotundate, anterior margin subtruncate medially.

Head densely punctate, punctures coalescent or separated by about one-fourth their own widths, front on same plane as clypeus; clypeus punctate as in front, clypeal structure broadly interrupted medially, side margins shallowly sinuate

[1] Fall, H. C., 1909, Revision of the Species of Diplotaxis of the United States. Trans. American Entom. Soc. 35:1-97.

medially, anterior margin subtruncate medially, angles evenly rounded, margins shallowly reflexed. *Pronotum* as wide as humeral angles of elytra, side margins evenly rounded, widest about middle; anterior margin nearly as wide as basal margin; disk with large punctures separated by about their own widths, more dense laterally, without lateral impressions. *Elytra* with sides subparallel to apical sixth, evenly rounded to apex, margins clothed with short erect pile; humeral and apical umbones prominent; surface irregularly punctate, punctures separated by about twice their own widths, costæ obscure, not elevated. *Undersurface* clothed with short golden pile; anterior tibiæ tridentate, basal tooth median in position, hind femora sparsely punctate throughout outer surface, hind coxæ sparsely punctate on apical half, posterior tarsi equal in length to hind tibiæ. Length 9 mm., width 4.5 mm.

Holotype in the writer's collection, taken in Cedar Canyon, Providence Mountains, San Bernardino County, California, June 10, 1940 by W. F. Barr on *Franseria eriocentra* Gray. Five paratopotypes deposited in the collections of W. F. Barr and the author.

Diplotaxis arta Cazier is most closely allied to *Diplotaxis fimbriata* Fall but can be distinguished from that species by its narrower pronotum, subparallel elytra, prominent humeral umbones, by having the pronotum and elytra fimbriate with short golden hairs and by having the metasternum longer. The metathoracic wings in this species are more highly developed than those of *D. fimbriata*. From *D. pacata* Lec. it can be distinguished by its more parallel form, larger and more densely placed punctures throughout, by lacking the lateral pronotal impressions, by having the side pronotal margins evenly rounded rather than subangulate and by its indistinct elytral costæ. It can be distinguished from *D. brevidens* Lec. by its subtruncate anterior clypeal margin, evenly convex and wider front of the head, by its less angular side pronotal margins and by its less hairy posterior tibiæ.

Diplotaxis ungula Cazier, new species

Medium sized, reddish-yellow; upper surface glabrous; labrum broadly accurately emarginate; mentum subhorizontal and nearly flat posteriorly, declivous in front, declivity margined posteriorly by a more or less acute arcuate raised line and a row of erect setæ; pronotal angles not impressed, side margins not distinctly bisinuate; front of head without post clypeal convexity; metasternum normally long; ungual tooth antæ-median in position, shorter than superior portion of claw; anterior clypeal margin shallowly sinute medially; sides of pronotum strongly, subangularly rounded at middle, not sinuate before or behind; clypeal margin broadly reflexed.

Head densely punctate, punctures separated by about one-fourth their own widths or coalescent, sparsely clothed with short golden pile; clypeus densely punctate, punctures separated by about one-fourth their own widths or coalescent, surface sparsely clothed with short golden pile; clypeal suture widely interrupted medially, margins strongly reflexed, anterior more strongly than lateral, anterior margin subtruncate or shallowly emarginate medially, lateral margins convex medially shallowly produced posteriorly at juncture with canthi, canthi strongly angulate in front of eyes. *Pronotum* shallowly convex, side margins prominently subangular at middle, margins in front and behind nearly straight, anterior angles not prominent; anterior margin narrower than posterior margin; surface moderately punctate, punctures separated by about twice their own widths. *Elytra* widest at about apical third; humeral and apical umbones prominent; surface with costæ obscure but present, first intercostal space irregularly punctate, punctures separated by about twice their own widths, second intercostal space with single irregular row of punctures. *Undersurface* sparsely clothed with rather long golden pile; anterior tibiæ strongly tridentate, basal tooth slightly post-median in position, tarsi longer than tibiæ, tibiæ clothed with long golden pile on inner surface, tarsal claws long, cleft subapically, inner tooth truncate. Length 11 mm., width 5.4 mm.

Holotype for Eagle Pass, Texas, March 30, 1908 returned to L. W. Saylor of the United States Biological Survey for deposition in the United States National Museum. One paratopotype in the writer's collection.

This species appears to be closely allied to *Diplotaxis sulcatula* Fall and *D. beyeri* Schaeffer. It can be separated from *D. sulcatula* by its angulate side clypeal margins, by its more angulate side pronotal margins, by its more proximally placed basal tooth of front tibiæ, by the long pile on the tibiæ and by the longer tarsal claws. From *D. beyeri* it can be distinguished by its subtruncate anterior clypeal margin and convex rather than sinuate side clypeal margins, by its less densely punctate pronotum and by the long tibial pile. From *D. illustris* Fall it can be separated by its reddish-yellow color, by its more strongly reflexed clypeal margins, by its angulate canthi, more strongly rounded lateral pronotal margins, by its much wider anterior tibiæ, by the post-median position of the basal tooth of the anterior tibiæ, and by the less dense tibial pile.

Diplotaxis bakeri Cazier, new species

Medium sized, black; upper surface glabrous; labrum broadly, arcuately emarginate; mentum feebly oblique behind, strongly declivous in anterior two-fifths, declivity concave from side to side, posterior margin convex but without raised line or setæ; thoracic angles not impressed; hind femora impunctate between submarginal rows of setigerous punctures; tarsal claws post median in position.

Head with punctures separated by about their own widths above, more densely placed anteriorly, front only slightly raised along clypeal suture; clypeus densely punctate, punctures separated by about one-fourth their own widths, suture entire, margins shallowly reflexed, anterior margin shallowly sinuate medially, angles evenly rounded, side margins shallowly sinuate, canthi not angulate; antennæ ten-segmented. *Pronotum* convex, side margins subangulate medially, sides strongly constricted anteriorly, narrowly constricted basally, anterior angles sparsely produced; anterior margin narrower than basal margin; surface shining, sparsely minutely punctate, punctures separated by two to three times their own widths, more closely placed laterally, medially with faint indication of longitudinal impression. *Elytra* with shallow costæ evident, intercostal spaces irregularly punctate, punctures separated by about one to two times their own widths, surface minutely alutaceous, costæ with single median row of small punctures; humeral umbone prominent; sides widest at apical third, evenly rounded apically. *Undersurface* sparsely clothed with short golden pile; anterior tibiæ tridentate, basal tooth slightly ante-median, tarsal claws with inner, truncate tooth ante-median, hind tarsi shorter than hind tibiæ. Length 10 mm., width 5.5 mm.

Holotype in the writer's collection, taken at Rancho La Golondrina, Rio Sabinas, Muzquiz, Coahuila, Mexico, June 28, 1938 by Rollin H. Baker after whom the writer takes pleasure in naming this species. Forty-three paratopotypes deposited in the collections of O. L. Cartwright, R. H. Baker and the author.

This species appears to be most closely allied to the Texan *Diplotaxis belfragei* Fall but can be readily distinguished from it by having the mentum declivous from anterior two-fifths rather than the middle, by its smaller size, generally more strongly angulate side pronotal margins, by the smaller less dense pronotal punctures and by its longer truncate ungual tooth. The mentum is somewhat variable in the type series and might conceivably allow specimens to be keyed out to the bracket including *D. mœrens* Lec. and *D. punctipennis* Lec. in Fall's key. *Diplotaxis bakeri* can be separated from *D. mœrens* by its shallowly emarginate labrum, more sparsely and finely punctate pronotum and by its more strongly declivous mentum. From *D. punctipennis* it can be separated by its distinctly sinuate side clypeal margins, by the smaller and more sparsely placed pronotal punctures and by having the inner truncate tooth on the anterior tarsal claws distinctly shorter than the claw proper. *Diplotaxis bakeri* superficially resembles *D. maura* Fall but can be distinguished from that species by having the pronotal punctures smaller and more sparsely placed, by having the basal tooth of the front tibiæ more nearly median in position and by having the tarsal claws more deeply cleft.

Diplotaxis volatica Cazier, new species

Small, reddish-brown; upper surface glabrous; labrum broadly, arcuately emarginate; mentum feebly oblique behind, strongly declivous for anterior two-fifths; declivity concave from side to side, posterior margin of declivity arcuate, without raised line or setæ; pronotal angles not impressed; hind femora sparsely punctate between submarginal rows of setigerous punctures; hind coxæ punctate in outer half; pronotum without impressed line along anterior border, anterior angles moderately prominent; tooth of tarsal claws ante-median in position.

Head with large asperate punctures above separated by about one-fourth their own widths, more densely placed along clypeal suture, front evenly rounded; clypeus densely punctate, punctures coalescent at base, clypeal suture entire, nearly straight medially, margins moderately reflexed, anterior and side margins shallowly sinuate medially, anterior angles evenly rounded, canthus angulate subapically. *Pronotum* with side margins subangulate medially, anterior angles prominent; anterior margin not impressed, narrower than posterior margin; surface minutely alutaceous, sparsely punctate, punctures separated by about twice their own widths, median longitudinal impression faint. *Elytra* widest at apical third; humeral umbones prominent; surface strongly alutaceous, costæ distinct, intercostal spaces irregularly punctate, punctures separated by two to three times their own widths, costæ with single row of median punctures. *Undersurface* with very short, sparse, golden pile; anterior and middle legs with tarsi distinctly longer than tibiæ, anterior tibiæ tridentate, basal tooth slightly in front of middle, tarsal claws with inner truncate tooth slightly ante-median in position. Length 8 mm., width 4.3 mm.

Holotype in the writer's collection, taken at Rancho La Golondrina, Rio Sabinas, Muzquiz, Coahuila, Mexico, June 28, 1938 by Rollin H. Baker. One paratopotype in the collection of O. L. Cartwright.

This species is most closely allied to *Diplotaxis bakeri* Cazier but can be separated by its smaller size, reddish-brown color, by the large asperate punctures on the front of the head and by the longer anterior tarsi. From *D. haydenii* Lec. it can be separated by its unimpressed anterior pronotal margin, by the ante-median tooth on the tarsal claws and by the asperate punctures on the head.

Diplotaxis completa Cazier, new species

Rather large, reddish-brown; upper surface glabrous; labrum broadly, arcuately emarginate; mentum strongly declivous at anterior third, margin without raised line, setæ absent at middle; hind femora with sparse irregular punctures between submarginal rows of setigerous punctures, hind coxæ sparsely punctate in outer half; pronotum without impressed line along anterior margin.

Head with larger punctures above separated by about their own widths, more densely placed toward anterior depression, interspaces finely punctate, front above clypeal suture abruptly elevated, surface sparsely punctate, front above slightly impressed; clypeus densely punctate, punctures close set or confluent, clypeal suture narrowly interrupted at middle, margins abruptly, prominently reflexed, side margins nearly straight, anterior margin shallowly sinuate medially, anterior angles evenly rounded, canthi evenly rounded. *Pronotum* widest slightly behind middle, evenly rounded basally, shallowly sinuate apically, anterior angles prominent; anterior margin narrower than basal margin; surface sparsely punctate, large punctures separated by about twice their own widths, interspaces finely punctate. *Elytra* widest at middle; humeral and apical umbones prominent; surface with costæ faint but indicated, intercostal spaces irregularly punctate, punctures separated by about three times their own widths, surface minutely alutaceous, costæ with single, median row of small punctures. *Undersurface* sparsely clothed with short golden pile; anterior tibiæ tridentate, basal tooth slightly in front of middle, hind tarsi longer than tibiæ, tarsal claws with inner tooth slightly ante-median, strongly truncate. Length 12.5 mm., width 6.1 mm.

Holotype in the writer's collection, taken at Serranias del Burro, Coahuila, Mexico, June 18, 1938 by Rollin H. Baker.

This species is most closely allied to *Diplotaxis dentella* Fall and *D. statura* Cazier. It can be distinguished from *D. dentella* by its more widely reflexed clypeal margin, by its evenly rounded canthi, by its more sparsely punctate front, the smooth anterior depression on the front above the clypeal suture, by its less elevated elytral costæ and longer tarsi. From *D. statura* it can be separated by its more widely reflexed anterior clypeal margin, more prominent anterior pronotal angles, by its wider and more densely punctate elytral intercostal areas, more weakly defined costæ, by the presence of the alutaceous elytral sculpturing and the more antemedian tooth of the tarsal claws.

Diplotaxis statura Cazier, new species

Rather large, head black, pronotum cupreous black, elytra dark reddish-brown, shining; upper surface glabrous; labrum broadly, arcuately emarginate; mentum strongly declivous at anterior third, margins without raised line, setæ absent at middle; hind femora with sparse irregular punctures between submarginal rows of setigerous punctures, hind coxæ sparsely punctate in outer half; pronotum without impressed line along anterior margin.

Head with punctures above separated by about their own widths, sparsely punctate along clypeal suture; clypeus with punctures separated by about one-half their own widths, margins shallowly reflexed, side and anterior margins shallowly sinuate medially, clypeal suture entire. *Pronotum* widest at middle, sides nearly straight to base and apex, anterior angles not prominent; anterior margin narrower than posterior; surface shining, sparsely, finely punctate, punctures separated by about twice their own widths, interspaces minutely punctate. *Elytra* widest about middle, humeral and apical umbones prominent; surface shining, costæ distinct, intercostal spaces sparsely punctate, punctures separated by about three times their own widths. *Undersurface* sparsely clothed with short golden pile; anterior tibiæ tridentate, basal tooth slightly ante-median, tarsi longer than tibiæ, inner tooth of tarsal claws median in position, truncate. Length 12 mm., width 6 mm.

Holotype in the writer's collection, taken at Buena Vista, Sierra de la Encantada, Coahuila, Mexico, Elevation 6000 ft., July 7, 1938 by Rollin H. Baker.

Diplotaxis statura Cazier is most closely allied to *D. dentella* Fall and *D. completa* Cazier. It can be separated from *D. dentella* by its shining, less densely punctate elytra, complete clypeal suture, and longer tarsi. From *D. completa* it can be distinguished by its less widely reflexed anterior clypeal margins, less prominent anterior pronotal angles, by its narrower, less densely punctate elytral intercostal spaces, more prominent elytral costæ, by the absence of the alutaceous elytral sculpturing and the median position of the tooth on the tarsal claws.

Diplotaxis cartwrighti Cazier, new species

Medium sized, dark reddish-brown; upper surface glabrous; labrum broadly, arcuately emarginate; mentum feebly oblique behind, strongly declivous for anterior half, declivity concave from side to side, without raised line; thoracic angles not impressed; hind femora nearly impunctate between the submarginal rows of setigerous punctures; tooth of tarsal claws ante-median.

Head with punctures above separated by about their own widths, more densely placed below, front nearly on same plane as clypeus; clypeus densely punctate punctures separated by about one-fourth to one-half their own widths, clypeal suture entire, anterior margin rather deeply sinuate medially, lateral margins shallowly sinuate medially, margins shallowly reflexed. *Pronotum* shining, convex, widest at middle, sides evenly rounded from base to apex, anterior angles not prominent; anterior margin narrower than basal margin; disk with punctures separated by two to three times their own widths. *Elytra* widest about middle, humeral and apical umbones prominent; surface opaque, sericeous; costæ faint but evident, intercostal spaces irregularly punctate, punctures separated by about twice their own widths. *Undersurface* sparsely clothed with short golden pile; anterior tibiæ tridentate, basal tooth slightly ante-median, posterior tarsi equal in length with tibiæ, inner tooth of tarsal claws truncate, ante-median in position. Length 11 mm., width 6 mm.

Holotype in the writer's collection, taken at Tanque de Malone La Babia, Coahuila, Mexico, June 20, 1938, by Rollin H. Baker. One paratype from Serranias del Burro, Coahuila, Mexico, June 18, 1938 (Rollin H. Baker) in the collection of O. L. Cartwright. The writer is pleased to name this species in honor of Mr. Cartwright who made available much of the material herein described.

The paratype specimen has the elytra shining and much less alutaceous than the type. Otherwise, they are similar.

This species is most closely related to *Diplotaxis stabilis* Cazier but can be distinguished from it by its smaller size, convex pronotum, alutaceous elytral sculpturing and longer tarsi.

Diplotaxis stabilis Cazier, new species

Large, dark reddish-brown; upper surface glabrous; labrum broadly, arcuately emarginate; mentum feebly oblique posteriorly, strongly concave from middle to front, without trace of transverse ridge, setæ absent; pronotal angles not impressed; hind femora nearly impunctate between the submarginal rows of setigerous punctures; tooth of tarsal claws post median.

Head irregularly punctate, dense medially and toward clypeus, area immediately posterior to clypeal suture more sparsely punctate, front on same plane as clypeus; clypeus densely punctate, punctures separated by about one-half their own widths or less, clypeal suture entire, anterior and lateral margins moderately reflexed, shallowly sinuate medially, anterior angles evenly rounded, canthi subangulate. *Pronotum* with side margins evenly rounded from base to apex, widest just back of middle, anterior angles somewhat prominent, not impressed behind; disk with punctures separated by about twice their own widths, interspaces minutely punctate. *Elytra* widest at about apical third, humeral and apical umbones prominent; surface shining, costæ rather flat but distinct, intercostal spaces irregularly punctate, punctures separated by two to three times their own widths. *Undersurface* sparsely clothed with short golden pile; anterior tibiæ tridentate, basal tooth slightly in front of middle, posterior femora with few minute punctures between the submarginal rows of setigerous punctures, hind coxæ sparsely punctate in outer half, hind tarsi shorter than tibiæ, tarsal claws with inner tooth strongly truncate, ante-median in position. Length 12.5 mm., width 6.8 mm.

Holotype in the writer's collection, taken at Mesa de la Encontada, Sierra de la Encontada, Elevation 7000 feet, Coahuila, Mexico, July 21, 1938 by Rollin H. Baker.

Most closely allied to *Diplotaxis belfragei* Fall but distinguishable from it by its less angulate side pronotal margins, smaller punctures throughout, shorter tarsi and by the more ante-median tooth of the tarsal claws.

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PSYCHE

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All new genera, new species and new names are printed in SMALL CAPITAL LETTERS.

CAMBRIDGE ENTOMOLOGICAL CLUB

A regular meeting of the Club is held on the second Tuesday of each month (July, August and September excepted) at 7.45 p.m. in Room B-455, Biological Laboratories of Harvard University, Divinity Ave., Cambridge. Entomologists visiting Boston are cordially invited to attend.

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VOL. XLVIII MARCH, 1941 No. 1

THE GENERAL MORPHOLOGY OF THE FEMALE REPRODUCTIVE SYSTEM OF A VIVIPAROUS ROACH, *DIPLOPTERA DYTISCOIDES* (SERVILLE)

By Harold R. Hagan

College of the City of New York

This widely distributed roach is rather robust and broad yet only three-fourths of an inch in length. It was collected by the author and an assistant, Mr. Francis Yap, some years ago in the Hawaiian Islands. This work on it was undertaken only last summer at the Biological Laboratories, Harvard University, where facilities were provided through the courtesy of Professors C. T. Brues, A. B. Dawson and Leigh Hoadley. Acknowledgement should likewise be made for the results obtained by my colleague, Professor James I. Kendall, in photographing sections not especially favorable for photomicrographs.

The method of reproduction by this roach made an examination of the genital tract eventually inevitable though only its general conformation will be given here. Fortunately, Snodgrass (1933) has rendered the task much easier by his excellent illustrations and detailed description of these parts in *Blatta orientalis*. The reproductive systems of the two species possess similar subdivisions varying only in their shapes, relative sizes and functions. To reveal these homologies, the reproductive system of *B. orientalis* has been shown in figure 1. It will at once be seen that the vestibule has been shortened in the viviparous species to be described while, on the other hand, *orientalis* possesses the rudiments of a genital pouch above and a brood sac below the junction of the oviduct with the genital chamber. These rudiments may have no important specific function in this species for, it will be recalled, the female is oviparous and utilizes the vestibular portion of the genital chamber for oöthecal formation and placement of the eggs within the oötheca cast there. Figure 2 gives diagrammatic dorsal and lateral views of this system in *D. dytiscoides.* The brood sac is somewhat enlarged and asymmetrical in shape for eggs with young embryos are enclosed. They are placed diagonally because their slightly narrower micropylar ends, occupying less space, are directed toward the left.

Six ovarioles comprise an ovary which is cone-shaped with the base resting on the distal end of a paired oviduct. Each ovariole tapers anteriorly to the germarium and terminal filament in the usual fashion. The former contains twenty or thirty oögonia within its lumen and there are always seven or eight clearly discernible oöcytes within the vitellarium or lower portion of the ovariole; two more than shown in the upper ovariole in the figure, for only part of the

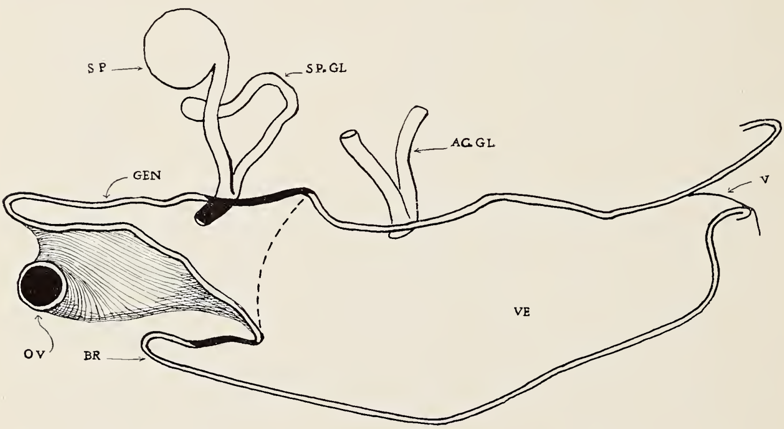


Figure 1. *Blatta orientalis.* Diagrammatic median section through the genital chamber of the female reproductive system. AC.GL, accessory gland; BR, rudiment of a brood sac; GEN., rudiment of a genital pouch; OV, cross-section of proximal end of left oviduct; SP, spermatheca; SP.GL, spermathecal gland; V, vulva; VE, vestibule. (Redrawn and relabelled from Snodgrass, 1933: Smithsonian Miscellaneous Collections, v. 89, no. 8)

seventh is visible at the left. Their panoistic arrangement and structure are typical of roaches.

The paired oviducts are short, stout tubes which convey the oöcytes from the ovaries. Each bears a slightly dilated distal end which might be termed the calyx of the oviduct. From the latter arise six terminal or subterminal urn-shaped pedicels. The lumen of the pedicel is continuous with that

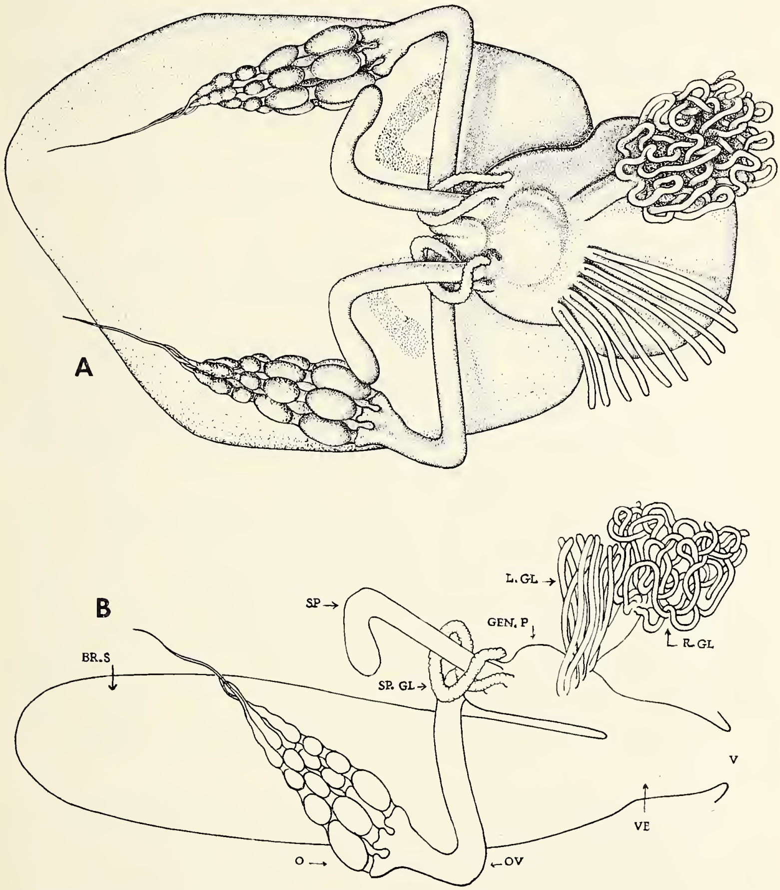


Figure 2. *Diploptera dytiscoides.* Diagrammatic views of the female reproductive system. A, dorsal aspect above; B, lateral aspect below. BR.S, brood sac; GEN.P, genital pouch; L.GL, left accessory gland; O, ovary; OV, oviduct; R.GL, right accessory gland; SP, spermatheca; SP.GL, spermathecal gland; V, vulva; VE, vestibule.

of the calyx but distally it ends blindly. The proximal end of an ovariole joins the blind end of each pedicel.

The wall of the paired oviduct is muscular while its lumen is lined by an epithelium which may be thrown into deep folds when it contains no oöcyte. Each oviduct extends a short distance ventrally and posteriorly, then bends abruptly toward the midline of the body. As the two meet each turns sharply posteriorly. At this point they are enclosed in a common peritoneum and musculature but their lumens are quite independent. This condition is illustrated by Plate 1, fig. 4 which also shows the epithelial folds previously mentioned. The united oviducts discharge almost immediately into the median oviduct. The latter is much abbreviated, lies within the wall of the atrium and differs from a paired oviduct only in the possession of a smooth, fairly thick, internal cuticula.

The genital chamber, or vagina as it is frequently termed, continues the tract to its external opening. It is by far the largest part of the reproductive system and the most interesting to the student of viviparity. The illustrations show it to be divided into a genital pouch or atrium, a brood sac or uterus and a vestibule. All bear a heavy musculature, but that of the uterine portion is much greater for from this chamber parturition takes place.

The genital pouch has a flat floor whose cuticula is irregularly folded over its posterior half. At the proximal margin it bends downward and becomes continuous with the roof of the underlying uterus. Its roof bears a slight elevation where the median oviduct joins it anteriorly, and a more pronounced central dome which, no doubt, facilitates the tilting of the eggs as they pass into the uterus. From its dorsal surface, too, various glands and the spermathecæ project into the body cavity. They will be discussed presently.

Considerable activity is centered in the genital pouch. In it the oöcytes are inseminated, directed into the brood sac and provided with an oötheca. These activities are coordinated by the operation of the valves of the ovipositor which lie in its lumen. In addition, the spermatophores from the male are deposited here till further disposition is made of their essential elements.

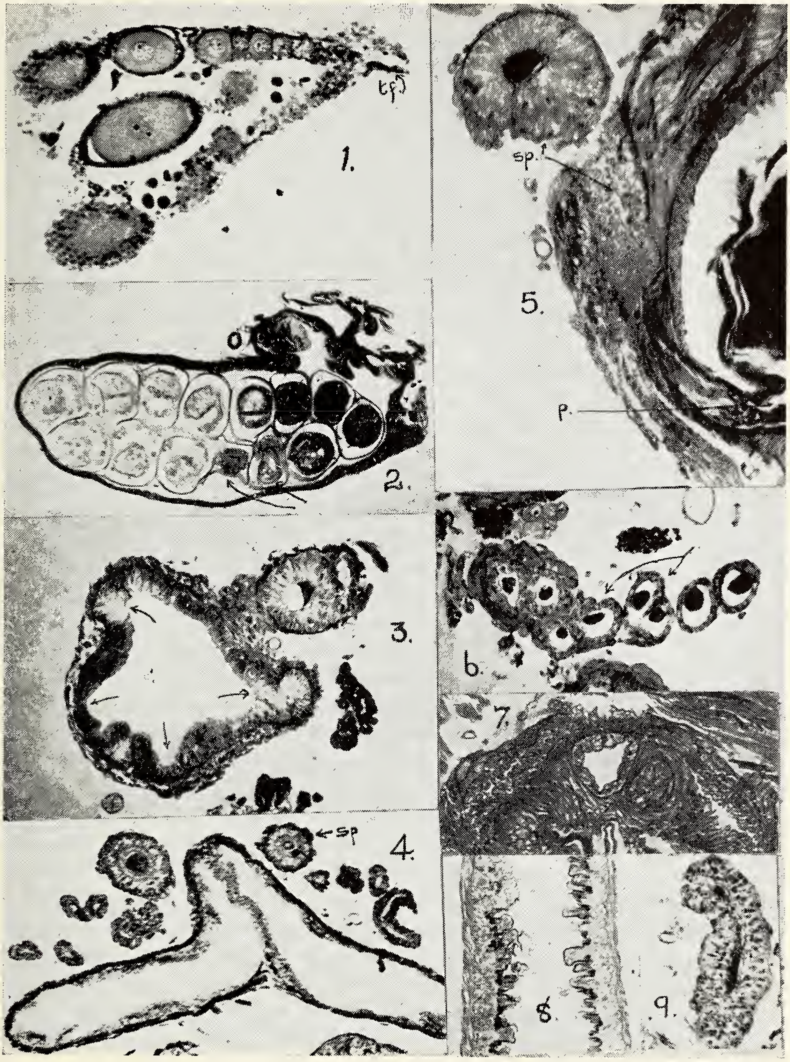
The uterine portion is huge compared with the rest of the tract and is capable of enormous distention during gestation. Plate 1, fig. 2 is particularly striking since fourteen developing eggs may be seen in it, while twelve is the usual number. The arrows point to two embyros which will not survive for they are forming in immature oöcytes. An empty uterus is always much folded and its cuticula and epithelium are thrown into massive fungiform papillæ. The vestibule is short, connecting with both atrium and uterus anteriorly and opening to the outside of the body by means of the posteriorly situated vulva. It is quite muscular and the intima is beset with low conical papillæ, each bearing a delicate seta.

The spermathecæ are two simple, tubular glands. Each projects into the body cavity from the roof of the genital pouch on either side of the elevation formed by the insertion of the oviduct. Their muscular walls enclose a remarkably tall, columnar epithelium with a cuticula bordering the relatively narrow lumen. The spermatozoa are bent in an arc at right angles to the length of the organ, hence the oldest gametes must be situated farthest from the opening in the atrium. The proximal ends of the spermathecæ traverse the distal wall of the latter and open from papillæ above the gonopore. A laterally placed spermathecal gland entwines each spermatheca and accompanies it through the atrial wall. This gland possesses an irregular superficial outline, thick walls and a narrow lumen. The latter is constantly filled with an intensely basophilic secretion.

Posterior to the median dome in the roof of the genital pouch lie two large glands. The left one is termed a crystalloid gland for its lumen always seems to contain granular secretions. Perhaps it, too, contains the proteinaceous basal substances which form the oötheca and thus conforms to the glands studied by Bordas (1909), Ito (1924), Pyror (1940) and others. Because of its persistent secretory activity, however, it may be a nutrient organ for the embryos. Its duct, upon leaving the lumen of the atrium, widens into an ampulla or reservoir, narrows quickly again, then branches four times toward the left to produce five tubes which reach the surface of the atrium. Just at the surface each one divides again to thrust a total of ten simple tubes straight upward into the hæmocœlar space. The arrows indicate two steps in such a division of the ducts though only eight of the ten branches are visible in Plate 1, fig. 6. Adjacent to this gland another is found to the right of the median line. Its general course is the same in the atrium but its walls are thick and the lumen practically closed. It appears in the hæmocœle as a stout column with an open lumen terminating in a calyx. From the latter arise approximately twenty very long, narrow, simple glandular tubes which coil around one another to form a compact knot. Its function is problematical. The six valvulæ of the ovipositor are approximately uniform in length yet no longer than the largest in *B. germanica.* They are, however, narrower and more delicate organs in *D. dytiscoides* than in the latter species. Two pairs are wide basally but taper distally to smoothly rounded tips. The valvulæ of the third pair are very slender throughout their length. They are not illustrated.

This, very briefly, is an outline of the female reproductive system of *Diploptera dytiscoides.* While its component elements introduce no new structures which *B. orientalis* lacks, still some of them vary greatly from the latter species that maternal care and incubation may insure viviparity. Such changes include a reduction in the number of ovarioles with a consequent limitation of the offspring to be accommodated at any one time. The lowered reproductive rate may also be associated closely with the apparent necessity for maternal nutrition of the embryos till hatching and birth, and the possible modification of the nature of the secretion from the right gland to furnish the required amount of nutriment. The oötheca, in turn, is reduced to a thin membrane which only partially envelops the egg mass and never turns brown upon contact with the products of the right gland as Pyror states is the case in oviparous species. Finally, the uterine portion of the genital chamber is definitely established as an enormous incubatory receptacle for the embryos till hatching. The maintenance of oviparous parts and accessories in the viviparous production of offspring once more recalls the old adage that "morphology is more conservative than physiology."

PSYCHE, 1941 VOL. 48, PLATE I.



Hagan — *Diploptera dytiscoides*

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Explanation of Plate 1

Diploptera dytiscoides. 1. Median section of ovary showing six follicles in an ovariole, part of a seventh, the germarium and two terminal filaments (tf). Portions of two other ovarioles are less complete. 2. The genital chamber, with genital pouch, brood sac (including 14 ova), portions of accessory glands, and vestibule. 3. Calyx of oviduct with part of one pedicel and basal attachments of others. 4. Sagittal section of paired oviducts and their junction to meet the common oviduct. 5. Cross-section of spermatheca (sp) and parasagittal section of its proximal end which terminates in a papilla (p) within the genital pouch. 6. Left accessory gland in cross-section near external surface of pouch. 7. Cross-section of left and right accessory glands as they penetrate wall of the genital pouch. 8. Fungiform papillæ lining empty brood sac. 9. Median section of portion of spermathecal gland. All figures greatly enlarged photomicrographs by Dr. J. I. Kendall.

WEST INDIAN CARABIDÆ VI.
THE JAMAICAN SPECIES, AND THEIR WINGS

By P. J. Darlington Jr.
Museum of Comparative Zoölogy

This paper is the sixth of my series on the carabid beetles of the West Indies. It is the first comprehensive treatment of the Carabidæ of Jamaica. All known Jamaican species (80) are listed taxonomically, and the list is annotated with data on the insects' wings and flight. At the end of the list, the distribution of flying and flightless species in Jamaica is summarized and discussed. The facts here put on record concerning the atrophy of wings of certain species in the mountains of Jamaica will be referred to again in a paper which I have in manuscript, on the wings of Carabidæ of mountains and islands.

The Museum of Comparative Zoölogy possesses a good representation of Jamaican Carabidæ collected by Mr. A. E. Wight, Prof. C. T. Brues, Mr. Chester Roys, and myself, and by some other persons. Besides this, I have had for study as a loan from the United States National Museum about 320 specimens of Carabidæ collected in Jamaica by Dr. E. A. Chapin and Dr. R. E. Blackwelder during the winter of 1937. This borrowed collection really provided the stimulus which has called forth the present paper. It adds several genera and species to the Jamaican list, and contains also numerous specimens taken "flying at dusk" in nets attached to automobiles. Records of species taken actually in flight are unusual, and are very interesting in connection with my studies of Carabid wings.

Species included in the following list without exact locality data are known in Jamaica only from the lowlands, below 1,000 ft. altitude, or are known merely from "Jamaica," presumably from low altitudes. Species noted as "winged" have the inner wings fully developed and apparently fitted for flight in one or more *Jamaican* specimens.

List of the Carabidæ of Jamaica

1. *Calosoma alternans alternans* (Fab.). Winged.
2. *Pachyteles sp.* Blue Mt. Peak, Dec. 13, 1890 (unique in M. C. Z.; collector unknown). This specimen has been submitted to Mr. M. Bänninger, who is not yet ready to describe it. Flightless; wings vestigial.
3. *Distichus granulipygus* Bts. Winged.
4. *Clivina dentipes* Dej. Winged.
5. *Clivina insularis* (J.-D.). Winged.
6. *Clivina biguttata* Putz. Winged.
7. *Oxydrepanus rufus* (Putz.). Winged; "flying at dusk" (Chapin & Blackwelder).
8. *Schizogenius arimao* Darl. Winged.
9. *Bembidion jamaicense* Darl. Slopes of Blue Mts. up to about 4,500 ft., along streams. Winged.
10. *Bembidion darlingtoni* Mutch. Winged.
11. *Bembidion sparsum* (Bts.). Winged; flies actively.
12. *Bembidion chevrolati* (G. & H.). Winged.
13. *Bembidion fastidiosum* (Laf.). Winged.
14. *Pericompsus blandulus* Schm. Winged.
15. *Tachys occultator* Csy. (provisional det.). Winged.
16. *Tachys bradycellinus* Hayw. Winged.
17. *Tachys carib* Darl. In Jamaica, from near sea level to about 4,500 ft. altitude, by streams. Winged; "flying at dusk" (C. & B.).
18. *Tachys abruptus* Darl. In Jamaica, from sea level to about 4,500 ft. altitude, usually by streams. Winged.
19. *Tachys trechulus* Darl. Known only from the types from Blue Mt. Forest Reserve, 5,000-7,000 ft., under deeply buried stones in damp cloudforest, *not* by streams. Flightless, wings vestigial.
20. *Tachys filax* Darl. Winged; "flying at dusk" (C. & B.).
21. *Tachys pumilus* (Dej.). Winged.
22. *Tachys striax* Darl. Winged; "flying at dusk" (C. & B.).
23. *Tachys cubax* Darl. Winged; "flying at dusk" (C. & B.).
24. *Tachys vorax* Lec. Winged.
25. *Tachys proximus* (Say). A single ♂ in the Chapin and Blackwelder collection is the first specimen of this North American species to be found in the West Indies. Winged.

26. *Tachys scitulus* Lec. Winged.
27. *Tachys* (near) *corruscus* Lec. Winged; "flying at dusk" (C. & B.).
28. *Limnastis capito* Bts. Winged; "flying at dusk" (C. & B.).
29. *Micratopus insularis* Darl. Winged.
30. *Perileptus jeanneli* Darl. Near sea level to 4,500 ft., by swift streams. Winged; "flying at dusk" (C. & B.).
31. *Perileptus minutus* Darl. Winged.
32. *Panagæus quadrisignatus* Chev. Winged.
33. *Morion georgiæ* (Beauv.). Winged.
34. *Morion costigerus* Darl. Known only from Cinchona in the Blue Mts., at about 5,000 ft. altitude, in rotten wood and under loose bark of dead trees. Flightless, wings vestigial.
35. *Agonum extensicolle cubanum* Darl. Winged.

— *Colpodes*. This is the principal genus of mountain-inhabiting Carabidæ in the West Indies: 50 species have been found in the Greater Antilles, almost all at considerable altitudes. A few of the species are winged, but the majority are flightless, with atrophied wings. Wing atrophy has evidently occurred independently in several different Antillean stocks of the genus.

36. *Colpodes cinchonæ* Darl. Known only from localities in the Blue Mts., at and above 5,000 ft., under various cover in damp forest. Wings vestigial.
37. *Colpodes faber* Darl. Known only from Blue Mt. Forest Reserve, 5,000-6,000 ft., under cover in wet forest, but (like most other Colpodes) *not* by open water. Wings vestigial, elytra ankylosed.
38. *Colpodes vagepunctatus* Darl. Known definitely only from Newton, 3,000 ft. Flightless, wings reduced.
39. *Colpodes macer* Darl. Known from Mandeville (probably mountains near), and from Cinchona in the Blue Mts., 5,000 ft. altitude. Wings vestigial.
40. *Colpodes subovalis* Darl. Known only from Blue Mt. Forest Reserve, about 5,000 ft., in rotten logs and piles of dead vegetation in damp forest. Flightless, wings reduced.

41. *Colpodes bromeliarum* Darl. From near Bath and Portland, at 300 and 1,000 ft. altitude, in epiphytic bromeliads. Winged.
42. *Colpodes roysi* Darl. Near Bath, in an epiphytic bromeliad. Winged.
43. *Colpodes punctus* Darl. Known only from Cinchona in the Blue Mts., at 5,000 ft.; habits unknown, but relationship to two preceding species suggests life in epiphytes.[1] Winged.
44. *Colpodes bruesi* Darl. Known only from Newton, 3,000 ft.; also a member of the *bromeliarum* group. Winged.
45. *Colpodes sp.* (Van Emden MS). Known only from Hartham; apparently another bromeliad species, the most highly specialized in structure of the group. Apparently winged (I have seen a specimen of this species, but did not examine the wings).
46. *Colpodes æquinoctialis* (Chd.). In Jamaica, on slopes of the Blue Mts. below 4,500 ft., along large streams. Winged.
47. *Colpodes latelytra* Darl. Known from a unique from Portland Gap, Blue Mt. Forest Reserve, 5,000 ft., from a pile of recently cut grass; the species may be arboreal. Winged.
48. *Lachnophorus leucopterus* Chev. Lowlands and slopes of Blue Mts. below 4,500 ft., by streams. Winged, flies actively.
49. *Anchonoderus subtilis* Bts. Winged, flies actively.
50. *Euphorticus pubescens* (Dej.). Winged.
51. *Perigona nigriceps* (Dej.). Winged, "flying at dusk" (C. & B.).
52. *Chlænius jamaicæ* Darl. Winged.
53. *Stenous duodecimstriatus* (Chev.). Winged.
54. *Stenous tibialis* (Chev.). Winged.
55. *Selenophorus flavilabris flavilabris* Dej. Winged.
56. *Selenophorus chalybeus* Dej. Winged.
57. *Selenophorus alternans* Dej. Winged.

[1]Since this was written, I have seen specimens of *punctus* in the Philadelphia Academy, collected by Mr. J. A. G. Rehn, definitely "from epiphytic bromeliads", "in mountain forest" at 4,980 and 5,600 ft. in the Blue Mts.

58. *Selenophorus sinuatus* (Gyll.). Winged.
59. *Selenophorus discopunctatus* Dej. Winged.
60. *Selenophorus puncticollis* Putz. Winged.
61. *Selenophorus aeneocupreus* Dej. Winged.
62. *Selenophorus nonseriatus* Darl. Winged.
63. *Bradycellus cubanus* Darl. Winged.
64. *Bradycellus velatus* Darl. Winged.
65. *Acupalpus* (*Stenolophus*) *ochropezus* (Say). Winged, "flying at dusk" (C. & B.).
66. *Masoreus brevicillus* Chev. Winged.
67. *Lebia bitaeniata* Chev. Winged.
68. *Lebia cyanea* Dej. Winged.
69. *Lebia abdominalis* Chd. Winged.
70. *Microlestes poeyi* (J.-D.). The single Jamaican specimen I have seen is winged, but *poeyi* has dimorphic wings in Cuba.
71. *Apenes marginalis* (Dej.). Winged.
72. *Apenes coriacea* (Chev.). Winged.
73. *Apenes parallela* (Dej.). Winged.
74. *Apenes aptera* Darl. Known only from Blue Mts., 5,000-7,000 ft., under stones in damp forest. Wings vestigial.
75. *Pentagonica flavipes picipes* Darl. Winged.
76. *Colliuris tetrastigma* Chd. Winged; related species fly actively.
77. *Colliuris limbatus* (Waterh.). This is the only species of Carabidæ recorded from Jamaica which is unknown to me. It is probably related to *C. picta* (Chd.), and is probably winged.
78. *Pseudaptinus apicalis* Darl. Winged.
79. *Pseudaptinus insularis* Mutch. Winged.
80. *Pseudaptinus dorsalis* (Brullé). Winged.

Of the 80 species of Carabidæ listed from Jamaica, some 63 occur in the lowlands, below 1,000 ft. altitude. All of these 63 species, in all the diverse lowland habitats, are winged. Some of them are known to fly well, and it is likely that all, or almost all, fly occasionally.

The middle slopes of the Jamaican mountains, above 1,000 and below 5,000 ft., have not yet been very thoroughly collected for beetles, but a certain number of Carabidæ have been found there. Most are winged. Half a dozen or so winged riparian species follow the mountain brooks up to an altitude of about 4,500 ft., which is about as high as there are brooks in the Jamaican mountains. Some of the same species occur also along lowland streams; others are confined to the banks of the mountain torrents. Two or more winged Colpodes of the *bromeliarum* group occur on the mountain slopes, and probably live between the leaf bases of broad-leaved, pineapple-like bromeliads, in trees. And other winged Carabidæ, some of them lowland species but others perhaps peculiar, are to be expected in proper habitats on the lower and middle mountain slopes.

With increasing altitude, a few flightless Carabidæ, with reduced or vestigial wings, begin to appear among the winged ones, and from the 5,000 ft. level to the highest summit (7,388 ft.) flightless species predominate. Ten species of Carabidæ have been found at or above 5,000 ft. in the Jamaican mountains. Only 2 of the these species, both perhaps arboreal, have fully developed wings. The other 8 species have reduced or vestigial wings, and are flightless. They live chiefly or entirely on the ground in damp cloudforest.

Of course, there is still much to be learned about the details of distribution of Carabidæ in Jamaica, but the main pattern is already very clear. In the lowlands, there is a rather numerous and diverse fauna of Carabidæ, all winged. On the middle slopes of the mountains, there is a smaller, mixed, transition fauna. And at highest altitudes there is a small fauna which is predominantly flightless.

Similar conditions are found throughout the Greater Antilles (*cf.* Darlington, *Memorias de la Sociedad Cubana de Historia Natural* 13, 1939, pp. 79-80). Throughout the lowlands of each island are found numerous and diverse Carabidæ, all or nearly all of which are winged. But wherever mountains rise above 5,000 ft. a few endemic, alticoline, flightless species occur, most of them apparently derived *in situ,* independently on the different mountain tops, from winged ancestors.

This is not an accidental phenomenon. It appears to be the result of the action of powerful environmental forces. But it is difficult to say just what the forces are, for they are complex as well as powerful. I shall try to deal with them in another paper.

EXPERIMENTS IN HOUSING VESPINE COLONIES, WITH NOTES ON THE HOMING AND TOLERATION INSTINCTS OF CERTAIN SPECIES

By Albro Tilton Gaul

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During the summer of 1939 I made the following observations on some species of the Vespinæ at Lakeville, Conn. The work was not begun until early July when the wasp season had fairly advanced.

Wasp nests were captured intact, anæsthetized and transported to the laboratory for observation (1).

Hives were built to accommodate the various nests. These were wooden cases built into the open window apertures, and securely fastened and weatherstripped to keep the wasps out of the laboratory. Each hive was divided into several compartments by heavy cardboard partitions; each compartment provided a home for a single nest of hornets. The window face of the hive consisted of wire screening to admit air and light, and an adjustable aperture on the floor of the hive to control the egress of the hornets. In the laboratory each compartment was accessible through a sliding panel, with a glass observation window and a trapdoor.

Nests were placed in compartments in positions as nearly normal as possible.

When the anæsthetized colony was first placed in the hive, the aperture had to be closed to prevent the escape of the wasps. Unless this precaution were taken, the whole adult population of the nest would desert as soon as they were able to move. In one such case, the population was discovered rebuilding a nest within a few feet of the old nest site, although this was well over a mile from the laboratory. This desire to desert the nest only lasted a few hours; a colony collected in the early evening could be permitted to gather food and paper pulp next morning.

About eight hours of confinement sufficed to persuade the adults to remain with the nest and continue their normal activities.

Once established in the new environment, a colony would not voluntarily desert despite further treatment with anæsthetic. One colony of *Dolichovespula arenaria* Fab. was periodically treated with ether that I might remove a portion of the nest wall for observation purposes. These did not leave the nest although they were free to do so.

As a result of enlarging the nest, one colony of *Dolichovespula maculata* Linn. expanded the brood comb until it came into contact with the observation window in the hive. The paper nest wall was removed by the wasps and the glass served as the wall. A similar observation was figured by A. H. Clark (2). This is evidently a normal method of building the nest into contact with any surface, as nests collected from rafters and walls of buildings exhibit the same structure.

Customarily new comb is built below the existing tiers of comb. In the circumscribed space of the compartments this could not be done, so the hornets increased the area of each comb by adding cells to the periphery.

Because of the limited vertical expansion in the compartments, some of the *Dolichovespula* colonies were forced to use the floor of the hive as the nest floor, without any paper. Lacking any excavating instinct, the wasps made no effort to remove the floor of the hive.

The nests gradually assumed a hemispherical shape. In these nests, the entrance was eventually made opposite the escape aperture of the hive and on the floor of the hive.

Old wasp comb and paper was supplied to assist certain colonies in gathering paper material. None would accept this paper.

Species of *Vespula* will also respond to hive conditions without the accustomed dampness of the earth. Few notes were made on this genus as observations were made too late in the season.

Wasps returning from the fields invariably return directly to the home window. In many cases, however, they would fail to select the proper hive compartment. Even when there were two or more species in a hive, they would repeatedly enter the wrong compartment. This was so common throughout the season that a number of the wasps must have made the same error many times. I can only offer the explanation that the nests are never in such close proximity in nature, and that a return to within a few inches would normally bring a wasp to her nest. But in the hive, all compartments look alike, a nest odor (if any) is confused with the odor from adjacent nests, and a few inches error would send a wasp into the wrong compartment. Eventually, of course, the wasps would seek out their home nest.

The continued intrusion of wasps into the wrong compartments afforded excellent opportunities to observe the natural tolerance and animosity of the various species toward the intruders. The results are very similar to tolerance observations on Polistes (3).

In one hive were two *maculata* nests and a weakened *arenaria* nest. In this hive a returning *maculata* worker would be set upon if she ventured into the *arenaria* compartment; similarly an *arenaria* intruder would be pursued in the *maculata* compartments. Members of one *maculata* colony were permitted to enter the compartment and to walk upon the nest of the other colony; they did not enter the nest of the other colony. As a result of removing workers from the *arenaria* colony, the remaining population could no longer protect itself and the intruding *maculata* workers soon learned to steal the *arenaria* larvae as food for their own brood.

Two adjacent *arenaria* colonies in another hive permitted the same freedom of trespass on their nests as was described above for the two *maculata* colonies.

In flight outside the hives all the species were on good terms. They caused no trouble by virtue of their proximity.

To discover the outcome of a prolonged intrusion of one species in the compartment of another, I closed the escape aperture of an *arenaria* hive and placed a large *maculata* worker within the *arenaria* nest. Immediately the *arenaria* workers formed a circle about the intruder, always facing her and reminding me of the entourage of worker bees about their queen. As soon as the *maculata* moved toward the screening in an attempt to escape, an *arenaria* worker jumped upon her back and attempted to bite off the wings, all the while flexing her abdomen in an attempt to sting the intruder. After this, several "defenders" would dart forward and nip at the legs, antennae and wings and return to the circle. This darting and biting continued until the first worker succeeded in injecting her sting, which concluded hostilities. Even after death, the intruder was worried and chewed by occasional wasps. The workers removed the dead *maculata* from the hive five days after the battle.

The *maculata* made no effort to defend itself. Aside from moving to escape, it submitted to its fate. Subsequent similar experiments with intruding *arenaria* workers on *maculata* nests resulted in the same results for the intruder.

It thus seems that members of one species of *Dolichovespula* will tolerate guests of the same species, while they are actively hostile to the intruders of another species. They are not loath to prey upon the larvae of another species and will enter the other nest to do so if permitted.

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A NEW SPECIES OF CEROPLATUS (DIPTERA, MYCETOPHILIDÆ)[1]

By F. R. Shaw

Amherst, Massachusetts

In September 1940, Dr. C. P. Alexander collected a specimen of an undescribed species of Ceroplatus on the steps of Fernald Hall at Massachusetts State College. In view of the fact that the insect was taken at Fernald Hall it was felt that species should be dedicated to the Fernalds, father and son, who founded and developed the Department of Entomology at Massachusetts State College. I take pleasure in naming this insect, *Ceroplatus fernaldi*, in honor of Professors Charles Henry and Henry Torsey Fernald.

Ceroplatus fernaldi n. sp.

Length 8 mm. General color dark brown.

Head. Vertex and occiput brown. Frons and palpi yellow. Antennae brown.

Thorax. Notum and pleurae of prothorax dark brown. Mesonotum dark brown with 3 black stripes which unite in front of the scutellum. Humeri yellow. Scutellum and pleurae brown. Hypopleurae with setae.

Wing. 5½ mm. in length. Sc_1 long ending about the distance from the humeral crossvein to the base of R_s beyond the origin of R_s. Sc_2 opposite the humeral crossvein. A dark brown spot covers R_4 and extends along R_5. Fused portion of media and radius about one third longer than the petiole of media. Veins $M_1 +_2$, M_3, Cu_1 and 2A all fail to reach the margin of the wing. Haltere yellow with a brown knob.

Legs. Prothoracic coxa brown at base, distal two thirds yellow. Trochanter yellow. Femur with a narrow brown

[1]Contribution from the Department of Entomology, Massachusetts State College, Amherst, Massachusetts.

band at base, remainder is yellow. Tibia and basi tarsus yellow. Tibia about .7 as long as the basi tarsus. Remainder of tarsus appears dark because of presence of setulæ. Coxa of mesothoracic leg yellow except for brown band on the outer anterior surface and a narrow black stripe at the distal portion. Trochanter yellow. Femur with a narrow brown band at the base, the remainder yellow. Tibia and tarsi yellow but covered with black setulæ. Coxa of metathoracic leg resembles that of the mesothoracic leg except that the brown area is larger. The rest of the leg is the same in appearance as the mesothoracic appendage.

Abdomen. Dorsum of segment one entirely dark brown. Segments two through five have the dorsum dark brown except for a posterior lateral yellow spot on either side. Ventral portion of abdomen yellow. Hypopygium dark brown, resembles somewhat that of *Ceroplatus militaris* Johannsen. It can be distinguished from that of Johannsen's species by the lack of dense clusters of black setae on the inner and dorsal surfaces of the base of the disti-style.

This new species would run to *Ceroplatus militaris* in Johannsen's key. It can be distinguished from *militaris* by the structure of the hypopygium, as already discussed; by the relative lengths of the fused portion of veins M and R and the petiole of media; and by the markings.

Described from one male taken in September 1940, at Fernald Hall, Massachusetts State College, Amherst, Massachusetts by Dr. C. P. Alexander. Type in my collection.

A NOTE ON *HIPPOBOSCA MARTINAGLIA* BEDFORD (DIPTERA, HIPPOBOSCIDÆ)

By J. Bequaert

Harvard Medical School and School of Public Health, Boston, Mass.

In my second revision of the Hippoboscidæ (1939, Psyche, XLVI, pp. 70-90), I accepted *Hippobosca martinaglia* Bedford (1939) as a valid species on the basis of the original description and figure. Shortly before his death, the late Dr. G. A. H. Bedford promised to send me a paratype, but unfortunately he was never able to do so. Dr. R. du Toit, Veterinary Research Officer at Onderstepoort, has since gone to considerable trouble in order to clear up the identity of this parasite. It was not possible thus far to trace Bedford's types, which are either mislaid or lost. In July, 1940, Dr. du Toit was, however, able to obtain specimens of a *Hippobosca* collected on the type host (Impalla, *Æpyceros melampus*) at the type locality (Bar R Ranch, Swaziland) of *H. martinaglia*. The male and female, which he sent me of this lot, agree well with Bedford's description and they are obviously his species. At the same time it is impossible to separate them from *Hippobosca fulva* Austen. Bedford's *H. martinaglia* I regard therefore as a synonym of *H. fulva*. The name *martinaglia* should be removed from the list of valid species of *Hippobosca*, which now number eight only. In the key of my 1939 paper, couplet 6 should be discarded, the second alternative of couplet 5 running directly to couplet 7.

The wing of *H. martinaglia* is exactly like that of *H. fulva*, the second longitudinal vein being about as long as the apical section of the third longitudinal (Bedford's figure is incorrect in this respect), and the basal section of the third longitudinal vein is bare. There is only one pair of vertical bristles on the head. The scutellum bears nine preäpical bristles in the one female seen and eight in the one male. The arrangement of the tergal sclerotized plates of the abdomen is, in the male, similar to that of the males of *H. equina* and *H. longipennis,* but the first (anterior) two median tergal plates are very small. In the female I can find no trace of a third median tergal plate, the second is small and the first barely indicated (Bedford's figure, drawn from the female, does not show the median tergal plates). The color-pattern, although fairly correctly outlined by Bedford, is by no means as boldly marked as in his figure; it agrees, moreover, with that of other specimens of *H. fulva* seen.

Dr. du Toit also sent me a male of *Hippobosca fulva,* taken by Mr. Alex. Cuthbertson from a purple-crested lourie or plantain-eater (*Gallirex p. porphyrolophus* Vigors) on the Sabi River, eastern Transvaal. The host was no doubt accidental.

I may emphasize, on this occasion, that color and markings are, as a rule, without value as specific characters in Hippoboscidae, a fact not fully recognized as yet by some recent authors. Not only do they vary individually within the same species, but they often change in the same specimen. During life, such color changes may be due to age (time elapsed since hatching), to the fed or unfed condition, to parturation (in females), or to the nature of the diet and other environmental factors conditioned by the host. After death, the color of the living insect may be more or less modified by the method of killing and preservation, as well as by the length of time the specimen was kept in collections.

THE SUMATRAN "TRILOBITE LARVA"

By Charles T. Brues

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The appellation of "Trilobite Larva" has been in use for many years to designate the larvæ of certain highly aberrant malacoderm beetles. These attain a length of one to several inches, with wide, greatly flattened body. The three thoracic segments are expanded laterally forming a sort of carapace and the abdominal segments bear long, curved projections. These gross characters give the larvæ an almost comical, but nevertheless extraordinarily striking resemblance to certain long-extinct trilobites.

The first reference to these larvæ appears to be that of Perty made over a century ago, in 1831. His account relates to a form from Java which Westwood figured in his "Modern Classification of Insects"[1] a few years later. With his usual taxonomic acumen, Westwood suspected that this larva belonged to some species of the family Lycidæ. Since that time a number of additional species have been discovered in various parts of the Indomalayan region to which they they are apparently restricted. They seem to be best represented in Borneo where at least six distinct types have been discovered. These have been dealt with at length by Mjöberg in 1925[2] who gives an historical and descriptive account that need not be repeated here. Mjöberg was successful in rearing one Bornean species to maturity and found that the large larvæ are females which are destined to undergo practically no external change on becoming adult. Unfortunately he overlooked a paper by the Dutch naturalist, J. C. Koningsberger[3] published more than twenty years pre-

[1]Vol. 1, p. 254; fig. 27, 1-2 (1839).

[2]The Mystery of the so-called "Trilobite Larvæ" definitely Solved. Psyche, vol. 32, pp. 119-153, 2 pls.

[3]Een Geheimzinnige Larve. De tropische Natuur, Jaarg. 1, pp. 17-20 (1912).

viously where the transformation of the common Javan species was accurately described. Koningsberger observed the molting of the large larvæ into larviform adults and proved them to be sexually mature females as several of his specimens deposited perfectly formed, though infertile, eggs. Koningsberger was disappointed not to secure the male which was discovered first by Mjöberg. The latter is a small lycid beetle, quite similar to the other members of the family Lycidæ and scarcely one-tenth the length of the huge larviform female. The larval form of the male has never been discovered; in fact no very small larvæ have ever been recorded and Mjöberg found only large ones obviously greatly in excess of the size which the male would attain before transformation into such a small adult. On this account he supposed that the larvæ must be sexually dimorphic, but this supposition does not necessarily follow although it must be admitted that the female forms are extraordinarily aberrant while the adult male is a perfectly normal beetle.

The species here illustrated is from the highlands of southern Sumatra, near the town of Pagaralam, in the edge of a jungle close to a waterfall a few kilometers out of the town at an altitude of about 3–400 feet. My wife and I had stopped to collect near the waterfall and she discovered two specimens beneath some loose rotted wood lying in an open area. We immediately instituted a search for further examples in the neighborhood, but without success.

A comparison of the two larvæ reveals that they are very different from any of the Bornean forms described and illustrated by Mjöberg. They resemble closely, however, one collected somewhere in the Malay peninsula illustrated by him. This specimen is in the Kuala Lumpur Museum, but no locality is mentioned and presumably its exact provenience is not known.

When I first examined the two Sumatran specimens, it seemed that they must be identical with the Javan one as they agree well with Westwood's figures and the description given by Perty. Furthermore, a cursory examination of specimens from Java which I saw later in the Buitenzorg Museum revealed no obvious differences and Mjöberg refers a specimen collected near Pematangsiantar, Sumatra to the original Javan species. Several earlier records of such larvæ from Sumatra also assume they are identical with the Javan one. There are, however, in the Museum of Comparative Zoology four specimens from Java[4] and closer scrutiny shows the Sumatran species to be quite distinct. It is evidently widely distributed as our specimens are from southern Sumatra and Mjöberg found it in the northern part of the island, strangely enough in a region where we failed to discover it although we spent some weeks in the jungle near Pematangsiantar. Kolbe in 1887 recorded its occurrence at Penang on the west coast.

In the collection of the Museum of Comparative Zoology there are a number of other trilobite larvæ one of which appears to represent a species that has never been described or figured and I am appending at the end of the present note a description of this as well as the Sumatran one together with the morphological characters that may be used to distinguish the several species that are available to me. The species are all readily recognizable by good taxonomic characters and these may be applied to the diagnosis of other species as they may come to the notice of entomologists.

The Sumatran Species

(Plate 2; Text–fig. 1)

Attaining a length of at least 37 mm. Color dark brown, but fading considerably in alcohol; the tubercles on the dorsal thoracic and abdominal segments shining black, the underside likewise brown, with the abdomen blackish at the sides and apex; the legs blackened apically. The lateral abdominal projections with yellowish tips, the pale color extending further basad on the apical segments, the last segment entirely pale both above and below. Thoracic segments rather wide and short, the mesothoracic dorsum almost two and one-half times as wide as long. The shining black tubercles or warts well developed, one on each side of the pronotum; a pair similarly placed on the meso– and the metanotum and all three segments with a pair of minute

[4]One from "Java" (Professor Roland Thaxter) and three from Bantar Gelbary (Bryant and Palmer).

ones at the posterior margin near the middle; abdominal tubercles very small, transverse, arranged in pairs near the middle of the hind margin of each of the basal six tergites, but these are lacking on the last three tergites. Lateral horns or processes on the abdomen long; except the first, all are curved backwards, but not upwards; those of the

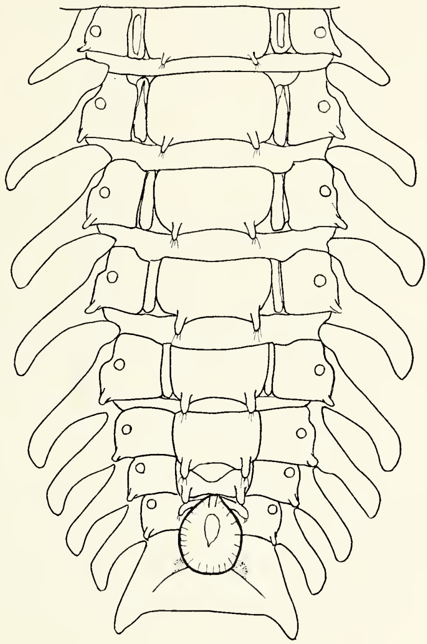


Fig. 1. Ventral view of abdomen of Sumatran "Trilobite" larva.

last tergite short, simply extending its lateral angles; those of the first short and pointed at tip, the others blunt. On the underside the meso– and metasternum each bear a minute, convex tubercle at the center. Each abdominal sternite with a tooth-like projection on each side at the posterior angle. Each of the pleurites, which lie directly below the lateral processes of the terga, is produced at the posterior angle into a blunt tooth and each is perforated by a deep, circular, spiracular opening. The two spiracles of the thorax are similar and lie at the anterior margin of the meso– and metathorax, just inside the lateral shelf-like extensions of these segments. Dorsally the anterior margin of these is sharply truncate with a slight, rounded tubercle at each side and a pair of more pronounced ones medially, separated by a slight median emargination.

In its general habitus this species is very similar to one illustrated by Mjöberg from the Malay Peninsula, but his photograph is not sufficiently clear to indicate this definitely, and other accounts of what may be the same species are likewise lacking in details.

The Javan Species[5]

(Plate 2)

The four specimens of this form are all smaller than the preceding species as the largest one does not exceed 30 mm. in length. The color is darker, but this is quite probably due to the preservation. The thorax is fuscous above or darker and the abdomen piceous or nearly black, with the lateral projections orange yellow on the apical half. Structurally, the differences are as follows. The larger, posterior tubercles of the meso– and metathorax are more strongly transverse; the posterior margin of the metanotum bears four small warts, the additional ones more minute than the median pair and forming with them an equidistant series of four. The abdominal warts are present on the seventh and eighth segments so that there are eight instead of six pairs. The thorax is wider, the mesonotum measuring nearly three times as wide as long. The lateral abdominal projections are stouter, more swollen apically and quite evenly rounded at the apex.

One specimen bears the label "Java, R. Thaxter". The others, collected by Bryant and Palmer, are from Bantar Gelbary.

A Bornean Species

(Plate 3)

A series of specimens from Sadong, Sarawak, Borneo collected by Harrison Smith are apparently the form figured

[5]Burgeois, (Bull. Entom. Soc. France, 1899, p. 61) has given a description of this form, but not having the Sumatran one for comparison does not refer to the differential characters.

by Mjöberg as "No. 5" which he speaks of as the common lowland type in this portion of Borneo. It is much lighter in color, being a uniform light brown with the dorsal protuberances and warts greatly reduced. The pronotum and abdominal tergites lack the warts completely and those of the meso– and metanotum are reduced to a single elongate, streak-like, smooth elevation midway between the median line and lateral margin, longer on the metanotum. The mesonotum is very wide, fully three times as broad as long and the metanotum is produced at each side into a very long, obtuse lobe. The lateral projections on the abdominal segments are very long, curved evenly upwards and backwards and evenly attenuated from the base to the tip, with the basal one as usual much shorter. The anterior margin of the pronotum bears four prominent rounded or more or less tooth-like tubercles or projections separated by conspicuous emarginations. The specimens range in size to fully 45 mm.

A description undoubtely of this form has been given by Bourgeois[6] and the preceding paragraph refers mainly to characters of use in differentiating it from other species.

Captain Barnard's Larva

(Plate 3)

This is a very striking form, similar in habitus to the Bornean species of which Mjöberg reared the female and later secured the male, *Duliticola paradoxa* Mjöb.[7] It differs at once, however, in the presence of large shining tubercles on the disk of the three thoracic segments. The arrangement and size of these raised areas are the same as in the Sumatran species as are also the minute warts on the posterior margin of these segments, except that the latter are very minute. The mesonotum is slightly more than twice as wide as long. The abdominal tergites bear also pairs of minute warts at the posterior margins; these are very distinct, becoming smaller on each succeeding tergite and not visible at all beyond the fifth. The lateral processes of the abdomen are very strongly curved upwards and posteriorly,

[6]Bull. Entom. Soc. France, 1899, p. 59.

[7]This is apparently the form described at length, but not named by Hanitsch in 1900 (Journ. Roy. Asiatic Soc., Straits Br. No. 34, p. 78).

almost hooked at their obtusely rounded tips. The entire larva is piceous or black, about 50 mm. in length.

The exact provenience of this specimen is unknown. It has been in the Museum of Comparative Zoology for over 60 years and bears the label "J. Barnard, East Indian Ship 'Monsoon' ". I have figured it as it adds still another species to the considerable number already known.

Explanation of Plates

Plate 2

Upper two figures, Sumatran "trilobite" Larva.

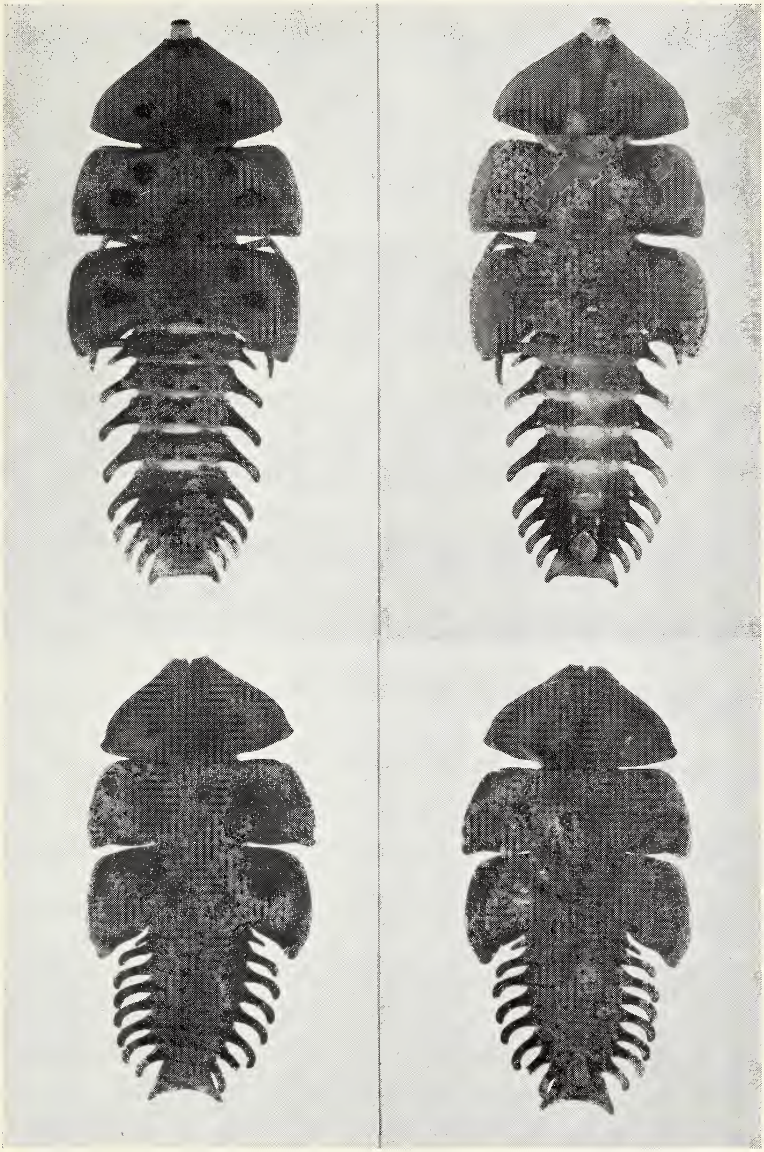
Lower two figures, Javan "Trilobite" Larva.

Plate 3

Upper two figures, Bornean "Trilobite" Larva.

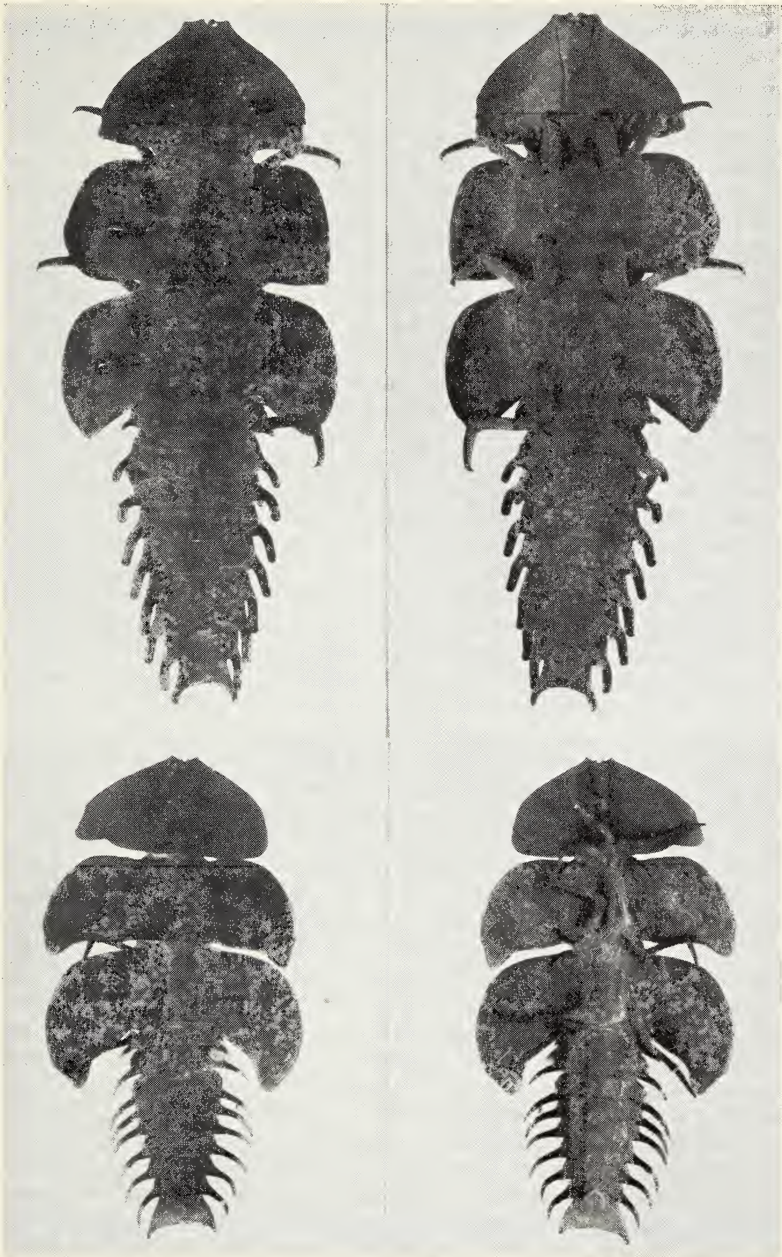
Lower two figures, Barnard's "Trilobite" Larva.

PSYCHE, 1941 VOL. 48, PLATE II.



Brues — "Trilobite Larvæ"

PSYCHE, 1941 VOL. 48, PLATE III.



Brues — "Trilobite" Larvæ

A NEW CUBAN MILLIPED, WITH NOTES AND DRAWINGS OF OTHER WEST INDIAN SPECIES

By H. F. Loomis

Bureau of Plant Industry
U. S. Department of Agriculture

In June, 1940, the writer visited the Museum of Comparative Zoology, Cambridge, Massachusetts, to examine certain type and other specimens of millipeds in the collection there. In the material seen was a recently received Cuban species of *Amphelictogon,* obviously differing from other known members of the genus. A description of this species follows.

Also the opportunity is taken for presenting drawings made from a number of R. V. Chamberlin's types of West Indian millipeds, especially those in the genus *Amphelictogon,* where the difficulty of distinguishing the species without reference to illustrations of the gonopods has been found very great or, in certain cases, impossible.

A species described by C. H. Bollman which, for over 50 years, has erroneously reposed in the family Platyrhacidæ is here transferred to another family where a new generic name is proposed to admit it.

Amphelictogon cubanus Chamberlin

Bull. Mus. Comp. Zool., vol. 52, No. 5, p. 224, 1918.

This is the only known member of the genus having the dorsal surface of its segments divided into definite quadrate or polygonal areas. A gonopod of the type is shown in figure *d* of the plate.

Amphelictogon bahamiensis Chamberlin

Bull. Mus. Comp. Zool., vol. 52, No. 5, p. 231, 1918.

The type and only known specimen of this species is approximately 15 mm. long. One of its gonopods is shown in figure *b* of the plate.

Amphelictogon rex sp. nov.

In the Museum of Comparative Zoology collection are three males, including the type, collected in the Sierra de Nipe, Cayo del Rey, Oriente Province, Cuba, April 1940, by J. P. Carabia.

Diagnosis: This species belongs in the series with color differences between the poriferous and non-poriferous segments. Its closest relatives appear to be *A. obscurus* Chamberlin and *A. bidens* Loomis but with obvious differences from them in coloration and modifications of the gonopods.

Description: Length 30 mm.; width 4.5 mm. across posterior margins of segments 1 and 2; 4 mm. across the middle of the body which is parallel-sided to about segment 15, after which it narrows to the last segment.

In alcohol the head is dark brown except for the narrow white anterior margin; antennæ with basal joints light colored, the outer joints dark brown; legs and ventral surface of all segments white; segments 1 to 4 dark brownish-black except the pure white posterior corners; poriferous segments from the fifth to the penultimate have the prozonites brown with a large white spot in front of the keels, reaching nearly to the middle of the dorsum; metazonites with the keels and sides of the dorsum white, only the median line dark brown; non-poriferous segments have the sides and dorsum of the prozonites dark brown metazonites dark brown, except the outer two-thirds of the keels, which are white; last segment brown at base, white at apex.

Surface of segments shining, the keels with two or three small granules, each with a tiny pit at middle from which a seta may once have projected; segments 2 to 8 with a tooth at the anterior corner of each keel; posterior margin of most keels from segment 5 to segment 16 with two teeth, the outer of which is largest; margins of poriferous keels raised above the inner surface of the keel, the elevation most evident at the rounded anterior corner; pore callus elongate, formed by the gradual thickening of the margin, the pore opening obliquely outward and upward.

Preanal scale rather thick, broadly rounded behind, with a tiny supplementary projection at middle of posterior margin.

Gonopod as shown in figure *a* of the plate.

Sternum between the third legs narrow, high, almost hemispherical and with a considerable number of erect setae; sterna between the fourth and fifth legs higher and with more erect setae than the third sternum.

Schizodira gen. nov.

Type *Stenonia maculata* Bollman, Proc. U. S. Nat. Mus., Vol. 11, p. 336, 1888.

Syn. *Platyrachus? maculatus* (Bollman) Chamberlin, Bull. Mus. Comp. Zool., Vol. 62, No. 5, p. 216, 1918.

Review of the original description convinces me that this species cannot possibly belong in the Platyrhacidae where Bollman and subsequent writers placed it. Bollman compared *maculata* with *Stenonia fimbriata* (Peters) but it appears that either he never had seen Peters' species or he misinterpreted the original description of it, for it is certain that *fimbriata,* made the genotype of *Tirodesmus* by Cook in Brandtia, p. 51, 1896, is not related generically, at least, to *maculata.*

I know of no species of Platyrhacidæ as small as *maculata,* and none of this family has an expanded, crenate, front margin on the first segment, completely hiding the head from above, nor does the body have a pronounced longitudinal median line. These characters, however, are found in the Chytodesmidæ and Stiodesmidæ but in the description of *maculata* there is given no character indicating in which of these families it should be placed. Nevertheless, Bollman's inclusion of it in the genus *Stenonia,* which he later distinguished in two keys on the position of the pores, allows the inference that the pores of *maculata* are on the dorsal surface, removed from the lateral margin of the keels, a character placing the species in the Chytodesmidæ, rather than in the Stiodesmidæ which has pores on special processes of the margins of the keels. As no other chytodesmid genus has a notch between the third and fourth crenation from the posterior corner of the first segment, the generic name, *Schizodira*, in reference to this character, is proposed for combination with *maculata*. Other diagnostic characters may be found in Bollman's statement "lateral carinae crenulate, the first six, the eighth, eleventh and fourteenth, with two crenulations, the rest with three," although it is probable that he actually meant segments 2–6, 8, 11 and 14, as segment 1 had previously been described as having 12 crenations. The pores apparently were in the normal sequence on segments 5, 7, 9, 10, 12, 13, 15–19.

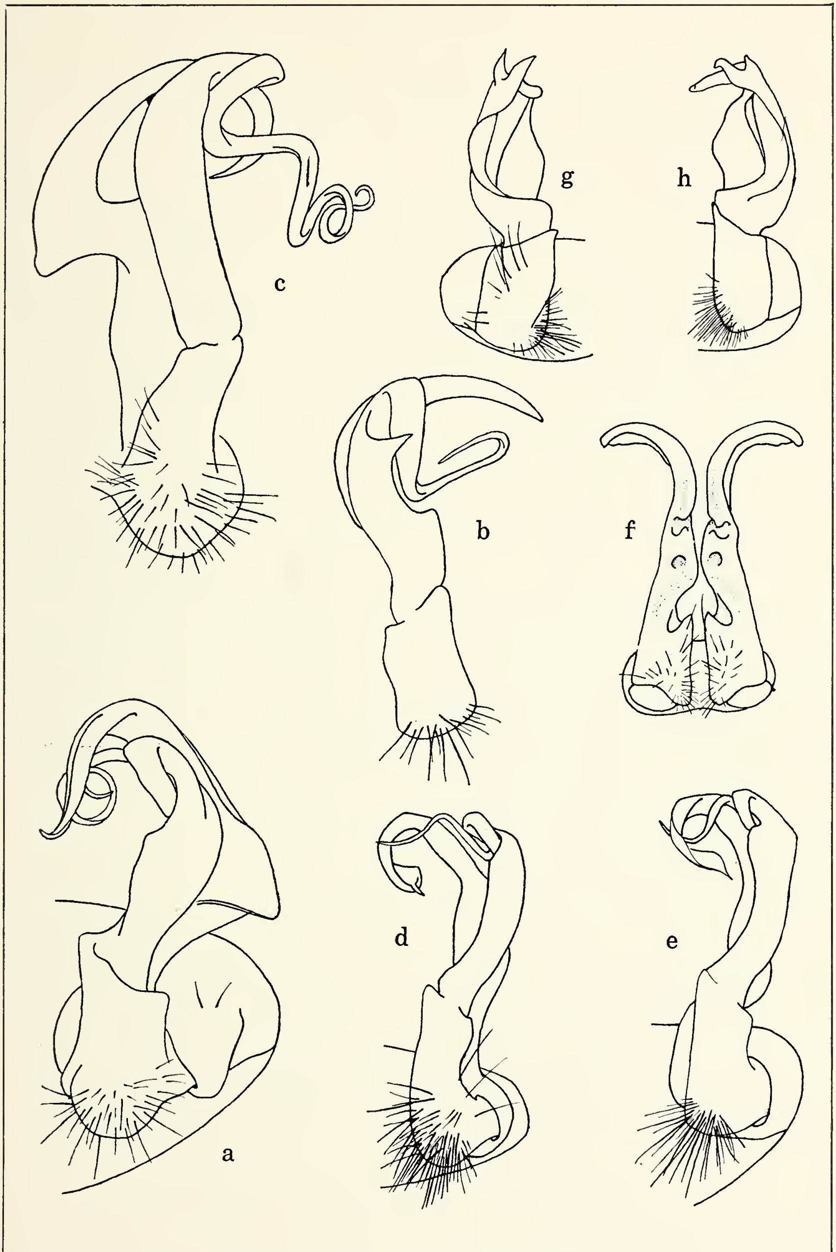
This species has not been rediscovered since Bollman's time and several hasty searches through the disorganized milliped collection of the U. S. National Museum have failed to reveal the specimens Bollman deposited there.

Explanation of Plate 4

a, *Amphelictogon rex*: Gonopod; b, *Amphelictogon bahamiensis* Chamberlin, Gonopod; c, *Amphelictogon pallidipes* Chamberlin, Gonopod; d, *Amphelictogon cubanus* Chamberlin, Gonopod; e, *Amphelictogon rubripes* Chamberlin, Gonopod; f, *Caraibodesmus bruesi* Chamberlin, Gonopod; g, *Cubodesmus ramsdeni* Chamberlin, Gonopod; h, *Cubodesmus pelopleurus* Chamberlin, Gonopod.

All drawings made from type specimens.

PSYCHE, 1941 VOL. 48, PLATE IV.



Loomis — West Indian Millipeds

CHARACTERISTICS OF THE LARVIFORM FEMALE OF THE LAMPYRID BEETLE, LAMPROPHORUS

BY CHARLES T. BRUES,

Biological Laboratories, Harvard University

In looking over the collection of larvæ of malacoderm beetles in the Museum of Comparative Zoology searching for specimens of the remarkable Lycidæ commonly known as "trilobite larvæ", I noted two specimens from Ceylon that represent the larva and larviform adult female of a species of Lamprophorus. The label indicates that these were received from F. Layard in January, 1865. Like the other known members of the genus the female larva attains a large size which corresponds to that of the adult female, in this case about 70 mm.

An early reference to these larviform lampyrids is a note on page xlviii the Proceedings of the London Entomological Society for 1908 that mentions the exhibition by C. J. Gahan of specimens of Lamprophorus (*Lamprigera*) and Dioptoma and sets forth briefly the slight differences that distinguish the sexually mature female from the larva. In the same journal for 1912 (p. 178) Green gives a very brief description of the "grub-like" female of *Dioptoma adamsi* Pasc. with an account of the luminous organs which are present in both sexes. Dioptoma is now placed in the related family Rhagophthalmidæ although Lamprophorus is still retained in the Lampyridæ.

Blair[1] has described a larva, probably of *Lamprophorus boyei* Mots. from Sumatra. These larvæ were collected together with the male of this species at two localities. In the same paper he records the female of *L. tenebrosus Walk.* from Ceylon, definitely identified as it was taken *in coitu* with the male. He notes that it is of very similar form to the larva, "but of pale colour with more feebly chitinized in-

[1]Journ. Fed. Malay States Mus., vol. 8, p. 176 (1928).

tegument; the antennæ are of similar form except that the third joint has become more elongate and divided into five small joints, the mouthparts differ in numerous particulars and the legs have a 5-jointed tarsus." In this same paper Blair gives a rather detailed description of the Sumatran larva, especially of the mouthparts and antennæ, but no further details are included concerning the more minute structures in which the female differs from the mature larva.

I have undertaken to do this for the two specimens before me as the matter is of considerable interest for it illustrates the great persistence of certain morphological characters in insects even when an almost complete degeneration of most bodily structures supervenes for one reason or another. In the great majority of cases among insects, or other animals, such great degenerative modifications or simplifications are directly traceable to parasitic life such as those shown, for example, by female Strepsiptera, parasitic earwigs and the like. Such is, of course, obviously not the case among the Lampyridæ where numerous other examples of larviform adults are well known. These occur in more than one series of related forms, at least one of which, Phengodes, is often relegated to another family and in the family Lycidæ where a closely similar condition exists in some Indomalayan genera. In the latter, as in Lamprophorous and its allies, a remarkable disparity in size between the sexes develops as the female becomes a ponderous creature in comparison with her diminutive, though normally proportioned spouse.

The fully grown larva and adult female of Lamprophorus are of essentially the same size and general proportions. The larva is not particularly extaordinary for a Lampyrid and the structure of the head with its appendages and the legs are of normal form.

The female differs most noticeably in its paler color and much more delicate integument which is far more flexible and apparently thinner. Ecdysis is complete as there is no indication of any bits or shreds of the larval cuticle still adhering to the surface of the body such as have been described by Mjöberg for one of the lycid "trilobite" larvæ which he reared to maturity. The head in dorsal view is much narrower behind than in the larva, but otherwise the dorsal segments are essentially similar in shape and even retain evidences of a rather complicated pattern of surface sculpture, indicating that aside from molting the pigmented layer of the cuticle, no metamorphic change in the integument takes place. The legs of the larva (Fig. 1,C) are of the usual form, with three joints and a single, simple claw. The leg of the adult female (Fig. 1,F) is a true imaginal structure with the coxa, trochanter, femur and tibia developed in more or less normal proportions and there is a five-jointed tarsus bearing two large, dentate claws.

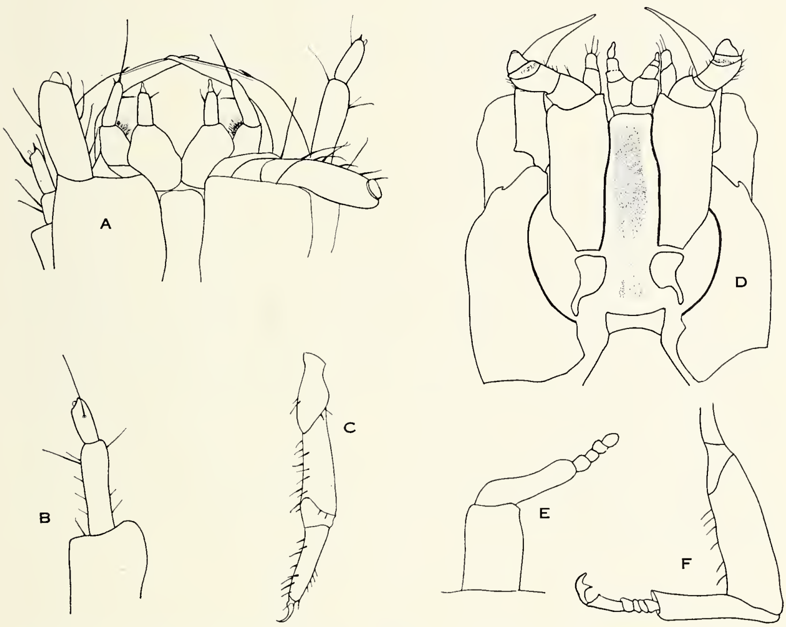


Fig. 1. Lamprophorus sp., details of larva and adult female. A, head of larva from below; B, antenna of larva; C, leg of larva; D, head of female from below; E, antenna of female; F, front leg of female.

The antennæ (Fig. 1,E) are but little longer than in the larva, but are clearly six-jointed. In this connection it is of interest to note that the males of Lamprophorus exhibit a shortening of the antennæ through the disappearance of several apical joints and shortening of the basal ones.

The presence of numerous spheroidal eggs about three our four millimeters in diameter proves that the specimen is fully mature.

Several changes in the mouthparts occur at the final ecdysis (Fig. 1; A, D). The large, pointed, falcate mandibles of the larva are tapered to a point and bear a conspicuous groove externally on their apical third. Those of the adult have the apex flattened into an obliquely truncate edge which lies in a vertical plane so that the tip appears acute in ventral view and only close observation indicates that the mandibles undergo a quite considerable change in shape. The maxillary palpi are obviously shortened in the adult, but the actual changes are slight. The maxillæ themselves are also shorter in the adult. The labium is changed mainly by the addition of another joint in the palpi. All of these changes in the mouthparts clearly represent a degeneration in functional capacity but they include also the retention to some slight degree of features involved in the increased complexity that normally characterizes the imaginal stage. The same is also true of the tarsi and this is of particular interest, since the segmentation of the tarsi is one of the most remarkably constant characters, among practically all groups of insects, and it is only slightly changed in the female Lamprophorus despite the inhibition of so many of the more conspicuous imaginal features and the absolutely larviform habitus.

The accompanying figures drawn for me by Mrs. A. S. O'Connor illustrate the several structures to which reference is made.

SOME FLIES OF THE FAMILY SYRPHIDAE, MESOGRAMMA

By Frank M. Hull

University of Mississippi

This paper describes some new species of Syrphidae from the Neotropical region, derived from various sources. Types are in the author's collection unless otherwise stated.

Mesogramma vitrea n. sp.

Male. Length 5 mm.. *Head:* face and front and antennæ light, pale yellow, the cheeks black, the vertex golden brown, becoming coppery just behind the ocelli. Occiput metallic brassy above, greyish white along the sides. *Thorax:* metallic brassy brown with a prominent median steel blue stripe on either side of which are two dark brown and two light brown stripes. Pleuræ shining metallic, with a small obscure yellow spot on the upper part of the sternopleuræ and the posterior margin of the mesopleuræ. Scutellum and humeri metallic brassy black. *Abdomen:* highly polished and shiny, first three segments wholly black, last two segments dark shining reddish brown. Hypopygium shining black. Pile of abdomen abundant, rather long, whitish upon the margins and lateral portions of all of the segments and blackish upon a central stripe down the middle of the abdomen which begins upon the posterior part of the second segment. *Legs:* chiefly shining black, the tips of the femora, the tips of the hind tibiæ and its base yellow. Hind basi-tarsi and the three terminal joints dark brownish black. Middle of the fore and mid-tibiæ with an obscure brownish band. Anterior tarsi darkened. *Wings:* pale brownish.

Holotype male. São Paulo, Juquia, J. Lane, Nov. 7.

Mesogramma picta Sch. variety **melleoguttata** n. var.

Female. Length 6 mm. *Head:* vertex violet, front shining metallic black, its narrow sides and the face pale yellow, cheeks black, occiput brassy brown above, becoming yellowish grey on the sides and below. Antennæ brownish, the ventral portion reddish orange. Arista brownish black, the antennal pile black. *Thorax:* with a broad median bluish grey shining vittæ, and lying outside of it, first a pair of dark brown vittæ, then a pair of somewhat yellowish vittæ, and bordering the continuous yellow side markings are a pair of wide brown vittæ. Pleuræ yellow on the posterior margin of the mesopleuræ and upper part of sternopleuræ. Scutellum metallic black, the margin pale yellow. *Abdomen:* black marked with light yellow, sides of the first segment and its narrow margin, a complete transverse stripe on the second segment that reaches the sides, its anterior corners narrowly, and traces of a median vittæ, all yellow. Third segment with a median yellow vittæ which does not quite reach the posterior margin and on either side of it two basal yellow spots. The outermost pair subrectangular, occupying the corners and narrowly confluent at the base with the submedial much larger spots which are twice as long as the more lateral ones. The submedial spot on inner surface is strongly indented and the black encroaches upon it, but only upon the basal half of its medial surface. Fourth segment with almost identically similar pattern. Fifth segment with large yellow spots on the basal corners and a pair of widely separated elongate, yellow spots broadly reaching the base of the segment with the posterior ends rounded and very slightly approximated. *Legs:* pale yellow, the hind tarsi, basal two-thirds of hind tibiæ and a wide black annulus apically upon the hind femora, black. *Wings:* pale grey, stigma pale brown.

Holotype female. Barro Colorado Island, Canal Zone, Aug. 25, 1937. Hull coll.

Mesogramma elongata n. sp.

Male. Length 13 mm. *Head:* face and front yellow, the antennæ brownish yellow, third joint slightly darker dorsally, cheeks shining blackish, upper part of vertex brilliant violet, giving way to steel blue just behind the ocelli, area between the ocelli golden brown, lower part of the frontal triangle greyish pubescent. Occiput yellowish grey pubescent. *Thorax:* mesonotum with a broad bluish grey median stripe divided posteriorly by a narrow steel stripe the greater part of the mesonotum outside of the stripe golden brown. Between the golden brown and the lateral yellow margins is another metallic grey stripe. Humeri posterior two-thirds of the mesopleuræ and a spot on the upper part of the sternopleuræ pale yellow. Suctellum pale yellow, the disc broadly metallic brown. *Abdomen:* black marked with yellow, first segment about half black, the anterior part yellow including the lateral margin which is narrowly continuous with the lateral margin of the second segment. Second segment shining black, with an extensive transverse yellow band from margin to margin which is in width barely over one-fifth the length of the segment. Third segment broadly black upon the posterior part; about one third of the way from the end of the segment it sends forward a broad vittæ that rapidly expands into a large black spot, the anterior pointed end of which reaches the base of the segment. From the base of this median vittæ at its posterior point of origin, the black extends obliquely forward to the lateral margin of the segment and thence forward to occupy almost all of the lateral margin of the segment. At its lateral marginal apex it is confluent with a small oval black spot situated anteromedially, which small spot is narrowly separated from the large median subbasal spot. Fourth segment with similar pattern but the apex of the segment and lateral margins of the segment are extensively reddish brown and the somewhat smaller sublateral, subbasal black spots are more slender, more pointed and isolated. There is a fine narrow median reddish brown line bisecting the middle black vitta. Fifth segment with a pair of obtusely triangular submedial brown spots and lying just outside of these, touching the base are a pair of elongate brown vittate spots hollowed out on the inside, on the posterior two-thirds of their length. *Legs*: pale yellow, a brownish band subapically on the hind femur almost the whole of the basal half of the hind tibiæ and all of the hind tarsi, fore and middle tarsi brownish. Hind femora with considerable, rather long, black, bristly pile ventrally. *Wings*: hyaline, stigma dark brown.

Three males. Cotypes; Muzo, Department Boyaca, Columbia, altitude 900 meters, 1936. J. Bequært col. A specimen deposited in the Museum of Comparative Zoology.

Salpingogaster pessulagyna n. sp.

Male. Length 13 mm. *Head:* face, cheeks and front pale yellow, the latter with a brownish black longitudinal spot. Antennæ wholly light orange, its pile dark brown. Vertex blackish. *Thorax:* with a pair of prominent, narrowly separated, golden pollinose vittæ. On either side of these are an additional pair of somewhat less conspicuous golden vittæ; these outer vittæ are bordered by blackish brown. Humeri, most of the notopleuræ, post calli and a confluent spot anterior to them, the wide posterior margin of the scutellum, a transverse fascia upon its base all pale yellow. All of the pleuræ pale yellow except a narrow, oblique, brown band and a darker brown spot anterior to the halteres. Greater discal part of the scutellum and the metanotum brownish black. *Abdomen:* chiefly light reddish brown without black markings. The first segment pale yellow, its posterior margin with a brown fascia which, however, does not reach the base on either side. Fifth segment brownish yellow. Hypopygium pointed, last sternite with a pair of prominent black setate nodulose projections. *Legs:* light yellow, the middle and posterior femora narrowly yellowish brown subapically. Femoral setæ brown. *Wings:* pale brown with a well developed anterior brown margin reaching to the end of the wing, the costal cell paler.

Holotype: male. Barro Colorado, Aug. 28, 1938 (F. M. Hull, collector).

Fazia hermosa n. sp.

Male. Length 10 mm. *Head:* face and lower part of occiput and the wide ocular margin of the front pale yellow. The pile abundant, long, erect and black. A broad black stripe running down the middle of the face enclosing the small but prominent tubercle. Front with a transverse, black spot above the widely separated antennæ, the spot continuing narrowly to the point of contact with the eyes. Epistoma standing out a little way beyond the base of the antennæ. Antennæ dark reddish brown, blackish along the dorsal third of the third joint. Mesonotum dull brownish black with a brassy cast, very feebly shining the humeri dark. There is a large, conspicuous, triangular, yellowish, notopleural spot that is confluent with a broad, post-marginal stripe of the mesopleuræ and an obscure spot on the upper spot of the sternopleuræ. Post calli and the scutellum light yellow, the latter with a diffuse, though conspicuous, black discal spot. Pile of thorax and pleuræ thick, erect and reddish brown, becoming longer and blacker on the scutellum. *Abdomen:* with nearly parallel sides, widest at the base of the fourth segment, where it is fully as wide as the widest part of the thorax. Abdomen nearly opaque black with five pairs of yellow spots, none of which, except the first pair on the first segment, reach the lateral margin. Spots on the first the segment. Third segment with more elongate spots, separated by less than the width of a spot. The spots of the fourth segment practically identical with the third; the spots rated by at least the length of a spot. The spots are roughly triangular, with rounded angles, and placed midway along the segment. Tihrd segment with more elongate spots, separated by less than the width of a soot. The spots of the fourth segment practically identical with the third; the spots of the fifth segment somewhat smaller, with sharply-pointed inner ends and more narrowly separated. Pile on the basal part of the abdomen reddish-brown, becoming almost yellow on the extreme corners, elsewhere black. *Legs:* chiefly black; base of the hind femora, their apices and the apices of the middle femora, front femora and the bases of their respective tibiæ dark brownish. *Wings:* with a strong brownish uniform tinge. Subapical cross vein elongate, the final section recurrent, the entire cross vein sigmoid.

Holotype: male. São Paulo, May 6-8, 1939 (J. Lane, collector).

THE ANTIQUITY OF SOCIAL INSECTS

By J. C. Bequaert and F. M. Carpenter

Harvard University, Cambridge, Mass.

The geological antiquity of social habits among the insects has been the subject of much speculation. Estimates of the time of origin of social insects show little agreement and range from the Permian to the Eocene. Up to the present time, however, actual remains of insects belonging to social families have not been found in strata older than the Eocene. For this reason the Cretaceous fossil recently described by Dr. R. W. Brown[1] as *Celliforma favosites* is of much entomological interest. In Dr. Brown's opinion this specimen represents the comb of a wasp nest and thus constitutes the earliest geological record of the social wasps and of social insects in general. Through the kindness of Dr. Brown, we have been able to examine the fossil itself and to discuss it with our associates. We are convinced from this examination that Dr. Brown's identification of the fossil is a doubtful one, and are of the opinion that it is not the nest of a social wasp. If this fossil were from a Tertiary deposit, it would have relatively little significance; but being from the Cretaceous, it would, if unquestionably identified, greatly extend the range of the social wasps. Because of this, we have decided to publish a discussion of the fossil and of our reasons for the above conclusion. The antiquity of social habits among the insects is a very complicated question, as we shall indicate later, and all suggestions deserve serious consideration; but we believe that evidence bearing on the subject should be critically and carefully examined before definite conclusions are reached.

The piece of rock containing the fossil is an irregular ironstone nodule, the center of which is occupied by the fossil. One half of the specimen (shown on plate 1 of Dr.

[1]Amer. Journ. Sci., vol. 239, January, 1941, pp. 54-56.

Brown's paper) shows a series of dome-shaped projections, arranged in rows; these are regarded by Dr. Brown as casts of the cells of the nest.[2] The counterpart of the fossil is lined by shallow cavities which fit over the ends of the projections. One portion of this counterpart also has projections like those on the other half, so that when the parts of the concretion are placed together, the dome-shaped projections extend inwards from both sides. This extraordinary condition, which is not mentioned by Dr. Brown, seems to require an explanation, if the specimen is regarded as a nest.

The method by which a wasp nest might be preserved so as to resemble the fossil in question is very difficult to imagine. Dr. Brown has concluded that the specimen represents part of a papery nest like that of *Polistes,* but he was apparently unable to explain to his own satisfaction the process of preservation, for he left "to the reader the pleasure of speculating as to the circumstances and method by which the original comb became this fossil." It seems clear that in order to have a nest so preserved, particles of sand and mud must have filled the cells and become cemented together while the walls retained their shape. Then, since there is no part of the actual nest remaining, its substance must have been replaced by additional sand and mud, as it disintegrated. In this way a cast of the nest or of a portion of it would be formed. This process of preservation, involving two steps, seems to be inevitable, and it is indicated by the lithology of the fossil, for the sand particles forming the casts of the "cells" differ in size and other details from those replacing the "cell" walls. What seems impossible to us is that the paper nest would retain its shape long enough to allow the filling in the cells to become so hard that it would hold its form after the disintegration of the paper walls. If a paper comb of any living genera of social wasps (i.e., Vespinæ, Polybiinæ, Polistinæ, Ropalidiinæ) were buried and filled with sand and mud, the thin soft walls between the cells would, in our opinion, inevitably disappear within a short time, long before the foreign material could harden. We have not, of course, experimented with a nest to determine how long it could hold its shape under such conditions;

[2]Dr. Brown refers to the fossil as a *mould,* but we consider the term *cast* more appropriate.

but anyone who has attempted to collect wasp nests without damage to them appreciates their fragility. Even when a nest is suspended from a tree or similar structure under natural conditions, it disintegrates in a few months' time after it has been deserted by the wasps. The most striking feature of the fossil in this connection is that the casts of all "cells" are complete in the preserved portion of the "nest". Because of the fragility of paper nests, it seems impossible for such regularity to be attained; if only a few cells were so preserved, in various parts of the fossil, Dr. Brown's determination of the fossil would seem more probable.

Possibly some method of preservation radically different from that mentioned above can be given in explanation of the "nest"; but our geological associates have been unable to suggest one.

Apart from the difficulty of explaining the preservation of a paper nest, there are several aspects of the fossil which are not at all characteristic of a wasp's nest. Since the fossil shows almost no "structure", comparisons between it and nests of living wasps are very hard to make. Dr. Brown was consequently led to his conclusion by "general appearance and analogy". The following differences between the fossil and the nests of Recent social wasps seem to us to be significant: a) The dome-shaped tops of the projections were considered by Dr. Brown to be the casts of bottoms of the cells. Now, although the top or open ends of the cells in a wasp nest show a regular arrangement, the bottoms or lower ends are irregularly arranged, as can easily be seen in sections or when the paper covering over this part of the nest is removed. Consequently, the regular arrangement of the lower ends of the cells in the fossil is not at all suggestive of a wasp nest.[3] b) The bottoms of the cells of Vespid nests are not dome-shaped, as in the fossil, but are flattened or angular. Also the level of the bottoms of the various cells is irregular, so that casts of them would be variable in height as well as in shape. This is not true of the fossil, however,

[3]The regularity of the "cells" in the fossil resembles the structure of the nests of some Meliponidæ and bumble-bees more than that of a wasp. There are other objections, however, which eliminate these as a possible interpretation of the fossil.

for the projections are remarkably uniform in shape and height. c) The cells of Vespid nests tend to radiate from the base of the nest, the individual cells being distinctly wider at their openings than at their bases. In the fossil the "cells" have a constant width for their entire length and there is no indication of a radiating arrangement. d) the walls in the cells of a wasp nest are of paper thickness only; in the fossil the substance between the "cells" is nearly as thick as half the diameter of the "cells".

These discrepancies between the fossil and the structure of known Recent Vespid nests, in addition to the difficulty of accounting for preservation of such a fragile structure, lead us to reject Dr. Brown's conclusions regarding this specimen. We believe the interpretation of *Celliforma favosites* is altogether too uncertain and problematical for it to be accepted as a Cretaceous wasp nest without more proof than has been offered and in view of the total absence of remains of fossil Vespidae, either social or solitary, from that period.

We might point out that there is some superficial resemblance between Dr. Brown's fossil and certain "fossil nests" which have been recently described from Uruguay by F. Lucas Roselli,[4] and which are thought to be of Cretaceous age, also. We refer particularly to the fossil named *Uruguay auroranormai,* which shows a somewhat similar arangement of cells of even diameter from top to bottom, ending in dome-shaped bases; the cells are not represented by casts, however, but are hollow, with their own walls preserved. If such structures were filled with sand or mud, they might presumably after hardening become "fossils" similar to that described by Dr. Brown. Some of the Uruguayan nests are claimed by Roselli to be the work of solitary diplopterous wasps, although this seems to us extremely problematical. Without examining these nests and knowing more about the conditions under which they occur, we cannot of course discuss them further; but they look suspiciously like nests built by certain Recent solitary bees. The female of the European *Halictus quadricinctus*, for example, digs a spacious chamber at the end of a tunnel in the soil, in which she

[4]Boletin de la Sociedad Amigos de las Ciencias Naturales Kraglievich-Fontana", vol. I, pt. 2, September 1938, pp. 72-102.

constructs as many as 16 to 20 earthern cells, arranged in a crude comb.[5]

Since incorrect and misleading statements about the geological age of social insects are common in both entomological and paleontological literature,[6] we include here a summary of the evidence bearing on the subject. Parental care of young occurs in many groups of insects (e.g., Embiaria, Hemiptera, Dermaptera, etc.), but truly social habits among Recent insects are confined to members of two orders, Isoptera and Hymenoptera. The earliest Isoptera known are from the Eocene period and the group is well represented in the Baltic amber (Oligocene). Since only the winged or sexual forms have been found fossil, we have no factual knowledge that these Tertiary species were social. However, inasmuch as the social organization of the termites is more highly developed than that of any other insects, it was probably well advanced even in the early Tertiary. This conjecture is supported by the presence in the amber species of the transverse suture along which the wing breaks after the insects have swarmed.

The Hymenoptera as a whole have been found as far back as the Jurassic, from which Siricoid and parasitic types have been described. Social habits have been independently developed many times within the order, as Wheeler has pointed out, but none of the social families have been found in strata below the Eocene. The Formicidæ (ants), which are the most highly social of the Hymenoptera, are represented in several Eocene beds. The presence of workers among these Eocene species is conclusive proof that the ants had a well-developed society by that period. This is not surprising, inasmuch as caste differentiation of the Baltic amber ants was as advanced as that of Recent Formicidæ. The social history of the bees (Apoidea) has clearly been very different from that of the ants, for as shown by several Hymenopterists, social habits have been developed on at least three

[5]Bischoff has figured a nest of this solitary bee (Biologie der Hymenopteren, 1927, p. 222, fig. 94.)

[6]For example, a recent edition of a standard text of historical geology states that termites and "social ants" occur in Jurassic strata. Actually, neither of these groups has been found in rocks older than the Eocene.

different occasions among these insects. The oldest bees known are from the Baltic amber (Oligocene), and some of these belong to highly social families (Bombidæ, Apidæ). None of the described amber bees, however, can be placed in existing genera of these social families.[7] Furthermore, since none of the amber bees have been positively identified as workers, there is again no factual evidence that they were social. The social wasps (Vespidæ) have a much weaker social organization than the termites or ants, and as in the case of the bees, social habits have arisen several times among the Vespidæ and even within certain genera of the family (*e.g.*, *Stenogaster*). The oldest known Vespidæ are from the Eocene, and several Baltic amber species (apparently) belong to existing genera which include social species. This fact by itself does not, however, prove the existence of social habits among the Eocene or Oligocene wasps. Recent Vespidæ have no structural characteristics definitely separating all social species from the solitary ones. Moreover, Recent social Vespidæ scarcely ever show structural differences between the workers and the queen.

As the geological record now stands, therefore, there is definite proof of the existence of social insects only as far back as the Eocene. Furthermore, only one Recent family, the Formicidæ, has a social history extending into that period. The termites have probably had a well developed society for at least as long a time as the ants, though there is no paleontological evidence for that conclusion. The bees and wasps, also, may have had a social development extending beyond the Eocene, but no fossil evidence for that has been found, and the nature of their present social structure is decidedly against that possibility.

[7]A true *Bombus*, *B. proavitus* Cock., has however been found in the Miocene of Washington (state).

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THE HABITS OF THE EUCHARIDÆ

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From many points of view the Eucharidæ are the most interesting of the families of Hymenoptera of parasitic habit. Though world-wide in distribution their habits and host relationships are little known. Studies thus far made have shown a parallelism in habit and development with the Perilampidæ, though revealing an even higher degree of specialization and greater variations between species. Accounts are being presented elsewhere of the oviposition habits and on the morphology of the immature stages of the family, and the present article deals principally with the host preferences and the habits of the adults and larvæ.

Host Preferences

All species of Eucharidæ are, so far as known, parasitic upon the mature larvæ or pupæ of ants. The host preferences of the species observed by the writer, so far as they were determined, are as follows:

Species	*Host**	*Country*
Chalcura deprivata (Walk.)	*Odontomachus hæmatodes* L.	Ceylon
Kapala terminalis Ashm.	*Odontomachus hæmatodes insularis pallens* Wheeler	Cuba
Kapala sp.	do.	Cuba
Eucharis scutellaris Gahan	*Formica fusca fusca japonica* Mots.	Chosen
Schizaspidia convergens (Walk.)	*Odontomachus hæmatodes* L.	Ceylon
Stilbula tenuicornis (Ashm.)	*Camponotus herculeanus japonicus* Mayr.	Japan
	Camponotus herculeanus ligniperdus obscuripes Mayr.	Chosen

*Determinations by W. M. Mann

Wheeler and Wheeler, in 1937, compiled the records of host preferences published up to that date, and their list comprises 31 species, of 15 genera. The questionable generic assignment of many species makes it difficult to summarize generic preferences, but 4 species of *Orasema* are recorded only from *Pheidole,* 1 from *Solenopsis,* 1 from both these genera, and 1 from *Wasmannia. Eucharis* has been reared from *Messor, Cataglyphis, Myrmecia,* and *Formica.* Three species of *Stilbula* are known to parasitize *Camponotus,* while species of *Chalcura, Kapala,* and *Rhipipallus* have been reared from several subspecies of *Odontomachus hæmatodes.* Considering that the larval and pupal stages of most of the castes of the different species of ants known to be parasitized by Eucharidæ are usually of sufficient size to bring the parasites to maturity, we might assume that they will all be subject to attack. The available evidence, however, indicates that in some species certain castes are exempt, and these are not the same among different species. Wheeler (1907) states that only the soldiers, males, and females of *Pheidole instabilis* Emery are parasitized by *Orasema,* as the workers are too small to provide sufficient food for the larvæ of the parasite. He also indicates that the single worker form of *Solenopsis validiuscula* Emery is immune to attack by *O. coloradenis* Wheeler for the same reason.

In his studies on *Stilbula cyniformis* Rossi, Parker (1932) noted that attack was limited to the large-headed wingless workers and to the winged forms of the same size, which are presumed to be the males.

An examination of the immature stages found in the nest of *Odontamachus hæmatodes* in the Botanical Garden at Peradeniya, Ceylon, indicated that only the slender, small-headed pupæ were parasitized by *Chalcura deprivata,* whereas *Schizaspidia convergens* developed also upon the pupæ of the larger workers having very large heads and long and heavy mandibles. These latter comprised a large portion of the host population.

Sufficient information is not yet available to explain the above limitations of eucharid attack to certain host castes. Even in *Solenopsis validiuscula,* mentioned above, where size is assumed to be the determining factor, some other cause may well be responsible. It is known that many parasitic insects possess a great adaptability in respect to the quantity of food required to bring them to maturity, and because of this some adults of certain species are as much as fifty times as large, by volume, as others.

Habits of the Adults

The adults emerge from the ant nest during the morning hours, the males usually slightly preceding the females, and mating takes place almost immediately. Swarms of males of *Stilbula tenuicornis,* numbering 100 or more, have been observed hovering in the air 1 or 2 feet above the entrance to a *Camponotus* nest (Clausen, 1923). As the females appeared at the entrance to the burrow they were pounced upon before they could take flight. A similar congregation of males over the host nest has been noted in *Eucharis scutellaris.* The stimulus which attracts these males to the host nest is not known; it may be the nest odor, or they may be able to detect the presence of the freshly-emerged females of their own species in the nest. Not all species show this extreme agitation and activity on the part of the males. Those of *Kapala terminalis* rest quietly upon foliage nearby and become active only when a female emerges from the host burrow.

Wheeler (1926) records the observations of W. M. Mann on a species of *Orasema,* five males of which were found mating with female pupæ in an ant nest.

The ants of the host colonies usually pay very little attention to the eucharid parasites following transformation of the latter to the adult stage, though Wheeler mentions that *Pheidole* workers carry the adults of *Orasema* about in the nest and even feed them. Field observations on *Eucharis scutellaris* revealed many freshly emerged adults being dragged about over the ground by *Formica* workers, evidently in an effort to carry them back into the nest.

Observations indicate that the adults of the majority of species do not feed. The entire quota of eggs in the ovaries is fully developed at the time of emergence of the adult female, and in many species these are all deposited that same day, so there is little need for food. Females of *Kapala furcata* (F.) of Panama were observed upon foliage heavily infested with aphids and apparently they were feeding upon honeydew. This was noted only during the afternoons and was upon a plant species different from that utilized for oviposition earlier in the day.

The oviposition habits of the Eucharidæ are extremely varied but in no instance are the eggs laid in the nest of the host. They may be placed in masses in overwintering buds of trees, in expanding leaf and flower buds, or in seed receptacles or pods, singly or in small groups in incisions in leaf tissue, or at random upon the surface of leaves. One species, *Psilogaster antennatus* Gahan, oviposits on the leaf surface only in the immediate vicinity of a freshly deposited thrips egg.

The obligatory inclusion of one or more plant species, for oviposition purposes, in the economy of each species of Eucharidæ serves as a very definite check upon its local distribution. The presence or absence of the required oviposition plants directly governs distribution, and this, in many instances, is much more of a limiting factor than is host distribution or abundance. It is because of this that eucharid colonies are almost invariably of small size and widely separated. Each of the species which has been studied is known through definite colonies of very limited extent rather than of general occurrence in a locality. The several species found in the Botanical Gardens at Peradeniya, Ceylon, which are all parasitic on *Odontomachus,* were found to infest only the ant colonies situated immediately beneath the trees in which the eggs are laid. This is believed to be due to the members of these colonies monopolizing the areas in which their nests are situated. The exclusion of ants from other nests prevents their coming in contact with planidia on the surface of the ground beneath the trees, and consequently these latter are not transported to more distant nests.

The distribution of a eucharid parasite is thus controlled by a factor which may have no influence upon the host itself and, as a result, the latter may be entirely free from attack over the greater part of its range. The Eucharidæ are therefore relatively minor influences in the natural control of ants. Even within the colony limits the parasitization is relatively low. The colony of *Stilbula tenuicornis* under observation at Koiwai, Japan, showed a maximum parasitization of 47 percent in a single nest in 1921. A total of approximately 10 million eggs, over 4 million of which were in a single tree, were deposited that season in an area about 100 yards square, yet in 1922 the resultant maximum parasitization declined to 16 percent.

The study of the biology and habits of the Eucharidæ was long handicapped by difficulties in associating the oviposition habits of the females with the immature stages in the ant nests. Sufficient is now known regarding the general habits of the family so that, in most cases, the infested nest can be found if a female can be found or captured or, if the infested nest from which adults are emerging is first found, the oviposition habit can be quickly determined. The females are intent upon oviposition immediately after emerging from the nest and, as they fly very slowly and can be readily kept in view, they can be followed and their method of oviposition observed. This normally takes place within 1 hour after emergence and often almost immediately.

If adult females have been captured or observed, the host nest can be located without difficulty. These females are usually limited to a radius of not exceeding 50 feet from the nest, and they fly no farther than is necessary to reach a tree or plant suitable for oviposition. In many species the actual nest entrance can be detected by the swarm of eucharid males hovering over it. In other cases the size of the parasites greatly restricts the number of possible hosts, so a relatively small number of nests need be examined definitely to establish the association. *Chalcura deprivata* and *Schizaspidia convergens* of Ceylon and *Kapala terminalis* and *Kapala* sp. of Cuba are all parasites of *Odontomachus*. A consideration of the size of the adults observed ovipositing in trees, and of the ant species present in the immediate vicinity, indicated that *Odontomachus* was the only one present of sufficent size to accommodate the parasites. In each case the first nest that was excavated confirmed the conjecture that this was the host.

Habits and Development of the Immature Stages

During the course of incubation the eggs change in color from the original translucent white to deep amber, this being due to the pigmentation of the skin of the developing embryo. In some species, notably *Stilbula cyniformis,* there is a distinct bluish reflection in the older eggs. The egg stalk, of course, retains its original color.

The very incomplete information on the habits of the planidia during their free-living period indicates that they attach themselves to worker ants and are thus carried into the nest, where they transfer to the larvæ. Those of *Stilbula tenuicornis* were found upon the twigs and foliage of aphid-infested plants frequented by worker ants in their search for honeydew. In the alert position they stand erect upon the caudal sucker and the body is braced by the long spines of the posterior abdominal segment and by the spinelike projections of the pleural plates. They quickly attach themselves to any moving object that comes within reach.

In the study of *Kapala terminalis* and *Kapala* sp. in Cuba it was found that the planidia have a highly developed capacity for jumping. They stand erect upon the caudal sucker and, without any distinguishable preliminary movements, hurl themselves into space. The horizontal distance covered is about 10 millimeters, which is approximately one hundred times their own body length. This habit, if general in the family, would explain how *Parapsilogaster læviceps* Gahan and *Kapala terminalis,* which oviposit in incisions in leaves, reach their hosts. In their foraging the *Odontomachus* workers do not ascend trees and consequently, if the parasite planidia remained upon the foliage, they would have no opportunity to attach themselves to an ant carrier and be transported into the nest. By jumping they reach the ground, where they may encounter worker ants of the host species.

The intervention of a carrier other than the adult of the host species is apparently obligatory in *Psilogaster antennatus* Gahan. The eggs of the parasite are deposited on the leaf surface only in the immediate vicinity of an egg of *Selenothrips rubrocinctus* (Giard), and the eggs of the two species hatch simultaneously. As the thrips larva scrambles about among the erect eggs of *Psilogaster* the planidia of the latter attach themselves to it and are carried away. They remain attached by their mandibles to the thrips larva, but without noticeable feeding, until its first molt, when they disappear. One young larva collected in the field carried 53 planidia upon its body, yet did not seem to be inconvenienced thereby. These thrips are not attended by ants nor is the host of the parasite known, so the significance of this relationship cannot yet be determined.

Stage of the Host Which Is Attacked

Because of the habits of the planidia, which are carried into the nests by the adult ants, it is assumed that that transfer is effected mainly, if not entirely, to the ant larvæ rather than to the pupæ. This would seem to be obligatory in attack upon hosts which pupate in cocoons. In all species which have been studied the parasite planidia have been found upon the larvæ, even though development may not take place upon this stage. The majority of species permit the host to attain the perfect pupal form before death. Wheeler found that feeding by the larvæ of *Orasema* was upon the prepupæ and that the host never attained the typical pupal form. He designates the deformed host pupæ, with reduced heads and appendages, as phthisergates, while depleted semipupæ of females and males, such as result from attack of *Orasema* upon *Pheidole instabilis,* are designated as phthisogynes and phthisaners, respectively. The abstraction of a portion of the body fluids has halted the development of these individuals and they eventually die. *Schizaspidia convergens* also kills its host in the prepupal stage and the antennal sheaths never extend beyond the middle of the thorax.

There are a number of variations in habit of the immature stages of the species which develop ectoparasitically. These relate to the position of the larva on the host body, the stage of its development at the time of transfer to the host prepupa, and the time at which death of the host takes place. After the planidia reach the host larvæ in the nest they attach themselves within a relatively limited area on the body. Those of *Kapala terminalis* are invariably found laterally on the throat, while *Stilbula tenuicornis* and *Schizaspidia* are found there or in one of the sutures between the thoracic segments. Occasional individuals attach themselves to the abdomen.

In the earlier account of the biology of *Stilbula tenuicornis* it was pointed out that the planidium feeds and attains its full growth while still upon the *Camponotus* larva, and that the first molt takes place just as the host is transforming to the pupal stage. The newly-formed second-instar larva makes its way from the larval skin of the host as soon as the latter is freed from the prepupa at the point of attachment of the parasites and it then takes up a feeding position, constant for the species, on the pleural region of the metathorax, beneath a wing pad, or beneath one of the hind legs, of the pupa. The exuviæ of the planidium remains attached to that of the host larva and is found with it at the base of the cocoon. This is the only species known to undergo the first molt prior to transfer to the host pupa. *Orasema wheeleri* Wheeler, *S. cyniformis*, *Chalcura deprivata*, *Eucharis scutellaris*, and *Kapala* sp. are still first-instar larvæ at the time of the host molt. The planidia of *Kapala* sp. are fully fed and consequently fully distended at this time, whereas those of *C. deprivata* and *E. scutellaris* show no increase in size or separation of the segmental bands, and they presumably do not feed extensively until the host pupa is reached.

The increase in size of the planidium before the first molt is relatively enormous, and Parker (1932) mentions an increase of 1,000 times in *Stilbula cyniformis*. In *Schizaspidia convergens* the body length is approximately 1 millimeter as compared with one-tenth that length for the newly hatched individuals, and the increase in volume approximates the figure given by Parker. There was some doubt that this larva was actually the first instar, rather than the early second with the exuviæ still enveloping the body. Upon close examination, however, the mandibles of the heavily sclerotized first-instar head were seen to move, and when the larva was removed from the host and then replaced the mandibles were again imbedded in the skin.

As soon as the larva, in either its first or early second stage, becomes attached to the host prepupa or pupa its feeding and consequent growth are exceedingly rapid. Only a single feeding puncture is made, and in *Stilbula tenuicornis*, *Schizaspidia convergens*, *Kapala terminalis* and *Chalcura deprivata* the contents of the host pupa are completely sucked out, leaving only the white collapsed skin. According to Parker this occurs also in *Stilbula cyniformis*. Wheeler has pointed out that the *Orasema* larva consumes only a portion of the body contents of the *Pheidole* prepupa, and that the latter may still be alive after the completion of feeding by the parasite. *Eucharis scutellaris* likewise only partially exhausts the available food supply in the host body, though death of the host occurs before the parasite larva is mature.

The complete consumption of the pupal contents by several species indicates an appreciable amount of preoral digestion. It is improbable that suctorial action alone, through a single minute feeding puncture, could accomplish such a complete withdrawal of the body contents without a more thorough liquefaction than normally takes place during the period covered by the feeding of the third-instar parasite.

Parker has called attention to the apparently complete lack of tegumentary muscles in the mature larva of *Stilbula cyniformis*, and states that no indication of muscular action could be detected at any time. The same is true of *S. tenuicornis*, but in several of the other species mentioned above feeble contractions were observed in the younger larvæ of this stage. In no instance was there any movement of the body as a whole.

When the mature larvæ are examined it is found that the cast skins are present and adhere closely in a characteristic way. In all species examined, with the exception of *Stilbula tenuicornis*, the two adhere ventrally to the thoracic and anterior abdominal segments. They are readily recognizable because of the darkened segmental bands of the first exuviæ. The line formed by these widely separated bands is transverse in *Chalcura deprivata* and diagonal in *Schizaspidia convergens* and *Eucharis scutellaris*. The head of the first exuviæ is detached and remains fixed in the feeding puncture in the skin of the host pupa. In *Schizaspidia tenuicornis* only the second exuviæ are present in this position, as the first are cast before pupation of the host and remain attached to the larval skin of the latter.

In the majority of species which develop upon hosts that form cocoons prior to pupation, the remains of the host prepupa or pupa are found as a deflated envelope upon which the parasite pupa lies. There is no crumpling of the remains into a mass, and the parasite pupa occupies the same position as that previously held by the feeding larva. However, the remains of *Odontomachus* pupæ which have died as a result of attack by *Chalcura deprivata* or *Schizaspidia convergens* are found in a crumpled mass at the posterior end of the cocoon. In these species the mature larva is capable of only feeble muscular contractions, although these may be sufficient to push the host remains into the position mentioned.

Incomplete information indicates that all Eucharidæ normally develop as solitary parasites, though the quantity of food material available may be sufficient to bring several to maturity. In a number of species it has been noted that an occasional host cocoon contains two parasite individuals, one on each side of the parasitized pupa. Thus the solitary habit is not obligatory, though the number of exceptions to this habit is small when compared with the number of host larvæ which bear several planidia.

Endoparasitic Development in Orasema

One of the most surprising of the recent discoveries in the biology of the Eucharidæ is the endoparasitic mode of development of two species of *Orasema* (Wheeler & Wheeler, 1937). The first-instar larvæ, both unfed and fully distended, of *O. sixaolæ* W. & W. and *O. costaricensis* W. & W. were found within the bodies of different sized larvæ of *Solenopsis tenuis* Mayr and *Pheidole flavens* Roger var. in Costa Rica. They had evidently entered the host bodies by direct penetration of the skin and remained there with the posterior segments of the abdomen protruding from the entry hole. The fully distended planidia were found to lie with the dorsum immediately beneath the host skin, rather than free in the body cavity. The posterior portion of the body of these individuals is enveloped by a "collar" which projects inward from the periphery of the wound. This formation is apparently identical in origin with the respiratory funnel of the Tachinidæ, but its function is not so clearly indicated. These larvæ do not possess the posterior spiracles; in fact the presence of spiracles is not mentioned in the descriptions, and the occurrence of an open tracheal system in the planidia of this family is still debatable. The small size of the planidia would permit of cutaneous respiration, and sufficient air may possibly enter the opening of the funnel and surround the body to provide for their needs.

Eighteen planidia of *Orasema sixaolæ* and seven of *O. costaricensis* were found in the bodies of *Solenopsis* and *Pheidole* larvæ and none was found externally upon either larvæ or pupæ. The intermediate instars were not found but the mature larvæ of *O. costaricensis* occurred free in the nest. It is therefore not known whether the larvæ are endo- or ectoparasitic after the first molt.

The ectoparasitic manner of development of *Orasema* had been conclusively demonstrated by W. M. Wheeler in his early work (1907) upon *O. wheeleri* Wheeler[1] and others in Texas and Colorado, and later authors found the same habit in other genera. It was consequently believed that the habit was general in the family. It was doubly unexpected that the endophagous habit should appear in species which belong to this same genus and are parasitic upon the same genera of hosts.

Another feature in the biology of the two species of *Orasema* above mentioned is that they appear to be strictly larval parasites, whereas other species of the family are known to complete their development only on the prepupa or pupa. The endophagous habit may be associated with the change in the host stage which is attacked. Somewhat similar differences in developmental habits are known in the related Perilampidæ.

The Life Cycle

The complete life cycle, with the duration of the different developmental stages, has been determined only for *Stilbula tenuicornis*. This species passes the winter and a large portion of the following season, representing an elapsed time

[1]According to A. B. Gahan (U. S. Natl. Mus. Proc. 88: 425-458, 1940) the biological data presented by Wheeler under *Orasema viridis* Ashm. relate to *O. wheeleri* instead.

of approximately 11 months, in the egg stage in the buds of trees. The larvæ are fully formed in the eggs within 20 days after deposition and they then remain in diapause for the remainder of the period. The duration of the first larval stage is variable, depending upon the length of time from hatching to entry of the planidium into the host nest, after which it must await pupation of the host individual before proceeding with its own development. The second and third larval stages and the pupal stage are passed very quickly and require 3, 4 and 6 days, respectively.

The incomplete data presented by Parker (1937) on *Stilbula cyniformis* indicate that its cycle may be similar to that of *S. tenuicornis*. Adults are present only during August and the females oviposit in the seed receptacles of *Picris*. The egg masses are blown away with the seeds a short time later and they may not hatch until the following spring.

Practically all the species found in distinctly temperate regions have only a single generation each year. *Eucharis scutellaris* of Chosen, which appears in the adult stage only during June, oviposits in flower buds, and the incubation period is only 15 days. In 1928 an examination of the colony site on June 4 revealed no adults, but these were present in numbers on June 7. A large quantity of *Formica* cocoons, comprising those of both the large females and the smaller workers, was collected on the latter date. In the large cocoons all parasites except two were in the pupal stage, and these two were prepupæ. In the worker cocoons, however, the hosts had not yet transformed to pupæ and their parasites were consequently in the first larval stage. There being only one generation per year, it appears that the winter must have passed by all individuals in the first larval stage upon the ant larvæ.

A similar annual cycle is followed by *Orasema coloradensis* in Virginia. Oviposition occurs only during July, and the eggs hatch in less than 2 weeks. In the tropics the cycles of the species of the various genera observed are much shorter, probably not exceeding 1 month, and adults are present throughout the year if climatic conditions are favorable. The incubation period of *Schizaspidia convergens* of

Ceylon and *Kapala* sp. of Cuba is 10 to 14 days, while Ishii (1932) states that it is only 1 week for *Kapala foveatella* Gir., *Parapsilogaster montanus* Gir., and *Losbanos uichancoi* Ishii in the Philippine Islands.

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METAMORPHOSES OF CUBAN NYMPHALIDÆ AND LYCAENIDÆ[1]

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This paper is intended to supplement an earlier communication on the immature stages of Cuban diurnal Lepidoptera (Dethier, 1940). The three species of Nymphalidæ and single species of Lycænidæ described below are four very common members of the Cuban fauna. Nevertheless, their early stages and oviposition habits are but imperfectly known.

Precis zonalis Felder & Felder

Egg. Biscay green. Height .75 mm. Greatest diameter .65 mm. Eleven raised longitudinal ribs. In general appearance the egg resembles those of species of *Anartia*. It is nearly round but seems squat due to the fact that the base is perfectly flat and the section of greatest diameter is nearer the base than the apex. The ribs are raised a greater height from the surrounding surface at the apex than elsewhere. The surface of the egg applied to the plant is made up of microscopic polygonal areas.

First Instar. Head height .4 mm.; head width .4 mm. Smooth, shiny, and nearly black. There are a few long scattered hairs of the same color. The arrangement of these hairs is shown in Plate V Figure 1. The spherical nature of the head and the shallowness of the apex are also shown. Body 2.5 mm. long. Amber yellow. The transparency of the integument allows the green coloring of plant material in the gut to be seen. Few long scattered black hairs. Most of these are recurved forward. No branched spines are present in this instar. The thoracic legs are the same color as the head. Spiracles same color as body.

Second Instar. Head height .6 mm.; head width .6 mm. Shiny black. Same shape as in previous instar. Hairs more

[1]This work was aided by a Harvard University Fellowship.

numerous. Body 4.5 mm. long. Amber yellow suffused with green dorsally. Large branched spines present. A mid-dorsal row of spines occurs on the abdominal segments. A para-dorsal row occurs on all segments but the first thoracic, a suprastigmatal row on the third thoracic and all abdominal segments, a substigmatal row on all segments but the first thoracic, and a prespiracular spine on the prothoracic segment. The thoracic spines are the largest. All spines and their spinules are black. All legs black. Spiracles amber yellow.

Third instar. Head height .8 mm.; head width .9 mm. Shiny black. Surface smooth. Black hairs more numerous. Two small spines at apex bearing two large spinules and several small ones. Head now much wider in appearance. The distribution and relative lengths of the hairs are shown in Plate V Figure 5. Body 6.5 mm. long. Legs black. Body deep slate-olive. On the first thoracic segment and at the bases of the suprastigmatal and substigmatal spines there is a suffusion of buff-yellow. There is a slight tendency toward the same on the dorsal side of the anal segment. Ventral surface buff-yellow. Spines black. Spiracles buff-yellow.

Fourth Instar. Head height .9 mm.; head width 1.1 mm. Head similar to the previous instar with the following exceptions: hair sockets yellow, clypeus yellow. Body 7.5 to 8 mm. long. Deep slate-olive dorsally. Abdominal legs and underside buff-yellow. Anal segment and prothoracic segment suffused with buff-yellow dorsally. Spines and spinules black. Arranged as in previous instar (cf. Plate VI Figure 7). Spiracles buff-yellow.

Eggs laid July 13 hatched three days later, July 16. Each instar required three days. The first moult took place July 19, the second July 22, and the third July 25. Eggs were laid on either side of the leaves of *Lippia*. The female usually came to rest on the top of small plants with the result that eggs were seldom found anywhere but at this position.

Anartia jatrophae jamaicensis Moeschler

Egg. Primrose yellow. Height .75 mm. Greatest diameter .60 mm. The egg of this species appears less squat than that of *A. lytrea chrysopelea* due to the fact that its height surpasses its diameter. There may be eleven or twelve longitudinal ribs. The same female may lay eggs of both types. In all other respects the eggs resemble those of the next species.

First Instar. Head height .3 mm.; head width .38 mm. Head shiny piceous. Nearly round. Few scattered black hairs. Plate V Figure 3 shows the locations and distribution of these hairs. Body 2 mm. long. Color before eating primrose yellow. After eating, parrot green. First abdominal segment orange. Body covered with scattered hairs arising from brown sclerites. Hairs long and microscopically serrate. Dorsally located hairs black. Forwardly recurved. Those below the subventral fold transparent and backwardly recurved. The distribution of the hairs dorsal to the subventral fold on the prothoracic segment is shown in Plate VI Figure 1. On the cervical shield are located four pairs of hairs. Three of these are in a transverse line on the anterior edge of the shield. The fourth is on the posterior edge. Ventral to the shield proper is a sclerite bearing two hairs directed downward. The more anterior one is longer. The prespiracular wart bears a single hair. In the subventral position are located two small transparent hairs of equal length. Both are directed downward. The arrangement of the hairs on the fourth abdominal segment is shown in Plate VI Figure 2. Hairs i, iii, and v are in a straight line and ii, iv, vi, vii, viii in a straight line on the posterior edge of the segment. v is ventral and slightly anterior to the spiracle. iv is directly posterior to the spiracle. Hairs i to v are long and conspicuous. Hairs vi to viii are minute. Spiracles same color as body. Rimmed with fuscous.

Second Instar. Head height .5 mm.; head width .55 mm. Head shiny piceous, nearly black. Region of ocelli black. Large branched spines on apex of head slightly lighter in color than the surrounding surface. Spine stouter and more swollen distally than in the next species. Plate V Figure 6 shows the arrangement of the hairs of the head in this instar. Body 3.75 mm. long. Parrot green. Now covered with large black branched spines. These are distributed as follows: a mid-dorsal row on all abdominal segments, a para-dorsal row on all segments (Plate VI Figure 6) but the prothoracic where there is a group of hairs, a suprastigmatal row on all segments, and a substigmatal row on all segments but the prothoracic. Here there is a prominent prespiracular spine. Spiracles same as before.

Eggs laid July 14 hatched four days later, July 18. The first instar required four days for completion; the second instar, four days. The food plant is *Lippia.*

Anartia lytrea chrysopelea Hbn.

Egg. Light chalcedony yellow. Height .60 mm. Greatest diameter .75 mm. The greatest diameter lies nearer the base than the apex. Eleven raisd longitudinal ribs. These project a greater height from the surrounding surface at the apex of the egg than elsewhere. In profile they present a serrated appearance. This is not so evident as in the egg of *Metamorpha stelenes insularis* (Holland). The ribs are joined by many microscopic parallel cross striations which at the apex of the egg form the micropyle rosette and at the base are replaced by polygonal areas.

First Instar. Head height .3 mm.; head width .38 mm. Head shiny, light yellow green. Region of ocelli dark brown. Region of future head tubercles light brown. Few transparent hairs scattered over head. Body 2 mm. long. General color light yellow almost cream. First abdominal segment very dark maroon dorsally. Body covered with long microscopically serrate hairs. The basal two thirds of the dorsal prothoracic hairs are black, the distal ends transparent and colorless. The remaining dorsal hairs of the body are black on the basal third. All dorsal hairs forwardly recurved. Hairs below the subventral fold backwardly recurved. The arrangement of the hairs on the prothoracic segment is shown in Plate VI Figure 3. Along the anterior edge of the cervical shield are four pairs of long forwardly recurved hairs arranged in a transverse line. Slightly posterior to the most lateral one and approximately dorsal to the spiracle is a short hair. There are two prespiracular hairs and the usual two hairs in the subventral position. The arrangement of the hairs on the fourth abdominal segment is shown in Plate VI Figure 4. Hairs i and iii lie at the anterior edge of the segment in a position more anterior than the spiracle. iv is posterior to the spiracle and v ventral to it. ii, iv, vi, vii, and viii lie in a line along the posterior edge of the segment. The hairs do not arise from conspicuous scleritized areas as in the preceding species. Legs same color as body. Spiracles with brown rims. Crochets uniordinal forming an elipse.

Second Instar. Head height .5 mm.; head width .575 mm. Head smooth, clear chalcedony yellow. The spines and the region of the ocelli are dark brown to black. Plate V Figure 2 shows the head spines and the distribution of the hairs. Body 2.5 to 3 mm. long. Chalcedony yellow. Covered with large branched spines. Green from gut visible. Legs and spiracles same as in previous instar.

Third Instar. Head height .7 mm.; head width .9 mm. Similar to second instar. Head spines longer and more conspicuous (Plate VI Figure 11). Body 5 mm. long. Shiny empire green. Spines conspicuously black. Dsitribution of spines same as in previous instars.

Fourth Instar. Head height 1 mm.; head width 1.2 mm. Head similar to previous instars. Lateral and ventral areas slightly suffused with green. Body 6 mm. long. Same color as before. Spines larger. Large branched substigmatal spines occur on all but the prothoracic segment. Here there is a prominent prespiracular spine (Plate VI Figure 5). Suprastigmatal branched spines occur on all segments. Those on the prothoracic and mesothoracic segments are more postspiracular in position. Branched para-dorsal spines occur on all but the first thoracic segment. The para-dorsal spine on the second thoracic segment is much reduced (Plate VI Figure 8). Mid-dorsal spines are found on all the abdominal segments. The surface of the body is finely rugose. The rugosities are deep maroon in color against a yellowish surface background. The green color of the body is due in great part to the color in the viscera. Legs same color as body. Spiracles with black rims.

Eggs laid July 8 hatched July 12, four days later. The first instar required two days with moulting taking place July 14. The second instar required three days with moults occurring July 17. The third instar required five days moulting occurring July 22. The female oviposited on species of *Tradescantia* and on *Lippia.*

The former was probably chosen by the female in error due to its proximity to the food plant. Larvæ would not feed on it.

Eumæus atala Poey

The larva and chrysalis of this species have been described in part by Scudder (1875). The following account deals primarily with the arrangement of setæ and body colors, aspects not previously considered.

Last Instar. Head height 2 mm.; head width 2.5 mm. Head yellowish. Few minute scattered hairs. The distribution of these is shown in Plate V Figure 4. On the head the primary and secondary setæ are indistinguishable. They are of little diagnostic value since they vary so greatly in number and position. Plate VI Figures 9 and 10 illustrate the marked variation in the distribution of these head setæ in different specimens of this species. The apex of the head is deeply indented. Surface smooth. Body 20 mm. long. General color brilliant crimson. First and last segments yellowish. Legs, prolegs, and para-dorsal spines yellow. Spiracles light brown, spherical. Para-dorsal row of fleshy tubercles on every segment. Each bears three to five stiff black spines. The para-dorsal tubercles on the first and last body segments are not distinct. Body covered with much short brown secondary hair. A substigmatal row of fleshy protuberances crimson in color. Prothoracic segment enlarged. Crochets triordinal, numbering approximately thirty-three. Arranged in one interrupted band with a spatulate fleshy lobe arising near the interruption.

Chrysalis. Length 15 mm. General color sienna. Scattered brownish spots.

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Explanation of Plate V

Fig. 1. Head of first instar larva of *Precis zonalis* Felder & Felder. Approximately x 58.

Fig. 2. Head of second instar larva of *Anartia lytrea chrysopelea* Hbn. Approximately x 33.

Fig. 3. Head of first instar larva of *Anartia jatrophe jamaicensis* Moesch. Approximately x 65.

Fig. 4. Head of last instar larva of *Eumæus atala* Poey. Approximately x 14.

Fig. 5. Head of third instar larva of *P. zonalis* Felder & Felder. Approximately x 40.

Fig. 6. Head of second instar larva of *A. jatrophe jamaicensis*. Approximately x 48.

Explanation of Plate VI

Fig. 1. Prothoracic segment of first instar larva of *Anartia jatrophe jamaicensis* Moesch. showing the arrangement of the setæ dorsal to the subventral fold. A, anterior; P, posterior. Approximately x 100.

Fig. 2. Fourth abdominal segment of first instar larva of *A. jatrophe jamaicensis* Moesch, showing the arrangement of setæ I to V. A, anterior; P, posterior. Approximately x 100.

Fig. 3. Prothoracic segment of first instar larva of *Anartia lytrea chyrsopelea* Hbn. showing the arrangement of the setæ dorsal to the subventral fold. A, anterior; P, posterior. Approximately x 66.

Fig. 4. Fourth abdominal segment of first instar larva of *A. lytrea chrysopelea* Hbn. showing the arrangement of setæ I to V. A, anterior; P, posterior; S, subventral fold. Approximately x 90.

Fig. 5. Prespiracular spine from the prothoracic segment of fourth instar larva of *A. lytrea chrysopelea* Hbn. Approximately x 66.

Fig. 6. Para-dorsal spine from the first abdominal segment of second instar larva of *A. jatrophe jamaicensis* Moesch. Approximately x 66.

Fig. 7. Para-dorsal spine from the first abdominal segment of fourth instar larva of *Precis zonalis* Felder & Felder. Approximately x 40.

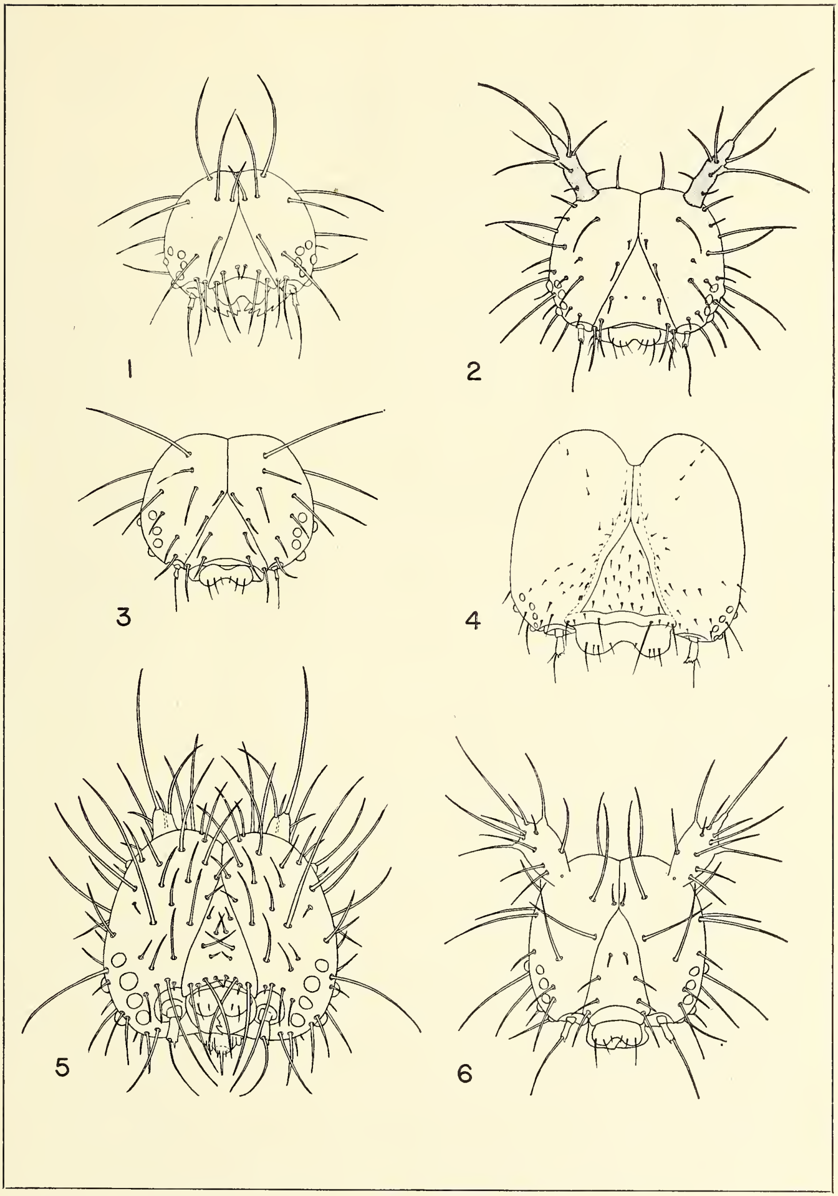
Fig. 8. Para-dorsal spine from the second thoracic segment of fourth instar larva of *A. lytrea chrysopelea* Hbn. Approximately x 70.

Fig. 9. Clypeus of last instar larva of *Eumæus atala* Poey showing the arrangement of setæ. Approximately x 30.

Fig. 10. Same.

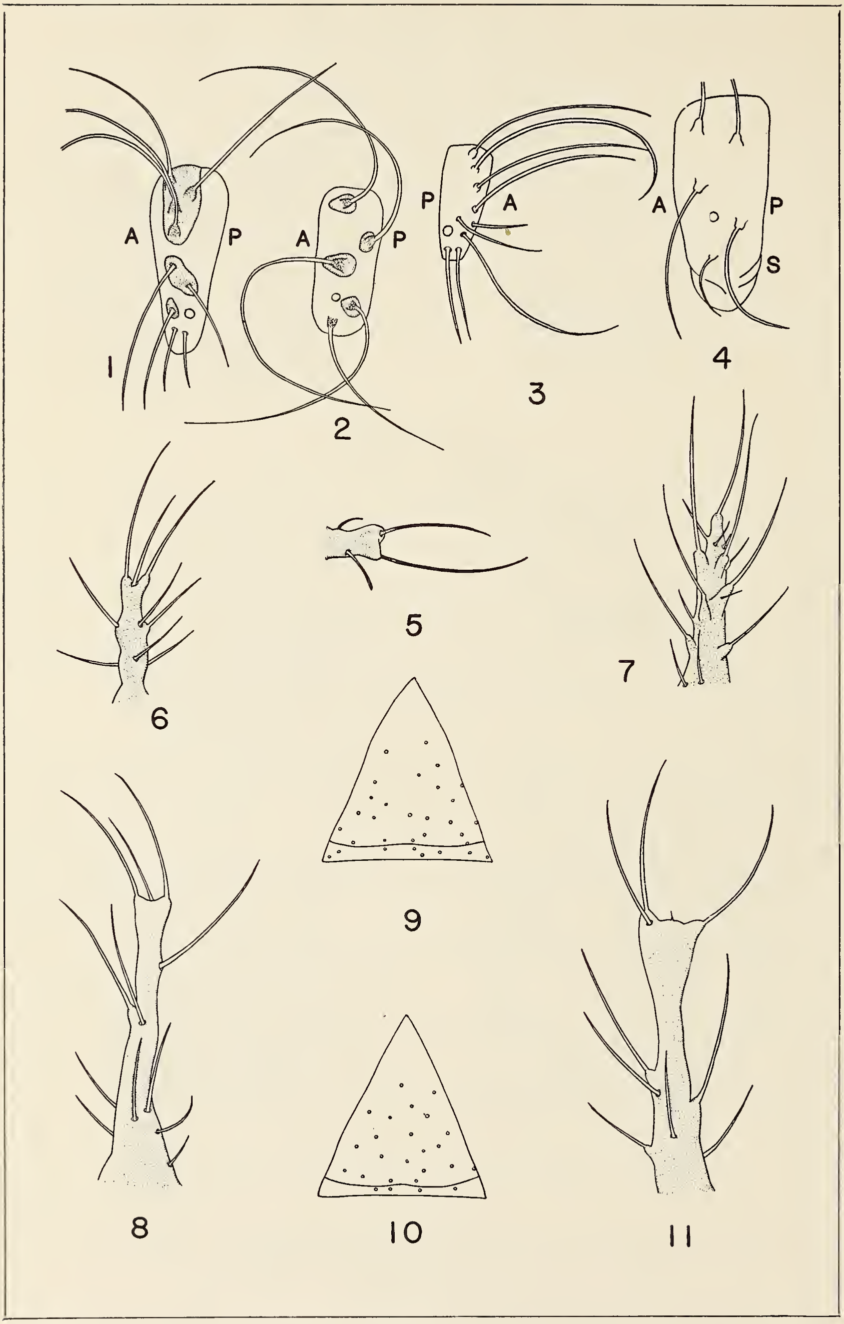
Fig. 11. Spine from head of third instar larva of A. *lytrea chrysopelea* Hbn. Approximately x 90.

Psyche, 1941 Vol. 48, Plate V



Dethier — Cuban Nymphalidæ and Lycaenidæ

PSYCHE, 1941 VOL. 48, PLATE VI



Dethier — Cuban Nymphalidæ and Lycaenidæ

THE TERMINAL ABDOMINAL STRUCTURES OF MALE DIPTERA

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The interpretation of the structures here described, was worked out a number of years ago, in preparing the chapter on the morphology of the Diptera for the forthcoming volumes of the Diptera of Connecticut; but the publication of this work has been indefinitely postponed due to lack of funds for its publication. Since the facts brought out in this study are rather "revolutionary" and indicate that the current interpretations of the terminal structures of male Diptera should be drastically revised, it has seemed advisable to present these facts at this time instead of waiting any longer to publish them.

Many male Diptera are able to twist their terminal abdominal segments about at least temporarily, in adaptation to the different positions assumed by the males during copulation, and a permanent displacement of the parts may occur as early as the pupal stage in the Cyclorrhapha (*Calliphora*), or just after emerging from the pupal stage, as in the Culicidæ, certain Tipulidæ, etc.

Even such primitive Diptera as the Tanyderid *Protoplasa fitchii* may exhibit an inversion of the ninth abdominal segment, as is indicated by all of the males of this species which I have examined (suggesting that the rotation may be permanent, instead of a temporary adaptation during copulation), and a permanent inversion of the ninth segment (which is rotated about the long axis through 180 degrees) occurs in male Culicidæ, certain Tipulidæ, etc., among the Nematocera. Among the Brachycera, an inversion, or torsion, may occur in certain Asilidæ and Dolichopodidæ, as well as in the Bombyliidæ and Certidæ, while a similar tendency toward a torsion of the parts is exhibited by the

Phoridæ Lonchopteridæ, etc., which occupy a border-line position between the Brachycera and the Cyclorrhapha (being placed among the Brachycera by some dipterists, while others place them in the Cyclorrhapha). A permanent torsion of the parts apparently occurs in all true Cyclorrhapha, as is indicated by a displacement of the external sclerites, spiracles, etc., and by the looping up of the ejaculatory duct, etc., over the top of the hindgut (from left to right) in all of the Cyclorrhapha I have examined (see Figs. 17 and 19 for illustrations of such a looping over of the parts in question).

In such Nematocera as the male Culicidæ, an inversion of of the ninth segment (together with the proctiger, or anus-bearing segmental complex) occurs by rotating the parts (through 180 degrees) from left to right around the long axis of the body of the insect; and the designation "rotation" should be restricted to such a transverse revolving of the parts around the long axis of the insect. The resulting inversion may be termed a rotated inversion or "transinversion" to distinguish it from the next type to be considered. After an inversion of this type, the anus, genitalia, etc., still project posteriorly along the long axis of the body.

In many of the higher Diptera, on the other hand, an inversion of the ninth segment (with the proctiger) may occur by twisting it forward and around in a more vertical plane. The resulting inversion may be termed a torque inversion, or "retroinversion", to distinguish it from the type of inversion mentioned above. After an inversion of this type, the anus, etc., is usually directed forward (instead of posteriorly), as is the case in the Syrphid *Heliophilus*, shown in Fig. 6, and in the Pyrgotid (Ortalid) *Pyrgota*, shown in Fig. 3. This type of torsion usually involves the displacement of the eighth sternite, which may be accompanied by the seventh and even the sixth, abdominal sternite as it is twisted upward. The way in which the displacement and modification of the parts has been brought about in the higher Diptera may be illustrated by a series of male Diptera shown in Figures 1 to 9, inclusive.

The Bibionid *Dilophus* shown in Fig. 1 may be taken as the starting point for the series, since the condition exhibited by it is fairly typical of the Nematocera in general, in which the ninth segment with the proctiger, etc., extends straight back in the long axis of the body (see also the primitive Nematoceran *Trichocera,* shown in Fig. 14). In *Dilophus* (Fig. 1) the eighth sternite 8s is very large, and shows no sign of displacement.

In the next stage represented by the Rhagionid (Leptid) *Rhagio,* shown in Fig. 2, the ninth segment is tilted upward and the conjunctivae or intersegmental membranes are very extensive, giving free play to the temporary twisting of the parts in mating. The eighth tergite 8t is reduced, but the eighth sternite 8s remains large, and the parts of the seventh segment are not effected by the process.

A slightly higher stage of specialization is illustrated by the Stratiomyid *Ptecticus,* shown in Fig. 4. In this fly the ninth segment is very large and the conjunctiva are very extensive to permit a twisting of the parts in copulation. The tergites of both the eighth and the seventh abdominal segments are reduced to narrow transverse strips, and the eighth sternite 8s shows signs of having been slightly displaced upward, at least temporarily, during the mating process (this specimen was captured in copula).

A still higher stage of specialization is illustated by the Syrphid *Heliophilus* shown in Fig. 6. The ninth abdominal segment remains permanently twisted forward in the torsion process, and the huge eighth sternite 8s, although still ventrally located, becomes slightly lateroverted, or displaced upward into the insect's left side. The eighth tergite has become atrophied, or is represented by the narrow transverse sclerite lying just behind the seventh tergite, 7t, and anterodorsad of the eighth sternite. The seventh tergite, 7t, is reduced, as is also the case with the sixth and fifth abdominal tergites, 6t, and 5t; and their sternites exhibit indications of slight lateroversion.

Turning next to the Syrphid *Chrysotaxoides,* shown in Fig. 8, we note that the ninth abdominal segment, 9t, is twisted still further around (ventrally) and the huge eighth sternite, 8s, becomes drawn up into the dorsal region, and is almost inverted. The seventh sternite, 7s, follows it to some extent, and is lateroverted into the insect's left side, but the seventh tergite, 7t, is not greatly affected by the process, and the left spiracle of the seventh segment remains but slightly displaced upward. In the Syrphid *Syrphus rectus* shown in Fig. 17, the ninth segment faces more nearly backward as the result of the continued twisting process, and the sixth and seventh sternites, 6s and 7s, follow the eighth sternite, 8s, as it becomes drawn upward. The ejaculatory dust, ed, shows through the thin integument of this Syrphid, and clearly indicates that there has been a clockwise torsion (viewing the insect from behind) of the parts, since the duct loops up over the top of the hindgut, from left to right. If there is any doubt that the sclerite 8s, interpreted as a sternite in these insects, is actually a sternite, rather than a tergite, it is only necessary to compare the parts with those of the Pyrgotid (Ortalid) *Pyrgota undata*, shown in Fig. 3, in which the huge eighth sternite, 8s, is only slightly lateroverted into the insect's left side, and preserves its typical relation to the seventh and sixth sternites, labelled 7s and 6s in Fig. 3; and if the sclerite labelled 8s were a tergite, instead of a sternite, the torsion would have to take place in a counter-clockwise manner, which it does not do in any of the insects whose internal structures have been examined.

Turning next to the Coelopid *Coelopa frigida* shown in Fig. 5, we note that the ninth tergite, 9t, has now completed the torsion process, and the anus faces posteriorly again, from this stage onward. The genitalia project downward, however, (instead of posteriorly as in the Nematocrea), and the aedeagus, ae, now projects anteriorly (instead of posteriorly) as in most Cyclorrhapha. This completion of the torsion process is spoken of as a "circumversion" or a reversion. The eighth sternite, 8s, has now become almost inverted and the asymmetrical seventh sternite, 7s, follows it upward into the insect's left side. The spiracle of the right side of the seventh segment has apparently become drawn down and around into the insect's left side, and the small narrow sclerite just below it appears to be the remains of a portion of the seventh tergite. The asymmetrical sixth sternite, 6s, is lateroverted and the right spiracle of the sixth segment is drawn down and around into the insect's left side indicating the extent of the torsion process in this region. The fifth segment is not affected by the process, in the Muscoids in general.

A further advance in the direction of the Muscoid flies is illustrated by the Helomyzid *Neoleria crassipes* shown in Fig. 7, in which the relative proportions of the segments are essentially those characteristic of the typical Muscoid flies next to be considered. The fifth segment is practically unmodified, the sixth tergite, 6t, retains its normal position, but its asymmetrically developed sternite, 6s, is lateroverted and becomes attached by one corner to the lateroverted seventh sternite, 7s, which, in turn, is attached by one corner to the inverted eighth sternite, 8s. The left spiracle of the seventh abdominal segment is displaced dorsad, but is not enclosed in the sclerites behind it.

A higher stage of specialization is illustrated by the Muscid *Hylemya antiqua* shown in Fig. 20, in which the parts bear essentially the same relations to each other as they do in Fig. 7, save that the seventh sternite, 7s, has now become adherent to the eighth sternite, 8s, from which it is demarked by an incomplete suture; and the left spiracle of the seventh segment is now borne in the anterior region of the composite sclerite made up of the lateroverted seventh sternite and the inverted eighth sternite (with which the reduced seventh tergite may also have united, although the fate of the seventh tergite cannot be definitely determined from the available material).

We may speak of the composite sclerite made up of the uniting seventh and eighth sternites (7s and 8s of Fig. 20) as a synsternite, to denote the fact that it is composed of the sternites of more than one segment, although it is usually spoken of as one "segment," called the first genital "segment," while the ninth segment is then called the second genital segment. The so-called second genital segment, (or ninth abdominal segment) of the Muscoid flies is called the andrium in lower insects, while its sternite is called the hypandrium and its tergite is called the epandrium; and these terms might also be applied to the parts in Muscoid flies, in which the term protandrium might then be substituted for the designation "first genital segment," which is not a single segment but is a composite synsternite.

The slender curved sixth sternite 6s of Fig. 20 supports a genital pouch, or cubiculum, in which the anteriorly directed aedeagus, ae, is received in repose, and this type of structure is typical of many Muscoidea. The fifth sternite labelled 5s in Fig. 20, has become cleft posteriorly to form two copulatory lobes, labelled 1, which function in the mating process, and also project backward below the aedeagus to protect it when it is received in the genital pouch.

The Metopiid fly *Phormia regina* shown in Fig. 21 is typical of the Muscoidea in general, and may serve as the basis for comparing the parts in the other members of this superfamily. Its structures are essentially like those of the fly shown in Fig. 20, but the union of the seventh sternite, 7s, with the eighth sternite, 8s, is more complete, and the seventh sternite is apparently reduced to the small indistinct area labelled 7s in Fig. 21. The left spiracle of the seventh abdominal segment is borne near the anterior border of the synsternite (composite seventh and eighth sternites) in Fig. 21, but in the Muscid fly *Parallelomma*, in which the synsternite (or composite seventh and eighth sternites) becomes greatly enlarged along the long axis of the body, the spiracle in question is situated far back in the enlarged synsternite, which may indicate that the seventh sternite, which contributes to the formation of the synsternite, is of considerable extent. On the other hand, in another Muscid fly *Musca domestica*, in which the synsternite is reduced to a narrow transverse sclerite, the left spiracle of the seventh segment remains far down toward the anterior margin of the synsternite, indicating that the seventh sternite forms a relatively unimportant portion of the reduced synsternite.

In *Musca domestica* a further specialization is indicated by the fact that the sixth abdominal sternite (which exhibits a tendency to attach itself to the synsternite labelled 7s and 8s in Fig. 21) migrates from its position below the sixth tergite, and becomes so closely associated with the ventral region of the narrow transverse synsternite that it appears to be the sternite of a segment whose tergite is represented by the narrow transverse synsternite; and it is small wonder that these structures have been misinterpreted in *Musca domestica*, although a comparison of the parts with those of the Muscoid fly shown in Fig. 21 (and tracing the parts on back through the series here described) would readily reveal the true homologies of the parts in the housefly.

The modificational trends exhibited by the series of flies shown in Figs 5, 7, 20 and 21, indicate a rather close relationship between the members of this series, but the modifications exhibited by such a fly as the one shown in Fig. 22, in which the sixth segment remains unaffected by the lateroversion of the seventh sternite 7s (and by the inversion of the eighth sternite 8s) would indicate that *Calobata* is a member of a series quite different from that to which the above mentioned flies belong, and the trends exhibited by these flies should be of considerable value for arranging them according to their natural affinities, although I do not know of any attempt to utilize the sclerites of this region of the body for such a purpose.

In this connection it may be remarked that the modificational trends exhibited by a Dolichopodid fly such as *Argyra* (shown in Fig. 23) seem to foreshadow many of the modifications later occurring in certain Cyclorrapha, just as the antennæ of certain Dolichopodidæ approach those of the typical Cyclorrhapha, and these facts may indicate that the Dolichopodidæ are much nearer to the ancestors of the Cyclorrhapha than is commonly supposed to be the case.

In like manner, the modificational trends exhibited by such Syrphidæ as *Paragus* (shown in Fig. 9) seem to foreshadow the modifications later occurring in certain higher Cyclorrhapha. Thus the lateroverted seventh sternite, 7s, unites with the inverted eighth sternite, 8s, in *Paragus* (Fig. 9) as it does in *Hylemya* (Fig. 20), for example. The sixth sternite, 6s, is asymmetrical and is strongly lateroverted in *Paragus* (Fig. 9), as it is in *Hylemya* (Fig. 20—compare also Fig. 7), and the fifth sternite labelled 5s in Fig. 9 of *Paragus* is deeply emarginated posteriorly, dividing the fifth sternite into widely separated parts which suggest the origin of the condition exhibited by *Hylemya* (Fig. 20), in which a deep posterior cleft divides the fifth sternite into the posteriorly projecting copulatory lobes labelled 1 in Fig. 20. These and many other facts suggest that the Syrphidæ represent the ancestors of certain other Cyclorrhapha as nearly as any known forms; and the Syrphidæ furnish the most useful clues for determining the homologies of the genital structures of the higher Cyclorrhapha, as will be shown later.

Before discussing the homologies of the genital forceps of the lower Diptera a brief statement may be made concerning the nature of the parameres of male Coleoptera and Hymenoptera, which represent the starting point for the derivation of the genital forceps of male Mecoptera, Trichoptera, Diptera, etc. Since the Coleoptera are more "orthopteroid" than the Hymenoptera, the condition exhibited by their genital structures should be more primitive, or ancestral, than is the case with the parts in the Hymenoptera, and the Hymenopterous type was probably derived from the more primitive Coleopterous type of genitalia occurring in such primitive Coleoptera as the Lampyridæ. In males of the common Lampyrid beetle *Lucidota corrusca*, the unsegmented parameres are borne on a broad basal ring corresponding to the narrower basal ring labelled gc in Fig. 11 of the primitive Hymenopteron *Xyela* (so that this type of basal ring is not peculiar to the Hymenoptera alone, as is commonly thought to be the case) in which the basal ring bears a pair of segmented forceps occupying exactly the same position (on each side of the median aedeagus) that the unsegmented parameres do in Lucidota. It is therefore evident that the unsegmented parameres of the more primitive Coleoptera merely become secondarily divided into a basal and distal segment in the Hymenoptera, although Snodgrass, 1941 (Smithsonian Misc. Collections, Vol. 99, No. 14) considers that the parameres of the Hymenoptera are represented by only the distal segments of the forceps. In the following discussion the basal segment of the forceps will be referred to as the basimere or basistyle (b of Figs. 11 to 13) and the distal segment of the forceps will be termed the distimere or dististyle (d of Figs. 11 to 13).

In the Bulletin of the Brooklyn Entomological Society for 1938, Vol. 33, page 3, the writer first called attention to the fact that in male Mecoptera Diptera, etc., the basimeres (b of Figs. 12 and 13) do not represent abdominal coxites, and the distimeres (d of Figs. 12 and 13) do not represent styli, as is commonly supposed to be the case, but these segments of the genital forceps of the Mecoptera, Trichoptera, Diptera, etc., are clearly homologous with the segments labelled b and d of the parameres of such a Hymenopteron as that shown in Fig. 11; and it is difficult to understand how anyone could examine such a series of genital forceps as that shown in Figs. 11, 12 and 13, without immediately realizing this fact, if comparative morphology has any meaning at all. The only baffling difficulty presented by the parts in these insects is the question as to the homology of the basal area bearing the label g in Fig. 13, which may represent either the basal ring gc of Fig. 11, or it may represent the remains of the ninth sternite which unites with the basimeres of the forceps, or it may represent a secondarily demarked area in the basal region of the uniting basimeres of the forceps, and the latter explanation seems as logical as any.

The ninth sternite is separated from the basal segments of the genital forceps in the Trichoceridæ (Fig. 14), as is also the case in such Tipulidæ as *Macrocera,* etc., but in the genus *Tipula* the ninth sternite tends to unite with the basal segments of the genital forceps, and this tendency is carried still further in many other Diptera. In the primitive Dipteron *Protoplasa fitchii* shown in Fig. 15, the ninth sternite 9s apparently becomes greatly reduced before it unites with the basal segments of the forceps, and the condition exhibited by *Protoplasa* suggests that the area labelled g in Fig. 13 may also represent such a reduced ninth sternite which has united with the basal segments of the forceps, although it is also possible that the area labelled g in Fig. 13 is comparable to the region between the bases of the genital forceps in the Trichoceridæ (Fig. 14), and a third possibility is that both the area labelled g in Fig. 13, and that interpreted as the reduced ninth sternite in Fig. 15 (9s), may represent the basal ring of the genital forceps of the Hymenopteron *Xyela* (Fig. 11, gc).

The distal segments of the forceps, labelled d in Fig. 15 of *Protoplasa,* are forked, and if the cleft of the fork were deepened basad, it would eventually divide the distal segment into an inner and outer distimere (or dististyle) like those labelled id and od in Fig. 10 of the Tipulid *Acantholimnophila;* and it is very probable that the outer and inner distimeres or dististyles characteristic of most Tipulidæ arose from such a longitudinal splitting of the distimeres.

The basal segments of the genital forceps of Acantholimnophila bear slender mesal processes called interbases (labelled ib in Fig. 10) ; and the ninth tergite, 9t, of Fig. 10, bears a pair of posterior lobes in this insect, which may correspond to the processes of the ninth tergite labelled st in Fig. 15 of *Protoplasa,* and these in turn may correspond to the long slender processes of the ninth tergite labelled st in Fig. 16 of the Ptychopterid *Bittacomorpha.* It is probable that such processes of the ninth tergite of the lower Nematocera become the articulated processes of the ninth tergite called surstyli, or edita, in such Cyclorrhapha as those shown in Figs. 8, 9, 20 and 21, etc., in which the surstyli are labelled st.

The proctiger, or anus-bearing region behind the ninth tergite, labelled 9t in Figs. 1, 2, 4, 5, 8, etc., is apparently composed of the greatly reduced tenth abdominal segment, with which the similarly reduced, cerci-bearing, eleventh abdominal segment, and the anus-bearing telson, have united. The structures labelled ce in these figures are interpreted as true cerci since they are clearly homologous with the cerci of female Tipulidæ and female Mecoptera, etc., in which the structures in question are borne on a distinct, though greatly reduced, eleventh abdominal segment, as is the case with the cerci of lower insects, in which the cerci are appendages of the eleventh abdominal segment.

In attempting to determine what genital structures of the higher Diptera shown in Figs. 19, 20, 21, etc., correspond to the segments of the genital forceps of the lower Diptera, such as those shown in Figs. 1, 2, 3, etc., it is necessary first to compare them with the parts in the key group Syrphidæ (Fig. 17) which occupies a position intermediate between the higher and the lower Diptera, and furnishes the necessary clues for tracing the modifications met with in the sclerites and other structures of the higher forms.

Starting with the lower Nematocera, in which the segments of the genital forceps b and d are long and slender, as they are in the Nematocera shown in Figs. 14, 15, etc., we note that the segments tend to become shorter and stouter in the genital forceps of the Brachycera shown in Figs. 2 and 4; and in the Stratiomyid *Ptecticus* shown in Fig. 4, the distimeres, labelled d, are broad and flat, like the distimeres labelled d in Fig. 17 of the Syrphid *Syrphus rectus,* while the basimeres labelled b in Fig. 4 of Ptecticus, are reduced and unite with the ninth sternite, as the basimeres, b, do in the Syrphid shown in Fig. 17. It is thus an easy matter to identify the parts of the Syrphid shown in Fig. 17 with those of the lower Diptera, and it is then comparatively easy to identify the structures of the higher Diptera which correspond to the parts in this Syrphid.

In the Muscid fly *Hylemya* shown in Fig. 20, the structures which occupy a position on each side of the base of the aedeagus, ae, comparable to the parts situated on each side of the base of the aedeagus, ae, of the Syrphid shown in Fig. 17, are the so-called anterior and posterior "gonapophyses" (b and d) of Fig. 20, and unless these so-called "gonapophyses" are structers peculiar to the higher Cyclorrhapha, having no relation to the structures of the lower Cyclorrhapha, it is possible that these structures labelled b and d in the higher Cyclorrhapha shown in Figs. 20, 21, etc., may represent the basimeres, b, and the distimeres, d, of the primitive Cyclorrhaphan, *Syrphus*, shown in Fig. 17.[1] In the same way, the appendages, st, of the ninth tergite, 9t, and the lobes, ce, on each side of the anal opening of the higher Cyclorrhapha shown in Figs. 19, 21, etc., may be identified with the surstyli, st, borne on the ninth tergite, 9t, and the cerci, ce, situated on each side of the anal opening, of the Syrphid shown in Fig. 17, and it is thus an easy matter to homologize the structures of the higher Cyclorrhapha by comparing them with the structures of the key group Syrphidæ.

With regard to the minuter details of the genital structures of the higher Diptera, it may be remarked that Lowne, 1895, in the second volume of his monumental work on the blowfly Calliphora, designates the slender structure labelled p in Fig. 21 of *Phormia regina* as the paraphallus, and calls the structure labelled h in Fig. 21 the hypophallus. The genital spine labelled e in Figs. 19 and 21, etc., is usually called the epiphallus, and the basal and distal portions of aedeagus ae, labelled a and ph in Fig. 21 have been called the phallophore and phallus.

Of the internal structures in this region, mention may be made of the phallic apodeme, pa, of Figs. 19 and 21, which

[1]It is preferable to refer to the structures labelled b and d in Figs. 19, 20 and 21, of the higher Cyclorrhapha, simply as the anterior and posterior gonapophyses until their homologies have been definitely determined.

operates the parts in the basal region of the aedeagus, and the hypandrial apodeme, ha, of Figs. 19 and 21, which is formed by an internal inflexion of the ninth sternite or hypandrium, 9s, for the attachment of muscles moving these structures. Lowne, 1895, designates the structures labelled pg in Fig. 19, as the paragonia (they have been called seminal vesicles by other writers) and states that the secretions of these structures coagulates in the ejaculatory duct, or in the vagina of the female, to form a type of spermatophore. The seminal fluid is ejaculated through the action of the ejaculator em of Fig. 19, which functions as a syringe to force the fluid out through the aedeagus when the muscles attached to the sclerite in its membranous walls, etc. contract.

The interpretations given the different structures here discussed are the same as those proposed six years ago in a short paper published in the Bulletin of the Brooklyn Entomological Society for 1936, Vol. 33, No. 4, p. 141. This earlier paper, however, was apparently too brief and the accompanying figures were too few, to carry any conviction for those who have published on the morphology of the Mecoptera, Diptera, etc., since that time, so that no consideration has been given by recent investigators to the views set forth in this previous paper. It is to be hoped, however, that a re-statement of these views, illustrated by a wide series of intermediate forms indicating the steps in the development of the structures of the higher Diptera, will cause other investigators to take these views into consideration, since the conclusions here drawn are based upon an extensive study of a wide range of Dipterous types, and the clear cut evolutionary trends here described must be explained in some other way if the interpretations here suggested are not accepted.

List of Abbreviations

a......... Phallophore
æ........ Ædeagus
b......... Basimere or basistyle (basal segment of forcipate parameres), also anterior gonapophysis.
ce....... Cerci
d........ Distimere or dististyle (distal segment of parameres), also posterior gonapophysis.
e......... Genital spine or epiphallus
ed...... Ejaculatory duct
em...... Ejaculator or ejaculatory syringe
g........ Area of united basimeres of genital forceps (9th. Sternite?)
gc....... Basal ring of forceps (gonocardo)
h........ Hypophallus
ha...... Hypandrial apodeme
ib........ Interbases
id....... Inner distimere or dististyle
l.......... Copulatory lobes of fifth sternite
od...... Outer distimere or dististyle
p......... Paraphalli
pa...... Phallic apodeme, or aedeagal apodeme.
pg...... Paragonia
ph...... Phallus
ps....... Phallosome
r......... Rectal papillæ
s......... Sternites
st........ Surstyli or edita
t......... Tergites
ts....... Testes

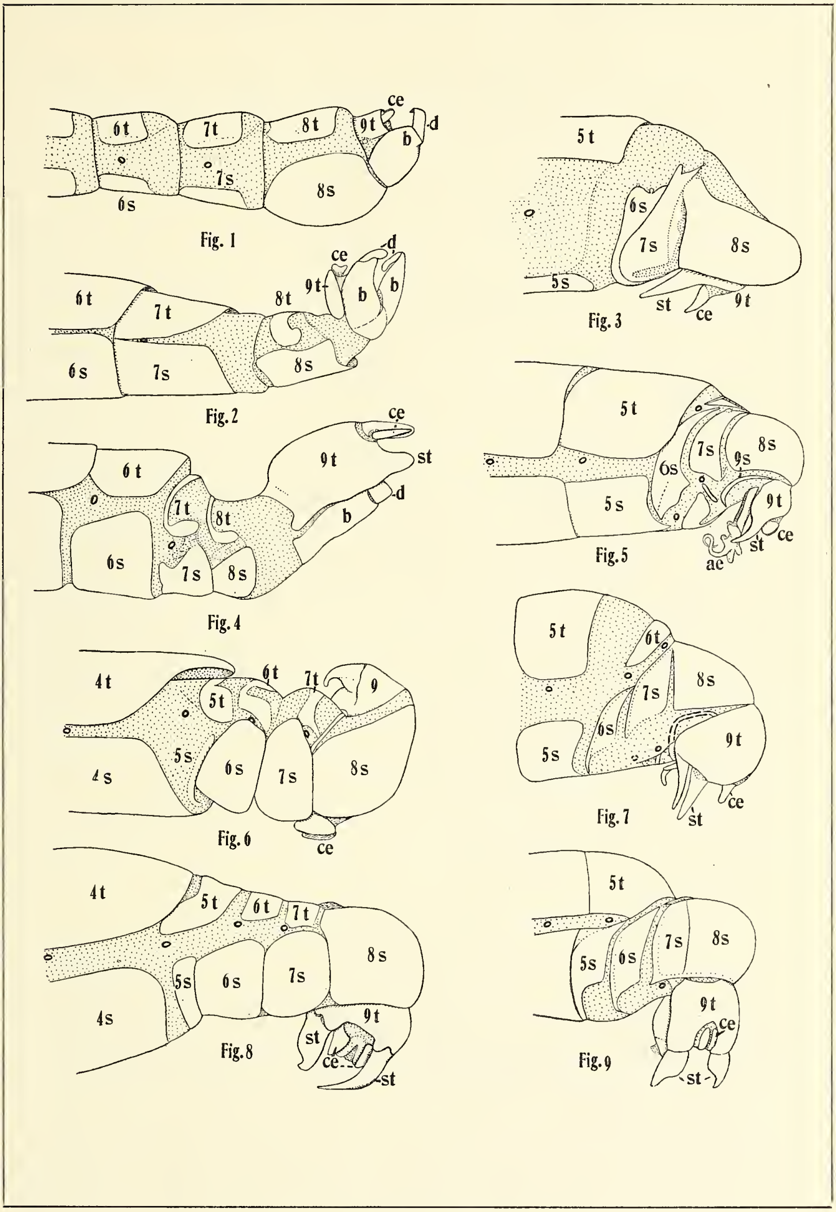
Explanation of Plate VII

Fig. 1......Lateral view of terminalia of *Dilophus* (Bibionidæ).
Fig. 2......Lateral view of terminalia of *Rhagio vertebratus* (Rhagionidæ)
Fig. 3......Lateral view of terminalia of *Pyrgota undata* (Pyrgotidæ)
Fig. 4.......Lateral view of terminalia of *Ptecticus* (Stratiomyidæ)
Fig. 5......Lateral view of terminalia of *Cœlopa frigida* (Coelopidæ)
Fig. 6......Lateral view of terminalia of *Heliophilus chaligosa* (Syrphidæ)
Fig. 7......Lateral view of terminalia of *Neoleria crassipes* (Helomyzidæ)
Fig. 8......Lateral view of terminalia of *Sericomyia chrysotaxoides* (Syrphidæ)
Fig. 9......Lateral view of terminalia of *Paragus bicolor* (Syrphidæ)

Explanation of Plate VIII

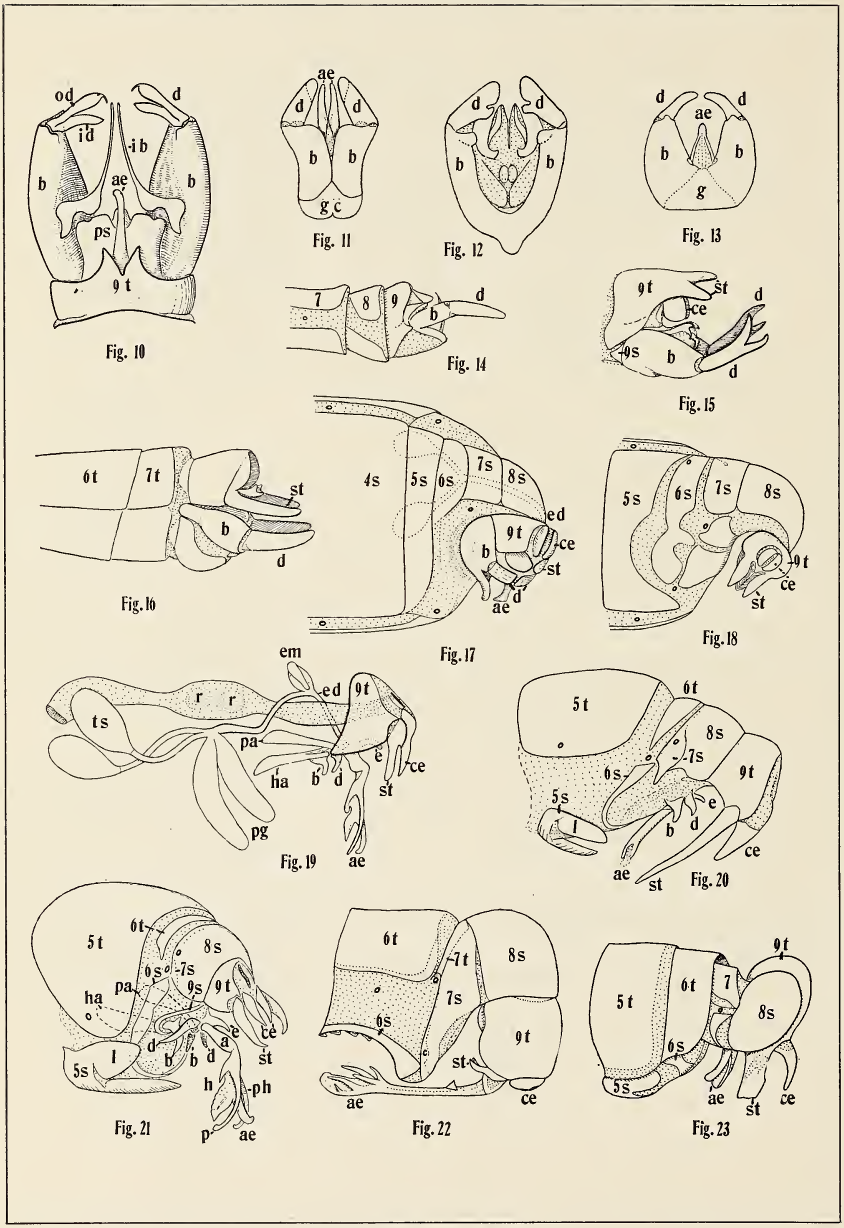
Fig. 10....Dorsal view of genital forceps of *Acantholimnophila maorica* (Tipulidæ)
Fig. 11....Ventral view of genital forceps of *Xyela* (Tenthredinidæ)
Fig. 12....Ventral view of genital forceps of *Tæniochorista pallata* (Panorpidæ)
Fig. 13....Ventral view of genital forceps of *Rhagio* (Rhagionidæ)
Fig. 14....Lateral view of terminalia of *Trichocera* (Trichoceridæ)
Fig. 15....Lateral view of terminalia of *Protoplasa fitchii* (Tanyderidæ)
Fig. 16....Lateral view of terminalia of *Bittacomorpha* (Ptychopteridæ)
Fig. 17....Ventral view of terminalia of *Syrphus rectus* (Syrphidæ)
Fig. 18....Ventral view of terminalia of *Mesograpta marginata* (Syrphidæ)
Fig. 19....Lateral view of internal genital apparatus of *Phormia regina* (Metopiidæ)
Fig. 20....Lateral view of terminalia of *Hylemya antiqua* (Muscidæ)
Fig. 21....Lateral view of terminalia of *Phormia regina* (Metopiidæ)
Fig. 22....Lateral view of terminalia of *Calobata pallipes* (Colabatidæ)
Fig. 23....Lateral view of terminalia of *Argyra* (Dolichopodidæ)

PSYCHE, 1941 VOL. 48, PLATE VII



Crampton — Male Diptera

PSYCHE, 1941 VOL. 48, PLATE VIII



Crampton — Male Diptera

TWO NEW SPECIES OF ARADIDÆ FROM BALTIC AMBER (HEMIPTERA)

By Robert L. Usinger

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A considerable collection of Hemiptera from Baltic Amber was received some time ago through the kindness of Prof. F. M. Carpenter. Of this material the aphids were examined by Prof. E. O. Essig, the scale insects by Prof. G. F. Ferris, and a beautifully preserved Tingitid by Dr. C. J. Drake. Two well preserved Aradids are treated in the present paper while the remaining specimens, mostly Fulgorids, Cicadellids, and Mirids, are as yet unstudied.

Only three species of Aradidæ, e.g. *Aradus supiestes*, *assimilis* and *consimilis*, and one Aradid nymph were recorded from Baltic Amber by Germar and Berendt.[1] Although specimens of these species have not been examined, the descriptions and figures clearly indicate that they conform to our present day definition of the nearly cosmopolitan though presumably originally holarctic genus *Aradus*. The present material is of more than usual interest in that the two species are the first representatives of their respective tribes in Baltic Amber. Moreover, the *Calisius* is the first representative of its tribe to be recorded from the fossil record.

Calisius balticus Usinger, new species

Oblong-ovate with sides subparallel, head transverse and antennæ relatively long.

Head one-eighth shorter than broad, 21::24; tylus slightly dilated at about middle, scarcely surpassing level of apices of second antennal segments; antenniferous tubercles short,

[1]Germar, E. F. and G. C. Berendt. Die im Bernstein befindlichen Hemipteren und Orthopteren der Vorwelt. In Berendt, G. C. Die im Bernstein befindlichen organischen Reste der Vorwelt. Berlin. Band II, Abth. I. pp. 22-23, Tab. II, figs. 11-13, Tab. III, fig. 17. 1856.

reaching about to level of basal third of second antennal segment, divergent and blunt; postocular tubercles distinct but not reaching so far as outer margins of eyes; upper surface feebly elevated with granular areas in front of and behind eyes and with two moderately elevated, anteriorly divergent longitudinal rows of about four large granules each at middle of vertex; eyes small, less than half as wide as interocular space, 5::13. *Antennæ* equal in length to head, the proportion of segments one to four as 3:5:5:8; first and third segments cylindrical, second roundly clavate, fourth fusiform. *Pronotum* just twice as broad across humeri as long on median line, one-seventh shorter than head, 18::21; disk moderately convex with a distinct transverse impression at middle interrupting the four distinct, posteriorly divergent longitudinal carinæ; subparallel median carinæ produced forward slightly beyond base of head; lateral margins nearly straight but for the deep notch at transverse impression, roundly lobed. *Scutellum* a little less than three times as long as pronotum, 51::18, and about half as broad as long; broadest at base where it is somewhat less than two-thirds as broad as long, 28::51, then with the sides concavely sinuate to narrowest point just behind middle where it is distinctly less than half as broad as long, 24::51, widening posteriorly to about half as wide as long and then rounded to broadly rectilinear apex; depressed portion of disk evenly punctate; longitudinal carina well elevated, impunctate; lateral carinæ coarsely granular, almost roundly tuberculate basally; four anteriorly directed projections of basal elevation but feebly developed. *Abdomen* only moderately dilated, about four-fifths as wide as pronotum, 35:43; connexival surface finely granular, the lateral margins of segments each with three feebly developed, rounded tubercles.

Size, male, length 2.5 mm., width (pronotum) .87 mm., (abdomen) 1.07 mm.

Holotype: No. 4634 (male), Museum of Comparative Zoology, Harvard University; in Haren collection of Baltic amber insects.

Closest to the European *ghilianii* (Costa) but smaller than that species with broader head, less prominent tubercles on head, pronotum, and base of scutellum, and entirely distinct antennæ. The antennæ of a female specimen of *ghilianii,* determined by Montandon and kindly loaned for comparison by Mr. W. E. China of the British Museum (Natural History), are much shorter than the head, 19::26, with the proportional length of segments one to four as 4:4:4:7.

The species of *Calisius,* due to their obscure habits and small size, have escaped the notice of most general collectors and hence are very imperfectly known. Most of the twenty-one species were described by Bergroth [2, 3] or by Horvath[4] in his excellent monograph of the old world species. Costa, Stal, Champion, Kirkaldy, and Schouteden have likewise added species and three as yet undescribed species are before me from islands of the south Pacific.

Occasional records from widespread localities throughout the world suggest that the tribe Calisiini is very widespread and may even prove to be tropicopolitan, though no species have yet been recorded from the great Oriental Realm. With New Guinea (4 species) as a possible center, somewhat less than half of the species known to me radiate southward to Australia and Tasmania, eastward to Fiji and the islands of central and southeastern Polynesia, and northward to Micronesia. All of these species, as well as the two European species, *ghilianii* and *salicis,* are similar in body form and lack the prominent black granules at the apex of the scutellum and on the sides of the scutellum near the middle which are characteristic of the American species.

The discovery of an Oligocene species which is clearly congeneric though falling in a separate group, as used above, with greatly reduced connexival and other granules, a very broad head, and uniformly dull and immaculate coloration indicates great age and relative stability for the group. A warmer climate and probably different limits of tolerance doubtless permitted *Calisius balticus* to survive so far north

[2]Bergroth, E. Notes on American Hemiptera. II. Canadian Ent., 45:1-8, 1913.

[3]Bergroth, E. A New Species of Calisius. Canadian Ent., 45:9, 1913.

[4]Horvath, G. Species mundi antiqui generis Calisius. Ann. Mus. Nat. Hungarici, 11:623-634, 10 figs., 1913.

for neither *ghilianii* nor *salicis* extends today beyond middle Europe.

Mezira succinica Usinger, new species

Figure 1

A relatively large species with broad depressed head, flattened and anteriorly dilated paraclypeal lobes reaching level of apex of first antennal segment, strongly produced postocular tubercles distinctly surpassing outer margins of eyes, moderately anteriorly produced and broadly rounded anterolateral pronotal angles, and strongly convex male genital capsule which exceeds lobes of basal genital segment. Surface in great part coarsely granular.

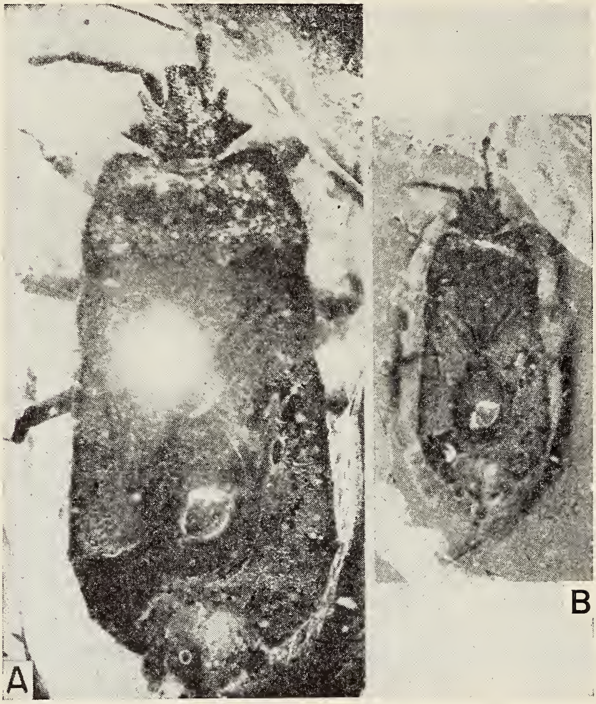

Figure 1. *Mezira succinica* n.sp. Photograph of holotype. A, x 8; B, x 4.

Male. *Head* broadest across postocular tubercles, transverse, the ratio of width to length as 6::5; anterior portion of head beyond insertion of antennæ almost as long as basal portion of head, 21::25, the tylus reaching slightly beyond its middle with the lateral lobes contiguous beyond it, subflattened, and dilated apically; antenniferous tubercles, measured from base of cleft in which the antennæ are inserted, two-thirds as long as first antennal segment and, though strongly produced, rather blunt at apices; postocular tubercles strongly produced, exceeding outer margins of eyes by a distance nearly equal to exposed width of an eye, $4\frac{1}{2}$::6; disk apparently concave, though elevated along tylus and middle of base, because of elevated sides including eyes and postocular and antenniferous tubercles and especially because of strongly elevated lateral plates which cover inner portions of each eye. *Antennæ* stout, the greatest thickness of first segment about equal to that of apex of front femur; short, the total length scarcely more than one-sixth longer than greatest width of head, 73::60; proportion of segments one to four as 19:18:17:19; first segment reaching level of apex of head. Rostrum obscured but not exceeding base of head. *Pronotum* transverse, being a little over twice as broad as long, 104::49; subequal to head on median line; posterior margin distinctly concave in front of scutellum; anterior margin likewise distinctly concave so that the pronotum is actually two-sevenths longer laterally than at middle; sides sinuately narrowed and distinctly elevated in front of broadest posterior fourth; antero-lateral angles extending to level of basal fifth of head, broadly, evenly rounded; disk depressed on anterior lobe between four elevated callosities and within elevated lateral margins. *Scutellum* about as long as pronotum on median line, its disk scarcely elevated basally, surrounded by abruptly elevated carinæ broken only narrowly at apex and with a distinct longitudinal carina at middle which does not reach to apex; shape subtriangular, the base slightly arcuate and sides evenly narrowed to apical fourth and then briefly subparallel to rounded apex. *Hemelytra* reaching nearly to base of genital capsule, strongly narrowed posteriorly when at rest, the transverse width at level of apices of coria only half the width of abdomen at this point; basal third of corium only moderately dilated and feebly arcuate, the distance across dilated bases of coria only slightly greater than greatest width of pronotum, 109::104, outer margin of corium beyond this concave to subangular apex; apical margin feebly, evenly arcuate. Connexivum unlike the rest of dorsal surface, apparently coarsely punctate. *Abdomen* gradually widening to the briefly flaring posterior lateral margins of fourth visible segment at which point it is almost one-fourth wider than greatest width of pronotum, 125::104, the margins of fifth segment concave but posteriorly convergent and margins of sixth gradually rounded. Lobes of sixth abdominal segment reaching apical eighth of greatly enlarged and obscured terminal segment. Under surface almost entirely clouded by a while film but with the abdominal venter evidently evenly and relatively finely granulate-punctate. Legs short, the femora strongly incrassate at middle. Color of entire body apparently rather uniform dark brown.

Size, length 7.45 mm., width (pronotum) 2.6 mm. (abdomen) 3.2 mm.

Holotype: No. 4635 (male), Museum of Comparative Zoology, Harvard University; in Haren collection of Baltic amber insects.

Closely allied to the widespread European *Mezira tremulæ* (Germar) which occurs along the shores of the Baltic today.[5] However, the antennæ are shorter and stouter, the paraclypeal lobes are broader and more dilated anteriorly, the antero-lateral pronotal angles are more produced anteriorly and are broadly rounded and the size is smaller than in *tremulæ*.

[5]Schumacher, F. *Mezira tremulæ* (Germar), ein Naturdenkmal aus dem Urwalde von Bialowies in Polen. Deutsch. Ent. Zeit., 1919: 285-288, 3 figs., 1 map. 1919.

THREE NEW SPECIES OF MYRMELEONIDÆ

By Nathan Banks

Dr. J. Bequaert on his recent trip to Arizona collected, with Mr. E. R. Tinkham, specimens of a new Myrmeleonid of the genus Eremoleon. It was found in a mine-shaft, and doubtless occurs in caves. The specimens are pale, the markings, although slight, are distinct, so that they are not teneral. This makes four species of this genus in the United States, others occur in Mexico.

Mr. John L. Sperry has recently sent me a small Myrmeleonid taken by himself and wife in California. It is a new species of Clathroneuria distinguished from all others by the very short tibial spurs.

I have added the description of a new form from the West Indies, a species of Puren whose known species occur in the western United States, Baja California, and Chile.

Eremoleon pallens, sp. nov.

Head and thorax pale yellowish, a faint brown mark above antennæ, sometimes faint brown spots on vertex; tip of antennæ black, before it is a stretch of pale, and the basal half mostly pale, but more or less marked, mostly above, with dark; palpi scarcely dark at tips; pronotum has the front part more or less pale brown, with a narrow median pale stripe, behind with two submedian brown stripes, sometimes scarcely indicated, and a short lateral pale brown stripe; thorax above with pale brown areas, more or less separated; pleura pale; abdomen pale, with dark bands above at near tip of several segments, much as in *E. nigribasis*, but the dark on the segments tends to spread forward in middle, so sometimes the segment is largely dark above. Legs pale, tips of femora and tip and subbasal spot on tibiæ dark.

Fore wings without the basal black spot of *E. nigribasis* and without the clouds on radials of *E. macer*, few of the cross-veins brown-bordered; the subcosta, radius and cubitus are interrupted with dark spots or streaks; there are four distinct almost black marks, all small; one at the connection of anal and cubital fork, one at the rhegma, one at and above the union of the radius and subcosta, and one on the last radial cross-vein beyond the stigma, all prominent; usually a few cross-veins obliquely beyond the rhegma less distinctly marked; many of the cross-veins are dark only at ends, the few cross-veins in apical area are pale, behind cubitus and toward tip are more dark cross-veins. In hind wing the three apical dark marks are present, but none near end of anal.

The pronotum is rather shorter than in *E. nigribasis,* the hair above is black, no long white ones on lower sides.

The fore wings are shaped more like *E. macer*, more broadened beyond the anal vein than in *E. nigribasis;* five to seven cross-veins before the radial sector, six radials before the stigma, about seven branches to radial sector, two or three cross-veins between cubital fork and first anal vein, and about five before cubital fork, none crossed.

The legs are slender as in other species, the basal tarsal joint fully as long, the spurs on front legs are equal to three joints, those of hind pair a little more than two joints.

Length of fore wing 22 to 25 mm., width 7 to 8 mm.

From Picacho Peak, Arizona, 23 July (Bequaert, Tinkham, and Flock), in a mine shaft. Type M.C.Z. no. 25519; paratypes, M.C.Z., Univ. Arizona, and with E. R. Tinkham.

Puren imbellis sp. nov.

Head and thorax yellowish, face with a large dark interantennal mark, truncate below antennæ, and above extending nearly to the vertex, but leaving a median pale yellowish spot; first vertex row of four almost connected black lines, behind is a row of brown spots, the median pair extending backward; palpi pale, last joint of labial palpi scarcely dark; antennæ pale on basal half, the joints faintly ringed with brown, beyond becoming darker where the tip is nearly black.

Pronotum pale brownish, with a median white line, and a lateral dark brown stripe near edge; thorax above pale brownish in middle, dark on sides and lobes; pleura pale yellowish; abdomen brown, with a pale median line or spots, that on second segment is a line, elongately enlarged at middle, and slightly enlarged at tip; third segment has a broad pale spot at base, partly divided at base and followed by a line which is widened at tip; fourth segment with a large pale spot at base, tapering toward tip; beyond mostly brown.

Legs pale, tips of femora dark, front and mid tibiæ largely dark, hind tibia dark at tip only, tarsi mostly dark at base and tip. Fore wings with the subcosta much interrupted with brown, radius with longer brown streaks, cubitus with more separated streaks; cross-veins often dark at ends; an oblique brown line up from near end of anal vein, and another obliquely outward from the rhegma; last radial cross-vein plainly bordered with brown, and some others faintly marked behind it, in hind wing last radial cross-vein bordered with dark.

Pronotum nearly as broad behind as long in middle, sides parallel, only short black hair above. Legs not as stout as in *P. inscriptus*, the femora not swollen; front and mid tibiæ with both black and white spines, hind tibiæ with black spines; spurs of front legs equal to three joints, of hind legs equal to two tarsal joints. In the fore wings the costal area is swollen, and the double series of cells reaches to the origin of radial sector; seven cross-veins before radial sector, ten radials before stigma, ten or eleven branches to radial sector, four cross-veins between cubital fork and first anal vein, no cubito-anal cells crossed; venation not especially dense.

In hind wing the tip is acute, the hind margin toward base almost concave, twelve radials before stigma, anal vein ends some distance before cubital fork, and with but four branches to margin.

Length of fore wing 23 mm., width 5 mm., length of hind wing 23.5 mm., width 4 mm.

From Port au Prince, Haiti, 20 November, R. C. Smith collector. Type M.C.Z. no. 25520.

Clathroneuria arioles sp. nov.

Face with a large black interantennal mark, reaching well below the antennæ and up nearly to the first vertex row, between this and the vertex mark is a pale transverse line from eye to eye; vertex largely black with two small pale spots near middle of front and two on each side toward eyes; antennæ dull black, tip rather paler; palpi black, last joint moderately swollen; pronotum with a very broad black median stripe, in the front part of which is a median pale line, and on each side of posterior two-thirds is another pale stripe; there is a short submarginal dark stripe on posterior part each side. Meso- and metanotum mostly black, more or less spotted with pale, mostly near middle; pleura dark, with a few pale spots below wings. Abdomen dull black the first, second, and basal half of third segments with a pale stripe each side above. Legs pale, the femora and tibiæ with some black spots or bands, apex of tibia black, tarsi with the whole of the fourth joint, and the tip of the others black.

Wings with the venation largely black, the subcosta much interrupted with snow-white, the radius less interrupted with pale, toward stigma the medius is white for a long distance, cubitus interrupted with white, and also the radial sector; many cross-veins partly or wholly white. Along the cubitus and at intervals beyond it is bordered with black, and a longer black streak obliquely up from the rhegma; at base of stigma and back on radius it is black.

In hind wings venation mostly black, but subcosta and radius interrupted with pale.

Pronotum much longer than broad, narrowed in front, the erect bristles are black, and short more appressed hair is white. Wings slender; in fore wing three cross-veins before radial sector, latter with six branches, some of the costals forked before stigma, a few cross-veins in apical field, eight or nine cubito-anal cross-veins before cubital fork, none connected; first anal vein connected to cubital fork three times; third anal with small apical fork; most of the cells in middle of wing are plainly longer than broad.

In hind wings two cross-veins before radial sector, latter with six branches, first anal connected once to cubital fork and with eight or nine branches to the margin.

The legs are moderately slender, more so than in the other small species of the genus, especially long is the tibia; most of the bristles are black; the spurs, unlike all the allied species, are short, hardly two-thirds as long as the basitarsus.

Length of body 20 mm., length of fore wing 16 mm., width 4 mm. One from Riverside, Calif., 25 September 1940, from Grace H. and John L. Sperry, to whom I am much indebted for many fine Neuroptera. Readily separated from others by the abbreviated tibial spurs. Type M.C.Z. no. 25568.

CONCERNING THE ANTIQUITY OF SOCIAL INSECTS

By Roland W. Brown

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In the March 1941 number of this journal J. C. Bequaert and F. M. Carpenter[1] published a six-page discussion of the antiquity of social insects. Two thirds of this space was given to a formulation of criticisms purporting to cast doubt on my identification of an object from Upper Cretaceous strata in southwestern Utah as the comb of a wasp nest called *Celliforma favosites*.[2] As most of these criticisms do not appear to be well founded a rejoinder is necessary to clarify the issue.

A small matter of terminology first needs attention. In footnote 2 Bequaert and Carpenter object to my use of the term *mold* for the fossil and say that they consider *cast* more appropriate. The popular conception of a *cast* is that of a *casting,* which is anything that has been poured into and, after hardening, has been removed from a *mold. Casting* in this sense is a general term. Paleontologists, sculptors, and others, however, use the term *cast* in a specific sense, namely, as a duplicate or positive of the original object; and *mold* as the reverse or negative of that object. Consequently, as the fossil I have described is merely the filling of the cells, it is not a duplicate of the original paper nest itself and is therefore not a *cast* but a *mold.*

It should be noted particularly, before considering their arguments in detail, that Bequaert and Carpenter do not deny that the object in question is a fossil, although I myself had qualms on this point and withheld publication for four years, because I sought evidence from mineralogy to account for the origin of the specimen by inorganic means alone. Re-

[1]Bequaert, J. C., and Carpenter, F. M. *The antiquity of social insects.* Psyche, vol. 48, pp. 50-55, 1941.

[2]Brown, Roland W. *The comb of a wasp nest from the Upper Cretaceous of Utah.* Am. Jour. Sci., vol. 239, pp. 54-56, 1941.

ceiving no encouragement in this direction from mineralogists I conceived and published a solution based on the hypothesis of an organic origin. That this hypothesis has the weight of evidence in its favor is apparent from two considerations. The object is enclosed in an ironstone concretion. Organic matter as a nucleus is frequently responsible for initiating the chemical and physical changes that produce concretions, as witness the well-known fossil-bearing nodules from Pennsylvanian strata on Mazon Creek, Illinois. Secondly, the structure of the fossil is apparently not correlatable with any produced by inorganic processes.

Inasmuch as *Celliforma favosites* is definitely from Upper Cretaceous strata, and as no social Hymenoptera themselves have yet been reported from strata older than Eocene, Bequaert and Carpenter (p. 50) intimate that such evidence suggesting the existence of the social habit among insects in Cretaceous time should be received with great reservations. Do these writers support the idea that the social habit appeared suddenly by accident, or special creation, and was not the result of a long, gradual evolution? Moreover, relatively little is known of Cretaceous insect life as compared with that of the Eocene, so that the discovery of a Cretaceous social insect is by no means precluded.

"The counterpart of the fossil is lined by shallow cavities which fit over the ends of the projections. One portion of this counterpart also has projections like those on the other half, so that when the parts of the concretion are placed together, the dome-shaped projections extend inwards from both sides. This extraordinary condition, which is not mentioned by Dr. Brown, seems to require an explanation, if the specimen is regarded as a nest" (p. 51). The portion of the counterpart referred to is at one end of the specimen, near the margin, and it is only in this portion that the condition described occurs. Have Bequaert and Carpenter never seen disintegrating nests in which portions around the margin of the comb are loose and turned back in inverted position on the main portion of the comb? Instead therefore of discrediting the fossil as a wasp nest, the recognition of this condition, it seems to me, is distinctly a positive contribution toward certainty of the original identification.

My critics chide me gently for leaving "to the reader the pleasure of speculating as to the circumstances and method by which the original comb became this fossil" (p. 51). Nevertheless, despite the fact that "the method by which a wasp nest might be preserved so as to resemble the fossil in question is very difficult to imagine" (p. 51), they accept my invitation and supply a probable version of the process. Their chief difficulty, although they admit they have not experimented with nests, is to see how it would be possible for a paper nest to retain its shape long enough to permit the mud and sand contents of the cells to become so hard as to retain its form after the disintegration of the paper walls. "The thin, soft walls between the cells would, in our opinion, inevitably disappear within a short time long before the foreign material could harden" (p. 51).

Obviously I do not know whether the postulated original nest hung from a tree, rock, or other support, or was a subterranean structure. Neither have I any information as to its topographic location; its proximity to a stream or other body of water; nor the conditions at the site of entombment whether on land or in water. These are the "circumstances" I had in mind when inviting the reader of my paper to speculate. As to the difficulties alleged by Bequaert and Carpenter in imagining a method of fossilization, it may be pointed out that if the cells of a papery nest were quickly buried in fine mud and sand so that pressure would be equal in all directions there would be little likelihood under normal conditions for much distortion of the cells, and the paper walls could conceivably serve as partitions for a long time, particularly if the paper were first partly carbonized or lignitized, as would very likely be the case in a comparatively short time. Something of this nature probably occurs during the fossilization of wood. Contrary to most statements in textbooks about "replacement atom by atom of carbon by silica," silicification of wood is essentially a process of infiltration and deposition of silica in the cells, and only secondarily one of replacement. The delicate cell walls generally remain carbonized as is shown by the fact that peels displaying the cellular structure as a deposit of carbon can be pulled from sections of the wood appropriately treated with hydrofluoric acid. Those who have seen fossil wood in which the minute details of anatomy are exquisitely preserved without distortion, or many other fragile structures of plants and animals equally well-preserved, need no further persuasion that fragility of the original object is necessarily a bar to perfect preservation provided other conditions are right.

Bequaert and Carpenter remark about the regularity and perfection of preservation of all the cells in the fossil, and suggest that, in view of the fragility of paper nests such regularity would seem impossible to be attained; and that if only a few cells were so preserved the identification of the fossil as a wasp nest would seem more plausible. The answer to this contention is that the fossil is apparently only a small portion of what was very probably a large nest and that it represents a protected portion which escaped injury and disintegration during the process of getting entombed in the sediments. I have had part of a nest of *Polistes* in water for some days now and, although waterlogged, it still retains its shape and can with care be handled without much distortion, especially of the cells several rows inward from the margin.

Comparing the fossil with nests of living wasps Bequaert and Carpenter allege a number of discrepancies. Some of these criticisms are in part well-taken, but all seem to rest on the assumption that primitive social wasps had nest-building habits that must have been exactly like those of living wasps. Such a rigid interpretation of the law of uniformity, although perhaps applicable to inorganic processes, does not seem appropriate for organisms. Without variation there can be no evolution of organisms or their habits.

In the fossil the dome-shaped projections representing the bottoms of the cells are arranged in parallel rows in three different directions. In the nests of living wasps, however, according to Bequaert and Carpenter, although the open ends of the cells may show such regular arrangement, the bottoms or closed ends are irregularly arranged, particularly as may be seen when the paper cover is removed. In all nests I have examined the paper surface covering the bottoms of the cells displays parallel rows of cells in three different directions with the same degree of regularity as the open ends of the cells. This is well-illustrated by figures

246, 248, and 249 in Duncan's[3] recent publication on vespine wasps. Irregularities such as tapering and curving of the bottom portions of the cells is common around the margin of the comb, and probably varies considerably with different species. Sections cut carefully along a row of cells through the central part of a comb usually show as much regularity of cell bottom arrangement as that in the fossil. See Duncan's figure 212.

The dome-shaped cell bottoms shown in Duncan's figure 212 will also serve to refute the statement that "the bottoms of the cells of vespid nests are not dome-shaped, as in the fossil, but are flattened or angular." It is true that around the margins of the combs of most nests the cell bottoms are flat or angular; but this is not true for all parts of the comb or for all conditions. The bottoms of most cells in long-abandoned nests are filled with irregular fecal pellets or other debris. In combs where remnants of the silk cocoons spun by the larvæ still line the cell walls and cover the fecal pellets deposited by previous inhabitants the bottoms of the cells are perfectly dome-shaped as may be seen in a nest of the common hornet, *Vespa* (=*Dolichovespula*) *maculata*, now in my possession.

The statement that the heights of the dome-shaped projections on the fossil are "remarkably uniform" is an unwarranted exaggeration. The degree of irregularity in height is as great as any observed in the nests of living wasps. To the criticism that the cells of vespid nests taper, being wider at their openings than at their bases, whereas in the fossil the cells have a constant width, the reply is that the degree of tapering varies from nothing to very considerable proportions in different nests and different species.

"In the fossil the substance between the cells is nearly as thick as half the diameter of the cells" (p. 53). This measurement was evidently estimated by looking down upon the dome-shaped projections of the fossil and noting the yellowish clay lying between the bases of adjacent domes. This extraneous material, however, is no indication whatever of the thickness of the original vertical cell walls, but may be

[3]Duncan, Carl D. *A contribution to the biology of North American vespine wasps.* Stanford Univ. Pub., Biological Sciences, vol. 8, no. 1, 1939.

a replacement of thickened portions of the paper over and between the bottoms of the cells. The true thickness becomes apparent at once in a vertical section where it can be seen as a paper-thin, yellowish deposit between adjacent cells.

Although Bequaert and Carpenter reject my specimen as the comb of a wasp nest, they do not, as stated, deny that it is a fossil. However, they offer no suggestion as to its probable identity except to point out a resemblance to nests called *Uruguay auroranormai* described by Roselli.[4] It appears from Roselli's description that these nests were taken from Cretaceous strata in Uruguay, but the evidence is not clear that they were made in Cretaceous time. However this may be, the resemblance between *Celliforma favosites* and *Uruguay auroranormai* is only superficially suggestive. The cells of both nests are arranged in parallel rows in three different directions. Those of *U. auroranormai* are larger, and it is quite evident from Roselli's figures 19, 20, and 31, that the cells are separated from one another by matrix approximating in thickness one-third the diameter of the cells. In *C. favosites* the cells, as stated before, are separated from one another by a thin deposit of paper thickness only. Roselli's figure 20 shows one cell that displays a spiral seal,[5] a circumstance which indicates strongly that the constructor of the cell was a mining bee rather than a wasp.

For the reasons given I am not convinced that the Bequaert and Carpenter arguments rule out the possibility of a vespine, or in broader terms, a social hymenopterous origin of the fossil. I would, however, make it clear that I am open-minded on the issue and am ready to accept satisfactory evidence, no matter what the result may be.

[4]Roselli, F. Lucas. *Sobre insectos del Cretaceo del Uruguay o descubrimientos de admirables instintos constructivos de esa epoca.* Boletin de la Sociedad Amigos de las Ciencias Naturales "Kraglievich-Fontana", tomo 1, num. 2, pp. 72-102, 1938.

[5]Brown, Roland W. *Celliforma spirifer, the fossil larval chambers of mining bees.* Jour. Wash. Acad. Sci., vol. 24, pp. 532-539, 1934.

PERIPATUS (*MACROPERIPATUS*) *GEAYI* IN PANAMA

By Charles T. Brues

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As the Caribbean islands and adjacent mainland have been more carefully explored by zoologists interested in terrestrial invertebrates, information on the distribution of Onychophora in this area has slowly accumulated. A quite considerable number of species are now known to occur there, but as these animals are by no means abundant, the geographical range of the several species is poorly known.

I have recently received from Dr. Ralph Buchsbaum a specimen from El Cermano, near the west coast of Panama, north of Panama City. It is one of a series of five obtained for him by a friend of Mr. James Zetek. Dr. Buchsbaum had them under observation and they served him as subjects for some remarkably fine colored motion pictures as well as for black and white photographs.

This species is *Macroperipatus geayi* described by Bouvier in his "Monographie des Onychophores" in 1907 from the coast of Guiana. It was later reported from Panama by Clark[1] on the basis of a specimen from La Chorrera. The present writer recorded it from the Santa Marta Mountains, Colombia[2] on the basis of two collections.

As the color of all the Neotropical species fades rapidly in alcohol, Bouvier was unable to ascertain the color of *M. geayi* in life, and noted no conspicuous pattern. Clark mentions "a broad, transverse, obscure yellow band" just behind the head. The specimens seen by me from Colombia also possessed the pale band or "necktie," with one exception. In the living ones observed by Dr. Buchsbaum the band is cream colored, but soon fades to nearly white in alcohol. The

[1]Smithsonian Misc. Coll., vol. 60, no. 17, p. 2 (1913).
[2]Psyche, vol. 32, p. 160 (1925).

general body color is red brown or rust colored. Morphologically it seems certain that there are no specific differences between the type and the gaudily marked Panamanian specimens. Dorsally the body bears lozenge-shaped marks, very distinct in contracted individuals, but much less noticeable when the body is extended. A similar conspicuous band is present in at least two other Caribbean forms, *Macroperipatus torquatus* Von Kennel and *Peripatus manni* Brues, as well as in the Andean *Oroperipatus peruvianus* Brues.

A Note Concerning Aggregations of *Ululodes villosa* Beauvois.

On June 15th, 1940, I was collecting dragonflies along the little Jicomé river in the lower valley of the Yaque del Norte in Santo Domingo. While wading in the streambed below the highway bridge (Km. 214, Monte Christi road), and crowding my way between some bushes that overhung a riffle at a narrows, I disturbed a company of these big brown Ascalaphids. A chance stroke of my net against the bushes flushed several dozen of them. They fluttered, butterfly-like, around my head for a few minutes, and then settled again on twigs overhanging the water.

Later, in the mountains near San Jose de las Matas I flushed another colony from the pendant low-hanging bough of a large tree where it overhung the riffle in the Iguamo river. These also fluttered about wildly for a time, and then reassembled on the same boughs, quite disappearing from view in the process.

James G. Needham.

THE INTER-RELATIONSHIPS OF CERTAIN JASSOID GENERA (JASSOIDEA, HOMOPTERA)

By J. W. Evans

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As a result of a study of Australian leaf-hoppers which has extended over several years, certain conclusions have been reached concerning the classification of this group of insects that disagree with the generally accepted ideas on the subject. These conclusions have already been published (Evans, 1939). The purpose of the present paper is to draw attention to the new proposed classification in so far as it affects certain genera represented in the North American fauna. It is not intended to repeat the arguments on which the new system is based, nor to give lengthy diagnoses of characters. Instead, recourse is made to brief comparisons supported by illustrations. These it is hoped will suffice to stimulate interest in the new proposals, and help to pave the way to a system based more on genetic affinity than on superficial characteristics.

The genera concerned are, Bythoscopinae: *Bythoscopus* Germ., *Agallia* Curtis, *Idiocerus* Lewis, *Macropsis* Lewis, *Oncopsis* Burm., *Neopsis* Oman; Gyponinae: *Gypona* Germ., *Penthimia* Germ., *Xerophloea* Germ.; Jassinae: *Jassus* Fabr., *Euscelis* Brullé, *Dorycephalus* Kirsch., *Hecalus* Stål, *Spanbergiella* Sign., *Parablocratus* Fieb., *Nionia* Ball; Koebelinae: *Koebelia* Baker.

Following Baker (1923), it has been found convenient to regard each of the more distinct groups of leaf-hoppers as a family unit, and the re-arrangement of the above genera into families on the basis of my system results in the following groupings:

Bythoscopidae	Gyponinae	Hecalini — *Hecalus, Parablocratus, Spanbergiella*
		Gyponini — *Gypona*
	Bythoscopinae	*Bythoscopus*
	Penthimiinae	Penthimiini — *Penthimia*
		(Thaumatoscopini*)

*Not represented in North America.

Euscelidae, *Euscelis*. Agalliidae, *Agallia*. Macropsidae, *Macropsis*, *Oncopsis*, *Neopsis*. Idioceridae, *Idiocerus*. Jassidae, *Jassus*. Thymbridae, *Nionia*. Ledridae, *Dorycephalus*, *Xerophloea*. Stenocotidae, *Koebelia*.

Whilst certain of the proposed changes, such as the separation of *Euscelis*, *Idiocerus* and *Jassus*, have been suggested previously by other workers, others, in particular the association of *Bythoscopus*, *Hecalus*, *Penthimia* and *Gypona*, are original, and may at first sight appear absurd. If in time the alterations proposed should become accepted in whole or even in part, it will not be the first occasion on which a

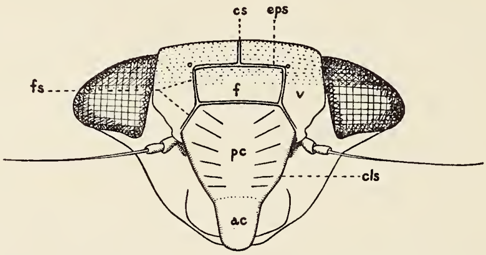

Figure 1. Head of a nymph of *Tartessus* sp. ac., ante-clypeus; pc., post-clypeus; f., frons; cls., clypeal suture; fs., frontal suture; v., vertex; cs., coronal suture; eps., epicranial suture.

knowledge of the Australian representatives of a group of organisms has led to a radical change being effected in the basic classification of the same group in other faunal zones.

The usual arrangement of the various genera into subfamilies on the basis of the position of the ocelli is clearly artificial and several workers have stressed this fact in the past. Nevertheless, whilst the position of the ocelli may be of little significance, the shape and structure of the head as a whole affords the most reliable single diagnostic character. Because certain terms will be used in referring to the head that are not commonly employed, a figure of the head of a nymph of *Tartessus* sp. is given with certain of the sutures and sclerites indicated (Fig. 1). This particular insect has been chosen for illustration as the front is present as a separate sclerite. With the backward migration of the dilator muscles of the sucking pump, the epistomal suture, which separates the clypeus from the frons, disappears;

such a condition is found in all adult leaf-hoppers. The sclerite made up in part of the frons and in part of the post-clypeus, will be referred to as the fronto-clypeus. It may be entirely central in position or extend onto the crown, and may, or may not, be directly continuous with the vertex. The morphology of the head of Homoptera has been fully discussed in three recent publications (Spooner, 1938; Evans, 1938; Snodgrass, 1938.)

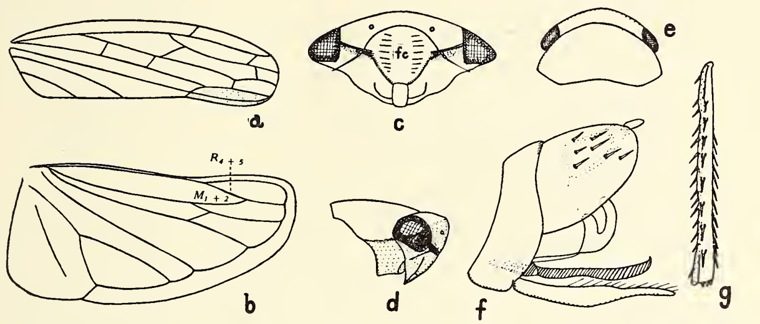

Figure 2. a, b, e, *Eurinoscopus punctatus;* c, d, g, *Bythoscopus lanio*; f, *Eurinoscopus* sp., male genitalia; fr., fronto-clypeus.

BYTHOSCOPIDAE

The principal features of the external structure of *Bythoscopus lanio* (L.) and *Eurinoscopus* spp. are shown in Figure 2. *Eurinoscopus* Kirk. is an Australian genus which according to Oman (1936) is synonymous with *Bythoscopus.* In Figure 3 the corresponding parts of *Reuteriella flavescens* Sign. are illustrated. This is an Australian leaf-hopper, which, because of the marginal position of the ocelli, would presumably be placed in the Jassinae by most Hemipterists. It is unnecessary to do more than draw attention to the very close similarity between the two groups of illustrations. The differences are, that in *Bythoscopus*, a frontal and an epicranial, but not a coronal, suture are retained, the reverse being the case with *Reuteriella.* The ocelli in the two genera are in identical positions, as is shown by a comparison of Fig. 2, d with Fig. 3, e, except that the backward extension of the muscles of the sucking-pump and the accompanying flattening and production of the head have changed their aspect in *Reuteriella.*

The process arising from the ventral internal margin of the pygophore of the male genitalia of *R. flavescens* is secondary, and of only specific value as a diagnostic character. Quite apart from structure, in appearance, habits and coloration, *Reuteriella* spp. and *Eurinoscopus* spp. are very similar.

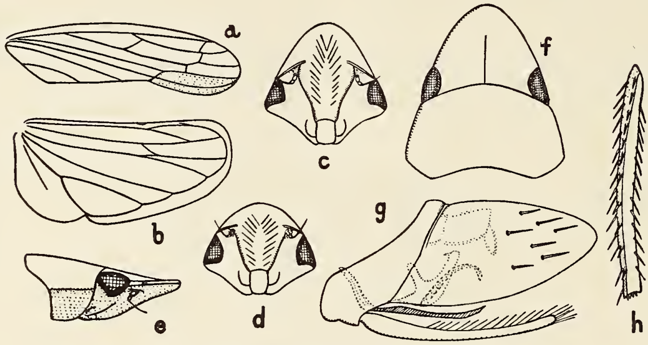

Figure 3. *Reuteriella flavescens;* c, ♀; d, ♂.

If it is accepted that *Reuteriella* should be grouped with *Bythoscopus* rather than in the Jassinae, there seems to be no good reason why *Hecalus, Parablocratus* and *Spanbergiella* should not also be placed in the Bythoscopidae. Although species in these genera may lack the character of having R_{4+5} fused apically with M_{1+2} in the wing, all have similarly shaped heads and pronota and flattened hind tibiae with an almost identical armature of spines. Furthermore, the tegminal venation is not basically dissimilar. Figures are given (Fig. 4, d–g) of *Spanbergiella vulnerata* (Uhl.) and *Parablocratus glaucescens* Fabr. (a Tunisian species).

The relationship of *Gypona* to *Bythoscopus* is not quite so apparent, but it is believed that *Krisna strigicollis* (Spin.), which occurs in Borneo (Fig. 5 a–e), is close to *Reuteriella.* A comparison of these figures with Figure 5 a_1–d_1 suggests that the two genera are not far removed from each other. Moreover, if *Penthimia* is grouped with *Gypona,* as is usually done, then the case for the inclusion of *Gypona* in the Bythoscopidae is strengthened. A comparison of the head of

Bythoscopus and *Penthimia,* illustrated in Figures 2, c and 4, b respectively, will show that the genera resemble each other in essential head structure. The occurrence of the hindmost part of the fronto-clypeus on the crown in *Penthimia* is a purely secondary feature brought about by the production and inflation of the fronto-clypeus. The Thaumatoscopini are a tribe comprising Australian genera that show complete gradation between species with ventral ocelli and rounded heads, and others with dorsal ocelli and spatulate heads.

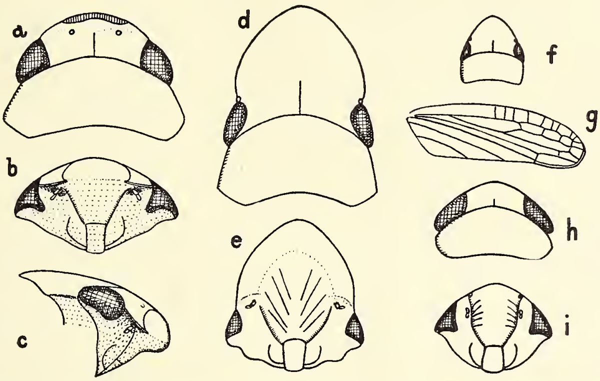

Figure 4. a–c, *Penthimia americana;* d, e, *Spanbergiella vulnerata;* f, g, *Parablocratus glauscens;* h, i, *Thamnotettix cockerelli.*

Euscelidae

This family, which comprises genera related to *Euscelis,* such as *Thamnotettix* Zett., *Eutettix* Van D. and *Deltocephalus* Burm., though distinct from the Bythoscopidae, is probably an offshoot from it. It is almost certain that *Hecalus, Parablocratus* and *Spanbergiella* are nearer to *Bythoscopus* than to *Euscelis.* For the purpose of comparison, figures are given of *Thamnotettix cockerelli* Ball. (Fig. 4, h, i).

Agalliidae

Agallia does not closely resemble *Bythoscopus* in shape, size, or coloration, nor in a single character of any significance; neither do any of the numerous genera usually associated with *Agallia.* For comparison with the illustrations of *Bythoscopus,* figures are given of *Euragallia farculata* (Osb.) (Fig. 6, g–i).

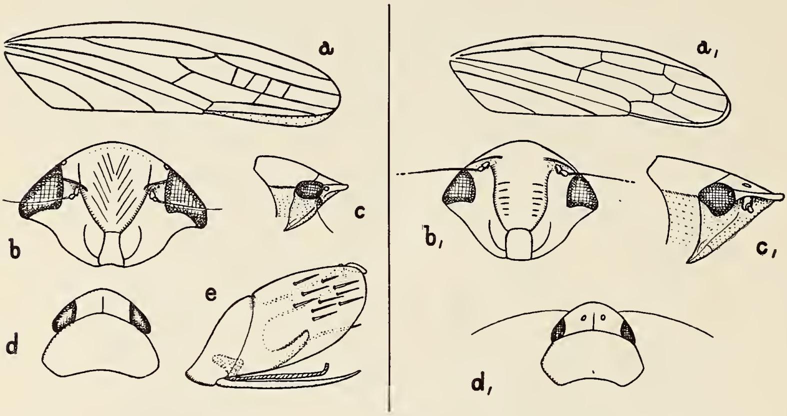

Figure 5. a–e, *Krisna strigicollis;* a, *Gypona scarlatina,* b–d, *Gypona 8-lineata.*

Macropsidae

Macropsis and *Oncopsis* likewise present no essential features in common with *Bythoscopus.* Oman (1936) has suggested that *Neopsis* Oman is intermediate in character between *Macropsis* and *Bythoscopus.* Through the kindness of Mr. Oman I have been able to examine a specimen of the genotype, *N. elegans* Van D., and am of the opinion that without any doubt it should be placed in the Macropsidae, any resemblance it may have to *Bythoscopus* being purely superficial. All the Macropsidae have a character in common that does not occur in representatives of other families. This is, that when the muscle impressions of the sucking-pump are visible on the fronto-clypeus, they are invariably confined with a pair of crescent-shaped markings.

Idioceridae

In 1936 Oman removed *Idiocerus* and related genera from the Bythoscopinae and referred them to the Eurymelinae. Whilst in agreement with the separation, I do not support the new combination. The following characters which occur in all the Eurymelidae are not found in *Idiocerus*: in the head the epicranial sutures are invariably retained; in the tegmen the media has always two, and sometimes three, distinct branches; in the male genitalia the aedeagus is not in direct contact with the basal plates. Quite apart from these features, the Eurymelidae differ from the Idioceridae in shape, coloration and habits. Figures of *Idiocerus dolosus* Ball (Fig. 6, d–f), are given for comparison with those of *Bythoscopus*.

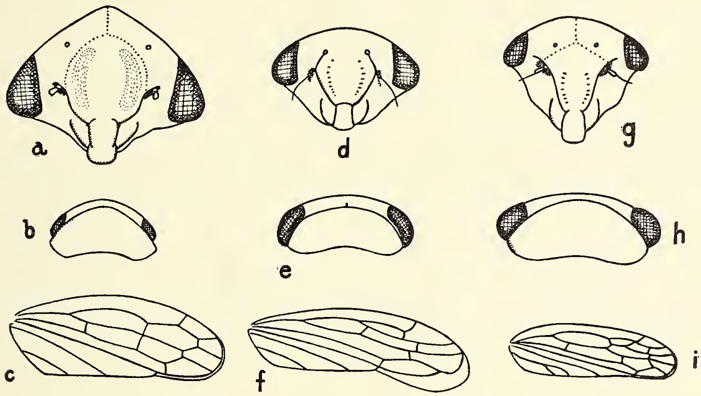

Figure 6. a, *Macropsis tasmaniensis*; b, c, *Oncopsis distinctus;* d–f, *Idiocerus dolosus;* g–i, *Euragallia furculata.*

Jassidae

Figures are not given of a representative of this family, but there seems no good reason why genera such as *Jassus* Fabr. and *Tharra* Kirk. should be associated with forms such as *Euscelis* and *Thamnotettix.*

Thymbridae

Oman, in referring to *Nionia* Ball, states that it was correctly placed by Ball as a relative of *Tartessus* Stål, but was more closely related to *Thymbris* Kirk. and *Epipsychidion* Kirk. I have not had an opportunity of examining a specimen of *Nionia,* but, if it is closely related to *Thymbris,* it is presumably a member of the Thymbridae, which contains several Australian genera and a single New Zealand genus. Thus it cannot be very close to *Tartessus*. The Tartessidae contain a number of genera which now occur in Australia, New Guinea, the Phillipines, New Caledonia and Mysol and which all have certain unique characteristics. One of these is the continuation of the ambient vein of the wing onto the anal area. The tegmen of *Mesojassoides gigantea* Oman from Cretaceous deposits of Colorado figured by Oman (1937), is very similar to that of a present-day *Tartessus*, and suggests that this family had a wider distribution at one time than it has at present.

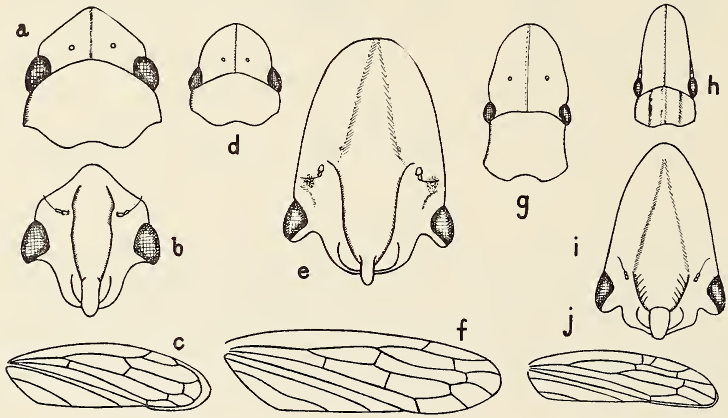

Figure 7. a–c, *Xerophloea viridis;* d, f, *Rubria sanguinea;* e, g, *Ledropsis crocina;* h–j, *Dorycephalus platyrhynchus.*

Ledridae

Xerophloea is usually placed in the Gyponinae because it has dorsal ocelli and is clearly not close to *Cicadella* Latr., *Dorycephalus* having marginal ocelli is placed in the Jassinae. Both genera are much closer to genera in the Ledridae, as may be seen in Figure 7, where figures of the Australian Ledrids *Rubria sanguinea* Stål and *Ledropsis crocina* Dist. are placed beside others of *Xerophloea viridis* (Fabr.) and *Dorycephalus platyrhynchus* Osb.

Stenocotidae

Baker (1923) considered *Koebelia* to be intermediate between *Ulopa* Fall. and *Paropia* Germ. on the one hand, and *Stenocotis* Stål on the other. For reasons previously given, (Evans, 1939), there would seem to be no justification for placing *Koebelia californica* Baker in a separate family, when it is essentially a Stenocotid.

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THE FIBER TRACTS OF THE FUSED THORACIC GANGLIA OF THE ADULT *EPHESTIA KUEHNIELLA* ZELLER (LEPIDOPTERA: PYRALIDÆ)

By Robert W. Pyle

Biological Laboratories, Harvard University, Cambridge, Massachusetts

The histology of the nervous system of the various orders of insects has been studied by many biologists, but nearly all of these have been concerned with the brain. As Snodgrass (1935) has stated the fiber tracts of the thoracic ganglia of an adult winged insect have not been worked out. Zawarzin (1924) has studied the ventral ganglia of Æschna larvæ; his figures and descriptions are excellent. Other workers, Binet (1894), Graichen (1936), etc., while studying the ganglia other than the brain have failed to elaborate upon the fiber tracts.

I wish to thank Prof. C. T. Brues, under whose guidance this work has been carried out, for helpful suggestions and criticisms, and Prof. F. M. Carpenter for reading the manuscript.

Adult Ephestia were fixed in Bouin-Duboscq-Brasil, embedded in tissuemat and serial sections cut at 10 micra. The sections were stained by the protargol method of Bodian (1937).

The fused thoracic ganglia of adult Lepidoptera in general are composed of the second and third thoracic and the first three abdominal ganglia of the larva. This ganglionic mass is roughly rectangular in shape (figs. 1 & 2), and is constricted near the middle (anterior-posterior aspect). The anterior portion, more conveniently termed the anterior lobe, is composed of the two larval thoracic ganglia (Th. II & III), whereas the posterior lobe is composed of the first three larval abdominal ganglia (Abd. I, II, III). These lobes are identified by a prominent tracheal tube (figs. 1 & 2 Tr.) which passes dorsad between them from the ventral surface of the ganglia in a median (dextro-sinistral) position. They are further differentiated by a noticeable constriction in the neuropile. (In these figures the neuropile is white and the ganglionic cell layer stippled. For the sake of clarity fiber tracts are shown as single fibers.)

In sagittal view (fig. 2) there are five bundles or tracts of fibers which enter the anterior lobe of the ganglia from the pro-mesothoracic commissures (c). The uppermost bundle (fig. 2 p) consists of motor association fibers originating in the prothoracic ganglion and extending to the posterior lobe of these fused ganglia. Fibers are given off from this bundle and ramify among the fibers of the neuropile of both lobes. Below this bundle there is a large fibre tract (fig. 2, q) which passes through the entire length of the ganglionic mass; side branches are given off which extend into the neuropile of each lobe. These are motor fibers originating in the brain and extending through the ganglionic mass.

The middle bundle of fibers (b) is quite large and ends in the neuropile of the anterior lobe. These are sensory fibers which come directly from the wings. It is quite surprising to find such a large bundle of nerve fibres which can be traced directly into the wings themselves, but this is more readily comprehended when one considers the large number of olfactory pores found on the wings of Lepidoptera by McIndoo (1917). In Ephestia this bundle leaves the pro-mesothoracic commissure (c) at a point just posterior to the prothoracic ganglion.

The fourth bundle of fibers (fig. 2 r) is comparable to the second in that it extends throughout the entire mass of fused ganglia passing toward the abdominal ganglia. It originates in the region of the brain and is composed of sensory fibers; side branches are given off to the neuropile of both lobes.

The lowest bundle of fibers (a) is the ventral counterpart of the uppermost group. These fibres originate in the prothoracic ganglion and end in the posterior lobe of the fused ganglia. Like the other bundles this one has side branches which ramify among the fibers of the neuropile in both lobes.

The association fibers (j′) which come from the abdominal region ramify among the fibers of the neuropile of the posterior lobe, but do not extend to the anterior lobe. There are association fibers, located on either side of the dividing line described above.

By examining the association fiber tracts (dorso-ventral, and dextro-sinistral) it is easy to differentiate the larval components which have contributed to the formation of the fused adult ganglia. There are well defined fiber tracts which extend from dorsal to ventral (n), and dextral to sinistral (e, j, k) areas (in both directions) in each section. Each group of fibers, on the whole, is confined to that portion of the ganglion which originally constituted a larval ganglion. In sagittal sections the dextro-sinistral fibers (o, o′) appear as well defined bundles and in frontal sections the dorso-ventral fibers have a like appearance. There are two main regions of dextro-sinistral association fibers as seen in sagittal view. The dorsal region (o) contains the motor association fibers, and the ventral region (o′) the sensory association fibers. Furthermore, each group of fibers gives off connectives to the adjacent groups; this assures communications between all sections.

The commissures to the mesothoracic legs (L 2 c) pass out of the ganglonic mass from the posterior lateral ventral portion of the anterior lobe; the motor cells (d) are located on the lateral anterior portion of the anterior lobe, e.g. that portion derived from the larval mesothoracic ganglion. Each of these cells gives off a large axon which in turn gives off a number of small branches to the neuropile before passing ventrally to the leg. There are a number of sensory fibers from the leg (f) which ramify among the various fibers of the neuropile of the anterior lobe.

Surprisingly enough the commissures to the metathoracic legs (L 3 c) leave the ganglionic mass at the posterior lateral point of the posterior lobe. The motor cells (h), however, which supply the neurones for these legs are located on the posterior lateral surface of the anterior lobe, e.g. that portion derived from the larval metathoracic ganglion. These cells, like those supplying the mesothoracic legs, give off large axons which in turn give off side branches to the neuropile before passing to the leg commissure. The sensory fibers (l) which pass from the metathoracic legs to the ganglia end in the neuropile of the posterior lobe; one group ends in the anterior ventral portion and the other in the dorsal median area, but neither extends into the anterior lobe.

The motor fibers (g) which innervate the thoracic muscles (and thus supply the impulses for flight) originate in cells located in the posterior ventral lateral portion of the anterior lobe. These fibers pass dorsad in the neuropile and give off side branches to the surrounding areas, especially the dorsal motor area, and pass among the ganglion cells to the surface in a dorsal lateral position (W M C) from which point they pass directly among the thoracic muscles.

The axons of the motor cells of the posterior lobe (i, i′, i″) all pass through the commissure (m) to the abdominal region. Each gives off fibers to the surrounding neuropile as it passes through it.

There are many small association fibers which pass from one section of the neuropile to another, but they have not been shown in the figures or discussed. This description is primarily concerned with the major tracts.

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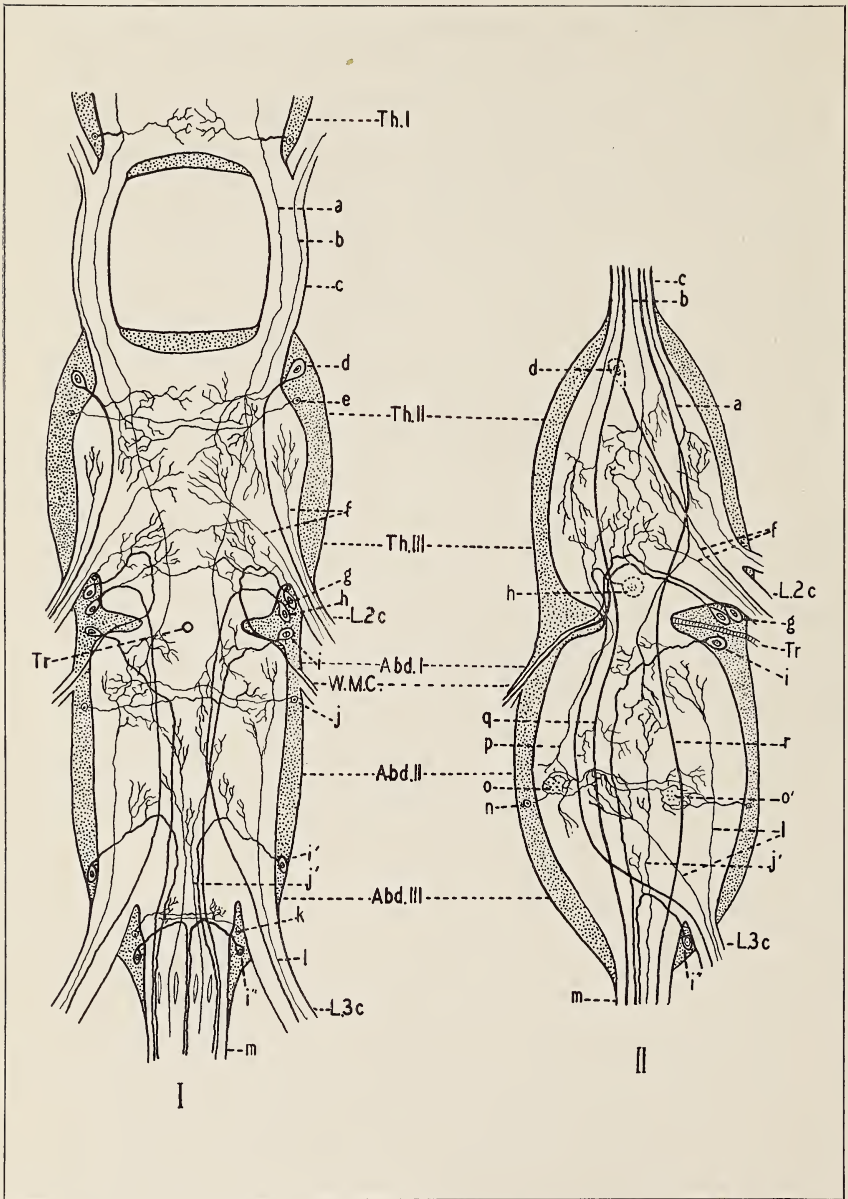
Description of Plate 9

Fig. 1. A diagrammatic reconstruction of a frontal view of the fused thoracic ganglia of *Ephestia kuehniella* Zeller. The neuropile is white and the ganglionic cell layer stippled. For the explanation of the lettering see the text.

Fig. 2. A diagrammatic reconstruction of a sagittal view of the fused thoracic ganglia of *Ephestia kuehniella* Zeller. The neurpile is white and the ganglionic cell layer stippled. For the explanation of the lettering see the text.

PSYCHE, 1941 VOL. 48, PLATE IX



Pyle — Thoracic Ganglia of Ephestia.

NOTES ON THE SPIDER FAUNA OF NEW ENGLAND

By Elizabeth B. Bryant

Museum of Comparative Zoology, Cambridge, Mass.

Nowhere, perhaps, in the New World, has the spider fauna of an equal area been more intensively studied than that of New England.

One of the first students of American arachnology was Nicholas Marcellus Hentz, (1797-1856). While confining himself chiefly to the study of spiders of Alabama and North Carolina, he received much material from his friend and correspondant, the well known New England entomologist, Thaddeus William Harris, (1795-1856). As was the custom of his time, Hentz wrote very brief descriptions, reliance being placed upon his colored drawings for ultimate identification. He described few new genera and distributed his species among the genera then known to Europe. From time to time, his papers were published in the Journal of the Boston Society of Natural History, covering the period from 1842 to 1867. Subsequent to the death of Hentz, the secretary of the Society, Edward Burgess, assisted by James H. Emerton, assembled these scattered records, and together with some few additions by Emerton, they were published in 1875 as the second volume of the Occasional Papers of the Society. The collections of Hentz, including his types, were dried and mounted on pins, in the manner of entomological specimens, with the result that today little remains but the labels in faded ink. The collection, together with his notes and such drawings as had not been distributed as souvenirs, became the property of the Boston Society, the present custodian.

The first to devote his entire attention exclusively to the New England region as a unit, was James H. Emerton, (1847-1931). When or why Emerton, who was a draftsman by training and of an artistic temperament by nature, became interested in the study of spiders is a matter of speculation. However, as early as 1874, he was evidently familiar with a paper by the Rev. Octavius Pickhard-Cambridge, (1828-1917), of Devonshire, England, on certain minute European spiders, since early that same year he sent a collection of similar New England forms to Cambridge for study and identification. All these American forms were recognized as new and were described and figured by Cambridge in the Proceedings of the London Zoölogical Society for that year, 1874. A second collection of similar material was sent by Emerton to Cambridge and was described and figured in the same journal in 1875. There can be little doubt that with Hentz as a model, Emerton made colored drawings of his material quite early. These have never been published.

In 1875, Emerton went abroad, taking with him a portion of his New England material. Some time was passed at Leipzig and Jena in study but he continued to collect in the surrounding country. Later, in France, he met Eugene Simon, (1848-1924), who was to become the foremost arachnologist of his time. From this contact, a life long friendship began. Together they made collecting excursions in the vicinity of Paris, and many specimens from Simon were added to Emerton's European collection, including material from the Pyrenees and Corsica recently described by Simon.

As early as 1864, Simon, then sixteen years of age, had published a comprehensive work on spiders under the title of "Histoire Naturelle des Araignées" and was already occupied with his monumental "Les Arachnides de France" dating from the year 1874. It is perhaps to Simon's example and probable suggestion, that we are indebted for one of the least known of Emerton's writings, "A Comparison of the Spiders of Europe and North America", a short paper published in 1877, in the Proceedings of the Boston Society of Natural History, vol. XIX. In 1882, the first of his systematic studies, "The New England Spiders of the Family Theridiidæ" appeared in the Transactions of the Connecticut Academy of Arts and Sciences. The series was continued at irregular intervals in the same publication until 1915.

In 1904, the Boston Society of Natural History published the first issue of its "Fauna of New England"; the ninth in the series, entitled "A List of the Aranea" appeared in April 1908. This listed 399 species. At the present time, 612 species have been reported, an increase of over 50%. Of these, Emerton has described 214 species, or over one third.

Since a comparison of the faunal lists of regions of similarly intensive study may have some interest, the following tabulation is included.

	Approx area (in sq. miles)	Species	Authority	Year
New England	65,000	612	Bryant	1941
New York	49,000	551	Crosby & Bishop	1928
Great Britain	89,000	556	Bristowe	1939

Possibly rather more than 10% of the spider fauna of New England is common to Europe. A number of species seemingly introduced by commerce have been established; such are *Theridion tepidariorum* C. Koch; *Scytodes thoracica* Latreille; and *Pholcus phalangioides* (Fuesslin.), all common house spiders. Others, probably circumpolar, are found across the continent but do not extend very far south. Of these we may mention *Cyclosa conica* (Pallas), *Aranea angulata* Linn., *Salticus senicus* (Linn.), *Zelotes subterraneous* (C. Koch). Of especial interest, is the discovery of *Cercidia prominens* (Westring), a northern Eurasian species, in a cold swamp in Holliston, Massachusetts, a locality from which several insects peculiar to the far north have been taken. This species also occurs in northern New England.

The following includes a description of one new species, two new names, a description of a European species new to New England, and new records of localities and a few corrections.

Family Oecobiidæ

Genus Tapinesthis Simon 1914.

Tapinesthis inermis (Simon)

Oönops inermis Simon, Ann. Soc. Ent. France, 1882, (6), 2: 240.

Orchestina saltitans Emerton, nec Banks, Trans. Conn. Acad., 1909, 14: 214, pl. 1, fig. 4.

Tapinesthis inermis Dalmas, Ann. Soc. Ent. France, 1916, 85: 242.

A pair of very small spiders was found in the basement of the museum of Natural History and figured by Mr. Emerton in 1909. Probably because they are very small and had but six eyes, he identified them as *Orchestina saltitans* Banks, the only six-eyed spider found in the north. Today, they are discolored by age and badly broken but it is evident that the do not belong to the genus *Orchestina* but, as Comte de Dalmas suggests, they may be *Tapinesthis inermis*, a species found in southern France.

Genus Orchestina Simon 1882

Orchestina saltitans Banks

Orchestina saltitans Banks, Ent. News, 1894, 5: 300.

Orchestina saltabunda Petrunkevitch, nec Simon, Ann. N. Y. Acad. Sci., 1910, 19: 207, pl. 21, figs. 2, 3.

Orchestina saltitans de Dalmas, Ann. Soc. Ent. France, 1916, 85: 240, figs. 35, 36.

These minute spiders (0: 8 mm.) are not often found in collections, probably because they are so small and colorless. They move very rapidly and because of the large femur of the fourth pair of legs, they can jump a great distance compared to their small size. A pair was found jumping on a window sill in Boston and they are not uncommon in southern Connecticut. The genus is based on a species from Corsica. Three more species are known from the Mediterranean area but *Orchestina saltitans* is the only species reported from North America.

Family Agelenidæ

Subfamily Hahninæ

Genus Hahnia C. Koch 1841

Hahnia monticola sp. nov. (Fig. 1)

Female. Length, 2.3 mm., ceph. 1.0 mm, abd. 1.6 mm.

Cephalothorax pale yellowish-brown, shining, slightly darker about margin, black about the eyes, anterior margin less than half the greatest width, thoracic groove faint; *eyes*, anterior row almost straight, a.m.e. smallest of the eight, almost touching, posterior row longer than anterior, procurved, eyes subequal, p.m.e. separated by almost a diameter and a half and from p.l.e. by a radius, lateral eyes touching; quadrangle of median eyes much narrower in front and as high as wide; *clypeus* below a.m.e. equals about a diameter of p.l.e.; *mandibles* vertical, attenuate, fang groove very short; *labium* as wide as long; *maxillae* twice as long as labium; *sternum* three-quarters as wide as long, heart-shaped, fourth coxae separated by more than a dia-

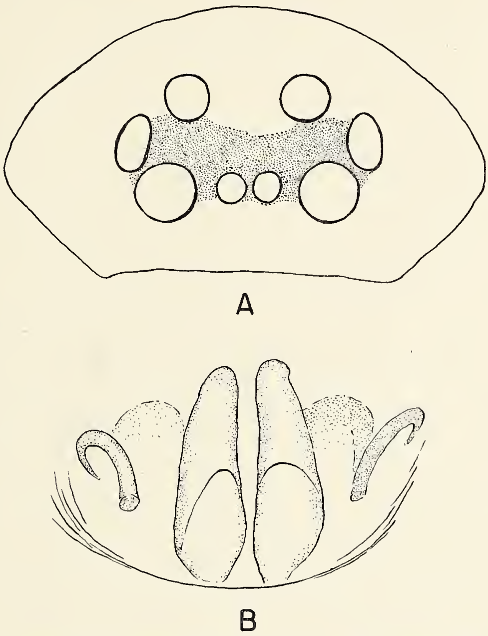


Figure 1. *Hahnia monticola* sp. nov. A, eyes; B, epigynum.

meter and sternum ending in an obtuse knob between, widest between second coxae, slightly convex, smooth; *abdomen* oval, widest on posterior half, flesh color with no markings, venter paler, opening of spiracle nearer spinnerets than to genital furrow, spinnerets in a straight line, distal joint of lateral spinnerets about half the length of basal joint, second pair with basal joint longer than that of lateral, distal joint very short, median pair separated by less than half a diameter; legs pale yellow, slender with a few weak spines;

epigynum showing two pairs of dark tubes beneath the skin, the median pair much the larger, decreasing in size, and slightly diverging, the lateral pair much smaller and curved.

Holotype ♀ New Hampshire; Mt. Washington, 5,000 feet, 1 July 1926, (Banks).

Paratype ♀ New Hampshire; Mt. Washington, 5,000 feet, 1 July 1926, (Banks).

This species lacks the abdominal pattern found on *Hahnia cinerea*, the anterior row of eyes is almost straight, the eyes are closely grouped and the epigynum is very unlike that species.

Family Pisauridæ

Genus Dapanus Hentz 1867

Recently Mr. Banks has called to my attention a name proposed by Hentz that has been overlooked by recent students. In 1867, "A Supplement to the Descriptions and Figures of the Araneides of the United States", was posthumously published in the Proc. Boston Soc. Nat. Hist., vol. 11:103-111, with two plates, from notes and figures by Hentz. In the volume of the Occ. Papers Boston Soc. Nat. Hist., vol. 2, 1875, which contains the collected writings of Hentz and is commonly used, these notes are distributed, always in brackets, to the original descriptions, and in the introduction a brief note states the origin. On page 44 of the Occ. Papers under *Micrommata marmorata*, appears the following: "Prof. Hentz had formerly considered this to be the type of a new subgenus, for which he gave the name *Dapanus*, distinguished by having its second pair of legs longest, the eyes subequal, the hinder row curved posteriorly. *Supplement*."

Micrommata marmorata is based on an adult female with a cocoon and is usually recognized as a synonym of *Micrommata undata* described on the preceding page. Mr. Emerton unfortunately placed the species in the genus *Ocyale* Audouin, (Lycosidae) and in 1898, Simon erected the genus *Pisaurina* for *Dolomedes mirus* Walck., (Ins. Apt., 1837, 1: 357, for Abbot's drawing pl. 65, fig. 321). This is usually recognized as the same as *undata* Hentz; so the species formerly known as *Pisaurina mira* (Walck.) with its many synonyms becomes *Dapanus mirus* (Walck.)

Family Theridiidæ

Genus Nesticus Thorell 1870

Nesticus cellulanus (Oliv.)

Aranea cellulanus Olivier, Araignée, Encycl. Method., 1789, 4: 211.

Araneus cellulanus Clerck, Aranei suecici, 1757, p. 62, pl. 4, fig. 12.

Theridion terrestre Emerton, Psyche, 1924, 31:140, fig. 1. ♀

A female of this European house spider was found out of doors at Holliston by Mr. Emerton. Later a male was found in Nova Scotia and it was recognized then as the European species. The position of the genus is very uncertain. As it has a distinct comb on the fourth tarsus, it has been placed by many in the *Theridiidæ,* the only family with this character. But it also has a huge paracymbium, a character confined to the *Linyphiidæ* and the *Argiopidæ.* It does not make a round web.

Genus Conopistha Karsch 1881

The genus *Argyrodes* was established by Simon in 1864, in the first edition of the Histoire Naturelle des Araignées, p. 253, for a small species found about the Mediterranean. Unfortunately, the name has been used by Guenée in 1845, for a genus of Micro-Lepidoptera. In 1928, Strand published "Miscellanea nomenclatorica Zoologica et palaeontologica" in the Arch. Naturgesch. Berlin, 92, A. Heft 8, pp. 30-75 and proposed *Argyrodina* for *Argyrodes.* But Karsch, in 1881, (Diagn. Japonicæ, Berliner ent. Zeitschr.) erected the genus *Conopistha* for the Japanese species *bona-dea,* a new species. Later, Bösenberg and Strand placed this species in *Argyrodes,* (Japanische Spinnen, Abd. Senckenb. Ges., 1906, 30: 129.). The name *Conopistha* has priority over *Argyrodina.*

The genus is very wide spread. The species are small, and both sexes are usually an iridescent silver. They live in the webs of larger spiders and catch small flies that escape the larger mesh. Two species of the genus are found in New England, *cancellatus* Hentz and *trigonum* Hentz.

Family Linyphiidæ

Subfamily Lophocareninæ

Genus Floricomus Crosby and Bishop 1925

Floricomus emertoni nom. nov.

Histagonia nasuta Emerton, Trans. Conn. Acad., 1911, 16: 390, pl. 1, fig. 9, name preoccupied by Simon, Hist. Nat. Araignées, 1894, 1: 583.

Floricomus nasuta Bishop and Crosby, Journ. N. Y. Ent. Soc., 1935, 43: 33, figs. 7-11.

The genus *Histagonia* was based by Simon in 1894, on a small species found in Africa. In his preliminary remarks, he placed in the genus, a species to which he refers as *Pholcomma nasutum* Emerton. His use of the name *nasutum* was obviously a lapsus calami, although it was used four times, for the reference to the Trans. Conn. Acad., 1882, 6: 30, shows that he intended *Pholcomma rostratum* Emerton. This was overlooked by Emerton, when he described a new species in 1911 and again by Bishop and Crosby when they revised the genus *Floricomus* in 1935. I propose the name *emertoni* for *Histagonia nasuta* Emerton, 1911.

Family Argiopidæ

Subfamily Araneinæ

Genus Aranea Linneus 1758

Aranea juniperi (Emerton)

Epeira juniperi Emerton, Trans. Conn. Acad., 1884, 6: 313, pl. 34, fig. 6, pl. 36, figs. 14, 15, 16; ibid. 1909, 14: 200, pl. 5, fig. 1.

This species was described from a female found on an island in Portland Harbor, Maine. The male was not found until several years later. Mr. Emerton then figured the male and the first and second pairs of legs. Unfortunately, he confused the position of the spines on the femora and shows them as ventral, rather than prolateral. This in some genera is of minor importance, but the genus Aranea, (Eperia) is divided by the presence or absence of ventral spines on the anterior femora. *Aranea juniperi* has no ventral spines on the anterior femora and has two spines on the patella of the palpus. The species is widely distributed from Maine to Florida and west to Missouri. As it is small, delicate in both form and color, it is easily overlooked and is not often found in collections.

Family Thomisidæ

Subfamily Philodrominæ

Genus Thanatus C. Koch 1837

Thanatus peninsulanus Banks

Thanatus peninsulanus Banks, Proc. Cal. Acad., 1898, (3), 1:265, pl. 16, fig. 11; Gertsch, Amer. Mus. Nov., 1935, no. 792:25.

Thanatus coloradensis Emerton, Ent. News, 1918, 29:74.

Thanatus retentus Chamberlin, Pomona Coll. Journ. Ent. and Zool., 1919, 12:9, pl. 6, fig. 5.

In the fall of 1914, Mr. Emerton found this spider in a restaurant in Boston and identified it as *Thanatus coloradensis* Thorell. A few years ago, an adult male was found in the store room of a restaurant in Cambridge. It had evidently been introduced with boxes of fruit from southern California and as far as known, it never has been found out of doors in New England. The species has a wide distribution from southern California as far south as Peru, South America.

Family Clubionidæ

Subfamily Clubioninæ

Genus Clubiona Latreille 1804

Clubiona bryantæ Gertsch

Clubiona bryantæ Gertsch, Amer. Mus. Nov.; 1941, no. 1148:16.

Clubiona agrestris Emerton, Psyche, 1924, 31: 144, fig. 6, nec *Clubiona? agrestris* Hentz, 1847.

I had intended to rename this species but Dr. Gertsch also discovered the error and has renamed it in a recent paper. The species is known only from the type specimens found at Holliston, Massachusetts and a pair from Conway, Michigan. It probably is local and becomes adult early in the season. The two large hooks on the dorsal side of the tibia of the palpus are very characteristic.

Subfamily Micariinæ

Genus Micaria Westring 1851

Micaria delicatula nom. nov.

Micaria aurata Bryant, Occ. Pap. Boston Soc. Nat. Hist. 1908, 7, no. 9 : 74, nec *Micaria aurata* (Canestrini), 1868, from Corsica.

Micaria aurata Gertsch, Amer. Mus. Nov., 1933, no. 637: 2, figs 4, 6.

Micaria aurata Kaston, Check-list of the Spiders of Connecticut, 1938, p. 194.

This brilliant spider was wrongly synonomized in the New England List of Spiders in 1908 and unfortunately later workers have continued the error. The original description of *Herpyllus auratus* Hentz is rather vague, but the brilliant color and the two pairs of lateral bars on the anterior half of the abdomen is emphasized. In the south, there is found a *Castianeira* with similar markings which probably is the spider that Hentz had, as the figure shows the head only slightly narrowed, a character found in *Castianeira,* rather than *Micaria* and no indication of an abdominal constriction that is usually found in Micaria.

Mr. Banks in his Catalogue, 1910, places *Herpyllus auratus* Hentz as a *Castianeira* and in 1913, Mr. Emerton wrote a brief description and figured the female and the male palpus, the female was from Staten Island, N. Y. and the male from Falls Church, Virginia. This he calls *Castianiera aurata* Banks, not Hentz. (Bull. Amer. Mus. Nat. Hist., 22 : 258).

Micaria aurata is a misidentification and therefore a new name is necessary. I propose for it *delicatula.* According to Kaston, it is found in Connecticut. The only adult male in the collection at the Museum of Comparative Zoölogy is from the Sand Spit, Cold Spring Harbor, Long Island, N. Y. It differs from *Micaria longipes* Emerton with which has been synonomized, by the longer and more slender tibia of the palpus and the brilliant coloring.

Family Salticidæ

Subfamily Hyllinæ

Genus Evarcha Simon 1902

Evarcha blanchardi (Scopoli)

Aranea blanchardi Scopoli, Ent. Carn., 1763, p. 402.

Attus hoyi Peckham, Descr. New or Little Known Spiders of the Fam. Attidae. 1883, p. 7, fig. 5, ♂

Attus pini id., ibid., p. 20, fig. 16, ♀

Hasarius hoyi Emerton, Trans. Conn. Acad., 1890, 8: 243, pl. 21, fig. 2.

Pellenes hoyi Peckham, Trans. Wisc. Acad., 1909, 16: 557, pl. 48, fig. 4.

Evarcha flammata Berland and Fage, Arach. France, 1937, 6 : 1240, 1270, figs. 2015, 2022.

In the revision of the Arachnides de France, 1937, 6 : 1271, the authors in a footnote, mention that they have many specimens of this species from Georgia, Colorado and Oregon and that they are surprised that Peckham did not recognize and figure it in his last paper. Peckham did know it but he failed to identify it with the common European species. In fact, even in Europe, it has received many names, as the male and female are differently marked. Clerck, (1757), gave it two names, Scopoli called it *blanchardi*, Walckenaer, (1802 and 1805), added two more names, C. Koch, (1837) another, Hahn, (1831), still another, Simon, (1868) one more and Karsch, (1874) still another. It is found all over Europe and Siberia and here it is common from New England to Washington and south to Georgia. It also has been placed in several genera and in 1902, Simon erected the genus *Evarcha* for it.

Subfamily Pelleninæ

Genus Habronattus F.O.P. Cambridge 1901.

Habronattus, F.O.P. Cambridge, Biol. Centr. Amer., 1901, 2: 241.

Pellenes, Peckham, in part, nec Simon, Arach. France, 1876, 3: 90.

The genus *Pellenes* was established by Simon in 1876, for *Aranea tripunctata* Walckenaer and *Attus lapponicus*

Sundevall, both widely distributed species in Europe. Later, the first species was selected as the type of the genus.

Simon and Peckham exchanged specimens of the common species found in North America and France but Peckham did not recognize the genus *Pellenes* and he described most of the American species in the genus *Habrocestum* that he afterwards placed in the genus *Pellenes.* In 1900, he redescribed all the American species with the third leg longest under the genus *Pellenes.* A year later, F.O.P. Cambridge, who must have been familiar with the European species of Pellenes, erected the genus *Habronattus* for the species found in Central America that have the tarsus of the male palpus not elongate, but more or less circular and flattened, with the bulb also circular, with two processes, sometimes widely separated, the outer usually longer but both following the contour of the cavity; the posterior legs are very spinose and the third and fourth tibiæ have a small dorsal spine at the base. These characters are just opposite to the European species of *Pellenes.*

The genus *Pellenes* is described with the quadrangle of eyes a little wider behind, small eyes midway between first and third rows, anterior legs robust, third pair longest, posterior tibiæ always lacking a dorsal spine. In the European species, the palpus is elongate, bulb long, with the embolus arising from the prolateral margin about the middle and continuing on margin as a stout, heavy spine to the tip of the cavity. There are a few American species that have several characters in common with the European. They have a similar palpus, and the posterior tibiæ have no dorsal spine, but the first pair of legs is longer than the third pair and the patella is normal. *Pellenes peninsulanus* Emerton and *P. longimanus* Emerton belong to this group but neither have been found in New England.

The genus *Habronattus* has many species in America. Eight are known from New England. All have the third leg longest and several have modifications on the first and third pairs.

Subfamily Dendryphantinæ

Genus Metaphidippus F.O.P. Cambridge 1901.

Metaphidippus, F.O.P. Cambridge, Biol. Centr. Amer., 1901, 2:262.

Dendryphantes Peckham, in part; Simon, 1903, in part, nec *Dendryphantes* C. L. Koch.

The genus *Dendryphantes* was based by C. L. Koch, (1837) on *Aranea pini* DeGeer, (*hastatus* Clerck), a common species in Central Europe. It is strikingly unlike the American species that have been placed in that genus. *Dendryphantes pini* has the cephalic portion of the carapace broad and swollen, the quadrangle of eyes plainly wider behind than in front, the second row of eyes nearer the first than the third row, the p.l.e. not on extreme margin of the carapace, pubescence of scales, three pairs of ventral spines on the first tibia, basal, median and distal, that are small and opposite, palpus with tibia and patella of about equal length, tibial apophysis slender, straight and parallel to the cymbium, embolus arises on prolateral side about one-quarter from the tip of the bulb, a long slender and slightly curved spine, almost half the length of the cymbium.

In 1901, F.O.P. Cambridge described the genus *Metaphidippus* basing it on the Mexican species *mandibulatus* and suggesting that the small species described by the Peckhams as *Dendryphantes* belonged to the genus. These have the lateral margins of the carapace almost parallel, certainly not swollen in the eye area, the quadrangle of eyes is the same width in front as behind, or in a few species only slightly wider behind, the second row of eyes is midway between the first and third rows, the p.l.e. is on the extreme margin of the carapace, pubescence of a few hairs, not scales, three pairs of ventral spines on the first tibia, restricted to the distal half or two-thirds, strong and not opposite, palpus with tibial apophysis a short, bent spur, embolus starts from the tip of the bulb, usually a broad, flat lobe, with lateral margins chitinized and prolonged in points beyond the middle area.

The genotype, *mandibulatus* has long, porrect mandibles in the male. Most of the American species have short, vertical mandibles in both male and female but the size and angle of the mandibles is a variable character among other genera of the *Salticidæ.* All eastern species of the genus have no spines on the anterior patellae.

At the same time, F.O.P. Cambridge erected another genus, *Paraphidippus* and suggested that *Attus marginatus*

Walckenaer, (*militaris* Hentz), belonged there. It is evident that he had never seen the species and knew it only from the description given by the Peckhams, although it has been reported from Mexico. In 1909, Peckham in his "Attidae of North America", places it in the genus *Dendryphantes*. It is not a true *Metaphidippus* as the small eyes are nearer the first than the third row, but it has more characters in common with *Metaphidippus* than with *Paraphidippus*.

Eight species of *Metaphidippus* have been found in New England. Probably the commonest is *Metaphidippus capitatus* (Hentz). The synonomy of this species is very unsatisfactory. A few of the names are given.

Attus capitatus Hentz, 1845, 5 : 200, pl. 17, fig. 15; reprint, p. 51, pl. 7, fig. 15.

Attus aestivalis Peckham, 1883, p. 2, fig. 2.

Icius crassiventer Keyserling, Verh. z. b. Ges. Wien, 1884, 34 : 503, pl. 13, fig. 11.

Dendryphantes aestivalis Emerton, Trans. Conn. Acad., 1891, 8 : 228, pl. 17, fig. 2.

Dendryphantes capitatus Peckham, Trans. Wisc. Acad., 1909, 16 : 469, pl. 36, fig. 4, pl. 38, fig. 5.

Hentz described *capitatus* from a single male collected in Georgia and on the plate, he failed to place a line next the figure to indicate the length, so it can be inferred that the drawing is the natural size. If this inference is correct, *capitatus* is probably a *Phidippus* and not found in New England as all the specimens found here are small. However, the male and female are marked differently and Hentz described several other species that are common in the south that would agree very well with the females collected in New England.

Attus aestivalis is described by the Peckhams, from a pair collected in Pennsylvania. Unfortunately the types are missing from the Peckham Collection in the Museum of Comparative Zoology, and neither can be found in the collection any specimens named by them. The figure of the palpus shows two dark, sinuous processes at the tip of the bulb but the processes are not connected. The figure of the epigynum is also rather indefinite, but the description states a "rounded opening at the posterior edge". The length of the lateral margins on the embolus and the shape of the opening of the epigynum are of specific importance.

The type of *Icius crassiventer* Keyserling is a female, from Massachusetts and is in the museum collection. It agrees with what has been called *Dendryphantes capitatus*.

Subfamily Sitticinæ

Genus Sitticus Simon 1901

Sitticus pubescens (Fabr.) (Fig. 2)

Attus pubescens Fabricius, Syst. Ent., 1775, p. 438.

Sitticus pubescens Berland and Fage, Arach. France, 1937, 6 : 1186, 1255, figs. 1869, 1871.

Male. Length, 4.8 mm., ceph. 2.2 mm., abd. 2.0 mm.

Cephalothorax a very dark brown, cephalic portion with scattered short, white hairs most numerous about p.l.e. and forming a white spot about the middle of the eye area, cephalic portion high, ending a short distance posterior to the third eye row with a shallow depression, eye area flat, thoracic groove short and deep, thoracic portion much longer and wider than cephalic, with rounded sides, in about the same plane as the cephalic until the posterior third when it slopes rapidly to the margin; *eye* area about two-fifths the length of the cephalothorax, wider in front, anterior row of eyes strongly recurved, eyes equidistant, row of long hairs above a.m.e., eyes of second row nearer first than third row, third row not as wide as cephalothorax and eyes smaller than a.l.e.; *clypeus* below a.m.e. about a radius of a.m.e.; *mandibles* rather small, vertical, flat in front, fang groove slightly oblique with four subequal teeth closely grouped on superior margin, inferior margin not defined but an oblique row of bristles from base of fang to median margin, fang with a wide base and evenly curved; *sternum* dark brown with white hairs about posterior margin, convex, anteriorly little wider than labium, fourth coxæ almost touching; *abdomen* dark brown thickly covered with white and faun-colored hairs arranged in no definite pattern, venter paler; *legs*, 4-1-2-3, yellowish-brown with many short white hairs, femora clouded with dark brown, anterior tibiæ with broken basal and distal dark rings, tips of tarsi dark, all joints of fourth leg longer than corresponding joints of first leg; spines, no spines on patellæ, I pair, tibia, ventral, 2-2-2, lateral, 0, metatarsus, ventral, 2-2, lateral, 0; *palpus* dark, terminal joint thickly covered with long, coarse hairs, femur curved at base and laterally compressed, seen from above,

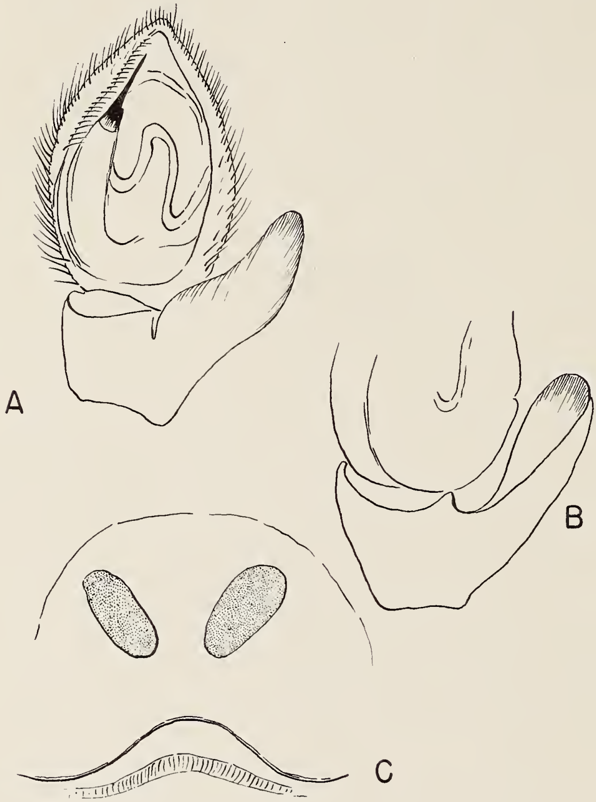


Figure 2. *Sitticus pubescens* (Fabr.). A, ventral view of palpus; B, tibial apophysis; C, epigynum.

patella and tibia subequal, tibial apophysis a large spoon-shaped lobe, longer than diameter of the joint, starting from the base of the joint and directed forward and slightly outward, not pressed against the tarsus and almost reaching the middle of that joint, on opposite side of the tibia a row of long black hairs, cavity extends length of the cymbium and filled with the palpal organ, bulb divided longitudinally, larger half shows duct of two loops in upper portion, smaller half with the rather short, straight embolus that starts at distal end with a short tooth near origin and tip near the end of cavity.

Female. Length, 4.9 mm., ceph. 2.0 mm., abd. 3.0 mm.

Cephalothorax dark brown, eye area black with a sparse covering of short white hairs, no median white spot as in the male but the same fringe of long black hairs above a.m.e., thoracic groove wanting; eyes, anterior row not as strongly recurved as in the male; mandibles, superior margin with five teeth, no oblique row of bristles on inferior margin as in the male; abdomen black with white and faun-colored hairs forming a pair of large white spots about the middle, followed by three pairs of very small dots, venter paler; legs and spines same as in male; epigynum, margin of fold distinctly notched and at some distance above, a pair of black oblique oval sacs beneath the skin.

♂ ♀ Massachusetts; Allston, 14 July 1932.

♂ ♀ Massachusetts; Allston in house, 15 July 1934.

This species is found throughout Europe and according to modern authors, it is subject to variations in color pattern and shape of the tibial apophysis of the male palpus and even the longitudinal division in the palpal organ. The museum collection has a male from the Paris Museum and a pair from the Peckham Collection, probably received from Simon. The male from the Paris Museum has the same large spoon-shaped tibial apophysis, the palpal organ with the longitudinal division but the embolus is half hidden, so that it is impossible to see if it has a tooth near its origin. The superior margin of the fang groove has three unequal teeth as figured by Simon in the Histoire Naturelle des Araignées, 2 :578, fig. 699; figure 700 on the same page shows the large spoon shaped tibial apophysis but the ambolus is a long slender tube, starting on the margin about the middle on the same side as the apophysis, (retrolateral), something that is not mentioned in any description of the species. According to Simon and Reimoser, it has received several names, which is not surprising from the variations in marking and habitat. Simon states in Arachindes de France, 1876, 3 : 108, "Commun dans toute l'Europe; il se trouve ordinairement sur les murailles exposées au soleil, même dans l'intérieure des villes".

A pair was found on a brick wall in the sun on a very hot morning in July 1932. Two years later on almost the same date, a pair was taken inside the house jumping on a window screen. In movements, it suggests *Salticus scenicus.*

THE LEPIDOPTERA OF THE DRY TORTUGAS

By Wm. T. M. Forbes

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The Dry Tortugas occupy an unique space in the geography of the United States, being the only "Oceanic" Islands in the Gulf of Mexico. In a sense they would belong to the Florida Keys, being a continuation of the same formation, but they lie so far beyond Key West (75 miles) that casual immigration would be limited to the stronger flyers; moreover, they are so low that they most probably have been completely under water since the last glacial period. Presumably the whole fauna has come in by sporadic accidents during the last few thousand years. Naturally most of the species of the list are wide-spread, being found both on the Mainland and in Cuba, but the Litoprosopus may possibly be endemic,—in any case it is more like the Bahaman *L. bahamensis* Hmps. than the Florida *L. futilis.*

I owe the material to the kindness of Prof. H. H. Plough of Amherst College, who collected it in the summer of 1936. I have not noted any other records of Lepidoptera from the Islands.

List

Pieris monuste. Both phases of the female were taken, but not extreme.

Nathalis iole. Garden Key.

Thecla columella. Apparently the commonest butterfly to judge by the number taken by sweeping.

Plebeius filenus (*hanno*). This is the filenus of Bates' "Butterflies of Cuba" and the *hanno* of most U. S. collectors. Holland figures something else (which I do not know) as *filenus* from Florida. In any case the Tortugas specimens are like those from the Antilles and the commoner form from Florida.

P. ammon. A single specimen.

Lerodea eufala.

Prenes panoquinoides.

Herse cingulata.

Syntomeida epilais. Larva on oleander. I have no records of this species for the Antilles, though it ranges south to Honduras on the Mainland. These specimens are like ours from Florida.

Peridroma margaritosa.

Mocis latipes.

Anticarsia gemmatilis. These three Noctuids are typical wanderers, with tremendous ranges.

Litoprosopus bahamensis Hampson. A single specimen, damaged by ants, is indistinguishable from bahamensis; but is decidedly colder brown, and with a much paler hind wing than true *L. futilis* from Florida. The large Texas species that passes for *futilis* appears to be undescribed, and matches this specimen much more closely in color. New to the U. S.

Synchlora aerata. Two specimens seem definitely to be this and not the common Antillean *S. frondaria.*

Cosymbia myrtaria form *triseriata* Prout. This species is discussed by Prout in the Macrolepidoptera of the World, viii, 96 (pl. 12, fig. d6) but is not distinguished in McDunnough's Checklist, where "myrtaria" includes this, the more familiar northern *packardi* Prt. and the endemic *benjamini* Prt. from Florida. The single female is damaged, but I think is this, which Prout reports from both Florida and San Domingo.

Camptogramma stellata.

Microgonia peosinata Guenee. One female, which is surely this. It also occurs in Florida, though it is not in our lists.

Hymenia perspectalis.

Ercta vittata Fabricius. New to the U. S. I found it abundant in Porto Rico.

Sameodes cambogialis Guenée (*citrinalis* Möschler). New to the U. S. *S. citrinalis* Hmps. is a distinct species.

Pyrausta tyralis.

Trichoptilus defectalis.

Undetermined micros. represent the Crambinae, Phycitinae, Phaloniidae and Blastobasidae.

DESCRIPTIONS OF SOME NEW SPECIES OF SYRPHIDÆ

By Frank M. Hull
University of Mississippi

This paper is a continuation of studies begun several years ago on the Syrphid flies in the collections of the Museum of Comparative Zoology, which I have been privileged to study through the courtesy of Professor Nathan Banks. In the paper are included notes and descriptions of recent additions to this large collection.

Syrphus melanostomoides n. sp.

Male. Length 9.5 mm.

Head: eyes touch for length of vertical triangle. Vertex, front and face dark shining black or brownish, the front above the shining bare callosity over the antennæ brownish pollinose. The face, except for the shining tubercle and a narrow stripe running upward to the antennæ, pale brownish, white pollinose. Cheeks and edge of oral margin, except in front, brownish yellow to fulvous. Tubercle of face rather prominent with considerable concavity below the antennæ. Pile of vertex and front black. Pile on upper face dark, on lower face white. Occipital pile white up to angle of excavation. Antennæ short, entirely black; first and second joints subequal, third not quite as long as first two combined. Arista thickened on basal four-fifths, bare. Eye facets slightly enlarged. *Thorax:* dark shining brown or black, rather convex on the dorsum; pile quite long, sparse, very slender, dark in color. Pile on scutellum similar but even longer. Ventrally directed fringe of pile on scutellar margin pale colored. Mesopleuræ and an area on the dorsal suture with a band of conspicuous yellow pollen, which is pale pilose. Halteres and squamæ light brown; lower lobe bare. Humeri and metasternum bare. *Abdo-*

men: black, obscurely shining. First segment metallic, the segment with a small semicircular yellow brown spot, its round side directed medianly, outer side straight. Third and fourth segments similar but with larger spots, except those on the third are more nearly triangular and the rounded angles again are medial, but the greatest length of the spot is vertically arranged on the segment; the spot on the fourth segment in contrast to the third, is placed transversely, but is angular—the angle placed medially. None of the spots touch the sides, and all are widely interrupted. The spots of the second segment may be wanting and on the fifth segment there may be more traces of yellow. Pile of abdomen long on the sides, pale in color, almost wanting on the surface but the surface is thickly beset with black, appressed, very short hair or bristles. Sides of abdomen parallel, much inrolled. *Legs:* black, tarsi very dark brown, extreme base of fore tarsi and apex of femora light brown. *Wings:* pale brown, stigma darker.

Female. Length 9 mm. Front shining black, on the lower part brown pollinose, with a faint median groove. Long pile of abdomen, thorax and scutellum wanting. Abdominal spots apparently wanting.

Eleven males from Tjibodas, Mt. Gede, Java, 9,000 ft. (Bryant and Palmer) ; one male, Seliban River, Mt. Apo, Mindanao, Sept. 17 ,C. S. Clagg). I place here provisionally, two females, Pangrango Mt. Java, 9000 ft. (Bryant and Palmer). Type and paratypes in Museum of Comparative Zoology. Paratypes also in the author's collection.

Baccha banksi n. sp. (Plate 10, Fig. 4)

Male. Length 10-12 mm.

Head: eyes touch for more than the length of antennæ. Vertical triangle a very acute triangle, rather convex, anteriorly opaque black, shining posteriorly. Ocelli crowded into anterior part. Eyes cut away behind the vertex leaving the occiput at mid-vertex and on either side unusually thick. Pile in the midline of vertex thick, short, black, but immediately on either side becoming longer and white. Front rather convex; pile short, sparse, black. Antennæ quite short, third joint rounded, all of a brownish yellow color. Arista darker, basally thickened. Facial tubercle fairly prominent, quite pointed; it and a widening stripe upward to antennæ shining black. A large triangular spot or callosity above antennæ, enclosing on each side a small yellow spot, shining black. Remainder of face and cheeks bright shining yellow, with a trace of white pile on the former. Mid occipital excision large and conspicuous. *Thorax:* black, moderately shining with suggestions of four narrow brown pollinose vittæ. Pleuræ vitreous black with sharp, pale yellow spots continued as a narrower stripe on the dorsal suture. Scutellum pale yellow, dully shining, narrowly black in the corners. Pile of dorsum erect, microscopically short, except for the anterior collar of pile. No ventral scutellar fringe. *Abdomen:* slender and elongate, terminal segments two and one-half times as wide as second. The second segment scarcely constricted anywhere; six times as long as wide. First segment black, its sides basally yellow. A suggestion of a small brown spot on the black second segment on each side of the middle. Remaining segments dark brown or black, shining, with yellow brown marks; on the third, on either side, a wide acute V, its sides thick, its ends sharp. On the fourth segment a long slender vertical spot near the midline on either side and lateral to this a shorter anteriorly placed, elongate spot. Posterior margin of fifth segment yellowish brown. Hypopygium long, nodular, rounded at tip. Abdomen thickly, short, black, bristle-covered. Abdomen larger than wings. *Legs:* coxæ and trochanters brown, femora black to brown, with apices narrowly yellow. Fore tibiæ dark brown, apices and base yellow; mid and hind tibiæ entirely dark, except basal third which is yellow. Tarsi brown, fore and mid basitarsi yellow. Pile of legs short, black. Mid femora slightly thicker than post femora. *Wings:* hyaline, whole marginal cell brown, whole costal cell yellow.

Female. Quite similar to male. Costal cell brown. Black of the face ascends to vertex, leaving each side of front narrowly yellow.

One male and one female, Bella Vista, Panama (Nathan Banks). Type male, in the collection of the Museum of Comparative Zoology. Paratype female in the collection of the author.

This species traces to *B. brevipennis* Schiner in Dr. Curran's key.

Chrysogaster gewgaw n. sp. (Plate 10, Fig. 11)

A small species obviously related to *Chrysogaster shannoni* Cur. and to *C. neotropica* Shannon. Characterized by its yellow tibia and basal two tarsal joints and glittering greenish silver color with its four copper stripes on the thorax. The third antennal joint is shorter than in *shannoni*, the front not so long, besides other differences. The wing picture, eye maculation and yellow tibiæ distinguish it from *neotropica*.

Male. Length 4 mm.

Head: eyes actually touching for a very short distance, but appear to be contiguous for the length of the vertical triangle, or length of second antennal joint. Vertical triangle considerably elevated, slightly longer than wide. Front short, not as long as second joint of antennæ, deep coppery brown, greatly pitted and rugose. The rugæ continue to be prominent and transverse on the sides of the shining coppery face, except that there is a vertical smooth unwrinkled band running from below antennæ to the base of the oral prominence. Oral margin in front produced as a small rounded knob, excavated deeply and sharply above; in this respect it must resemble *shannoni* Curran. Eyes marked with two vertical bands, looped and folded in a way suggesting a bow-knot. Occipital rim or margin very narrow, practically absent. Cheeks narrow. Antennæ light yellow, dark brown on the third joint just past arista. Arista pale, extremely delicate, basally thickened and reaching just past third joint. First joint not half as long as second; second and third joint subequal. Pile of face sparse, quite short, pale, inconspicuous. *Thorax:* rich, coppery, finely rugose with four prominent dark brown vittæ and traces of another on each outer margin. Scutellum coppery, finely punctate or wrinkled, its rim faintly impressed, its edge rounded but slightly squared. Pleuræ coppery. Halteres pale brown. *Abdomen:* disk of abdomen dull shining brown. Sides of abdomen (and the hypopygium especially so) glittering, brassy in color. *Legs:* all the femora, except their narrow yellow apices, glittering brassy in color. Tibiæ and tarsi, except the last three tarsal joints, pale yellow. *Wings:* with brown spots in the cross veins, in the middle of the marginal cell, middle of first posterior cell, tip of third longitudinal vein and a prominent cross band running down the wing from the termination of second longitudinal vein.

Two males, Soledad, Cuba, May 24, 1925 (George Salt). Type in the Museum of Comparative Zoology.

Lathyrophthalmus obtusus n. sp.

Male. Length 10 mm.

Head: upper facets enlarged, touching for twice the width of the vertical triangle, the latter nearly equilateral, much elevated. The ocelli standing out conspicuously. Front gently convex, dark brassy brown, with yellow-grey pollen, bare in the center. Antennæ situated about the middle of head, entirely light brown. Arista similarly colored, bare, two and one-half times length of third joint. Face with a small oval knob, bare, gently concave below antennæ, brassy black in color, densely yellow pollinose. Cheeks shining and bare, except for a narrow pollinose stripe. Spots of eyes small, two to three times as far apart as wide, clustered into an obscure horizontal band about the middle. *Thorax:* brilliant brassy or coppery with four yellow pollinose vittæ and a fifth exceeding narrow medially, the three central ones connecting with a transverse band before scutellum. Scutellum shining, varying from light yellowish brown on its rim to dark at base. Pile of thorax and scutellum upright; long, yellowish and black hairs intermixed. Pleuræ bears a conspicuous diagonal stripe, pollinose, from before wing toward fore coxæ and a spot high above mid coxæ. *Abdomen:* opaque black, first segment brownish yellow, blackish in middle and narrowly on posterior edge. Second segment with two large yellow spots on basal edge, their hind borders convex and meeting centrally. Posterior border narrowly shining. Third segment and fourth with narrow diagonal yellow pollinose stripes not interrupted; posterior borders and lateral margins of these segments widely shining to metallic. *Legs:* femora shining black with apices narrowly yellow. Tibiæ and tarsi light yellow, distal ends of tibiæ dark brown, mid tibiæ less so, hind tibiæ entirely dark brown except the narrow base. Tarsi yellow except last three black joints of hind tarsi. *Wings:* hyaline, stigma cream colored, brown at either end.

Three males. Buitzenborg, Java (Bryant and Palmer). Type in the Museum of Comparative Zoology.

Psuedovolucella apimima n. sp. (Plate 10, Fig. 5)

Male. Length 14 mm.

Head: eyes touch for distance equal width of posterior ocelli. Front very short, with narrow median groove or line. Head and face produced deeply but very flat and not produced forward. Antennal prominence inconspicuous. Front and face and cheeks light pale brown, pale yellow pollinose, except for bare shining obtuse facial knob and pollinose, darker strips between cheeks and face. Antennæ brown, third joint half again as long as wide. Arista twice as long as third joint, densely plumose, pale brown, its rays long, forty to forty-two above. Eyes bare. *Thorax:* dull brown, obscurely shining, with exceptionally narrow whitish pollinose streaks on the suture. Pile thick, erect, pale, growing bushy on the pleuræ. Scutellum reddish yellow to brown, with bushy, dense, long, yellow pile. Squamæ and pleuræ light brown. *Abdomen:* light brown on first, second segments and dark blackish on the third and fourth, a brown band formed as two slender wedges on the second segment whose points meet medially and a convex brown band on the base of the same segment. On the third segment a single, uninterrupted, yellowish-brown band, narrowly reaching the sides, widest in the middle and placed on the anterior half of the segment. Pile of abdomen very short, appressed, yellow and longer on the base of the abdomen, bushy on the basal corners, yellow on the light bands, black with some yellow hairs on the dark portions. Hypopygium with scattered, long, black bristles. *Legs:* light brown, the hind femora much darker on the outer half. Pile of legs light in color, but sides of hind femora outwardly bear numerous, short, black bristles. Hind femora strongly thickened, greatest past middle, an accentuated concavity ventrally, due to a terminal knob. Hind tibiæ basally with a small blunt knob. *Wings:* tinged with pale brown, darker about the stigma.

One male. Tjibodas, Mt. Gede, Java, 7800 ft., 1909 (Bryant and Palmer). Type in the Museum of Comparative Zoology.

A very remarkable resemblance to *Eristalis tenax* and to a honey bee. It is certainly very close to Shiraki's species *mimica.* Nevertheless, it appears to me that the hind femora of *apimima* are more strongly thickened and incrassate and that the arista has some forty dorsal bristles to twenty-four or twenty-five in *mimica,* judging by Shiraki's figure.

Volucella nitidithorax n. sp.

A large shining black species with yellowish brown face and yellow tinted wings. It belongs to the *V. nigricans* group.

Male. Length 18.5 mm.

Head: eyes densely black hairy, the black pile of the vertex twice the length that of the eyes, fine and bristly. Front protuberant, small, black bristly. Antennæ and thick plumose arista orange brown, the third joint small, short, barely longer than broad and tapering quickly to a rounded point. The face has the appearance of being dark shining brown with a wide, shining, brownish-yellow middle stripe from base of antennæ to oral margin. Yellow stripe covered with numerous fine black bristles interspersed in which are a few pale ones, all beginning just above the tubercle. The tubercle or knob is prominent but flat, leaving the face deeply excavated below the antennæ. Occiput black, black pruinose, with very short black pile. *Thorax:* and scutellum shining black, covered on the former with very dense, erect, fine black, bristly hair. There are some quite long black bristles on the upper pteropleuræ, sides of thorax and scutellum. Humeri dark brown. *Abdomen:* dorsally and ventrally shining black, covered with thick, short, black bristles, quite appressed, a little longer on fourth and fifth segment. *Legs:* entirely black, black pilose. Hind femora quite slender. *Wings:* suffused with yellow. More prominent on the veins and brownish along the posterior terminations of the veins.

One specimen, Mt. Apo, Mindanao, Phillipine Islands, Mainit River, 6500 ft., Oct. 27 (C. F. Clagg collector). Type in the Museum of Comparative Zoology.

Volucella pallidithorax n. sp. (Plate 1, Fig. 8)

Female. Length 12 mm.

Head: face descending into a slender cone, quite pointed at apex. The tubercle prominent, leaving a concavity below antennæ but apart from the tubercle the profile of the face from antennal base to tip of epistoma is almost perpendicular. Front not wide; nowhere wider than length of third antennal joint, at vertex over three times the width of ocellar tubercle; the ocelli very small and close set. Head everywhere, except the posterior occiput, post vertex and above the cheeks, pale shining yellow. Antennæ entirely orange brown. Aristal rays long and loose, twenty-one to twenty-two above. Pile of eyes not half as high as vertical pile, the former pale, the latter black, merging into the long, pale, upright pile of lower front. Pile of face short, appressed, sparse, golden. *Thorax:* pale greenish yellow, a brown pair of stripes medially, stopping well before the scutellum, an outer pair black, interrupted at suture, pointed posteriorly, nearly reaching the scutellum. Pleuræ and scutellum pale yellow, the latter translucent with four very long, black bristles on either side not arising from noticeable tubercles. Four similar bristles on posterior calli, one on mesopleuræ and four on sides of mesonotum. *Abdomen:* pale yellow, translucent, a narrow black border posteriorly on the second segment, wider at the angles, with a suggestion of a narrow median streak. There is a wider similar border on the third, with a median black prolongation that reaches the anterior margin of the segment. The fourth segment marked much as the third. The yellow of the third reaches the margin very narrowly but on the fourth reaches the margin in full width; pile of yellow areas yellow, of black areas black. *Legs:* yellow, the bases of all of the femora, distal fourth of the fore and mid tibiæ and greater part of hind tibiæ and all its tarsi black. *Wings:* with a yellowish tinge.

One female. Honduras, Rosario Mires. Type in the Museum of Comparative Zoology.

Related to *V. prescutellaris* but the front is yellow, not black, and is partly black pilose. The abdominal segments differ.

Phalacromyia bipunctata n. sp.

Male. Length 8 mm.

Head: eyes with upper facets enlarged, contiguous for twice the length of the second antennal joint, densely pale yellow pilose, their pile almost as long as depth of third antennal joint. Antennæ pale orange brown, the third joint at least twice as long as wide, rounded at the tip with a slight indication of a dorsal excavation. Arista yellowish with darkened apex and thirteen to fourteen bristles dorsally. Face and cheeks entirely pale shining yellow, the knob small and evenly rounded with a number of short yellow bristles and some longer yellow hair on the sides of the face near the middle. Occiput yellow, yellow pilose. *Thorax:* dorsum shining light yellow with faint indications of darker vittæ, the long, thick, erect pile and the lateral and scutellar bristles all golden yellow. Scutellum with a small brown spot on either side of the flat depression, the basal roughened areas slightly wider than long. Pleuræ yellow translucent. *Abdomen:* upon the base pale translucent, yellowish brown as far as the middle of third segment where the posterior edge of the light coloration is trilunate. Remainder of abdomen shining brownish or blackish. *Legs:* all the femora pale brownish yellow except narrowly at the tips, the tibiæ brownish, darker apically and the tarsi brownish. *Wings:* and stigma except a tiny brown spot at the base tinged with greenish yellow.

Female. Similar, a faintly suggested brown stripe on cheeks, a lunate depression in the middle of the shining yellow front. There is also a suggestion of brown at each basal corner of the scutellum where there is a rugose depression suggesting *Volucella chalybescens*. Abdomen subtranslucent greenish beyond the middle of the second segment. Tibiæ and tarsi somewhat more blackish.

Several specimens, Pastorea, Paraguay, Jan. 1922 (Donald Wees collector). Type, male, allotype female and paratype in the collection of the Museum of Comparative Zoology; three paratypes in the author's collection.

This species is very similar to Curran's species *circe* but is distinct I believe, in the different maculation of scutellum and abdomen.

Graptomyza flavorhyncha n. sp. (Plate 10, Fig. 6, 7, 9)

Male. Length 6.5 mm.

Head: sides of face and front parallel. Upper half of front and vertex shining black with a gentle concavity on the former marked by a lunulate depression on either side. Front above antennæ pale yellow. Cone of face long and slender, acute, marked by a narrow shining brown median stripe reaching antennal base; cheeks shining brown. Remainder of face shining pale yellow, vitreus. First and second joint of antennæ very short, third very long, flattened, tapering quickly from apex to a dorsal point, its upper margin narrowly brown. Remainder of antennæ light orange brown. Arista slender, long, short pilose, black on apical half, yellow basally. *Thorax:* and pleuræ shining dark brown. Humeri and the front of thorax to and including coxæ, a dorsally confluent spot on anterior mesopleuræ in front of wing, lateral calli and a thoracic band before scutellum light yellow. Pile very short, erect, sparse, pale.

Scutellum light brown, darker apically, with a curious and perfect oval depression lying transversely, its rim posteriorly short pilose, the margin of the scutellum with a few long black bristles, similar to others on post calli and sides of thorax. Halteres and squamæ yellow. *Abdomen:* light brownish yellow, subtranslucent, with a wide but dorsally invisible black, continuous, lateral margin. The following black markings occur on the abdomen: the apical border bands on the second and third segments, the anterior edges of which are trimammillate, a median wedge and a posterior point on the fourth segment, together with a rounded dash-like spot on either side of this segment. First segment wholly yellow. Abdomen very convex. *Legs:* light brown, the narrow base of all femora, apical half of fore tibiæ, median band of mid and hind tibiæ and fore and mid tarsi black. Hind basitarsi simple. *Wings:* uniformly yellowish brown. No spurs.

One male, Mainit River, Mt. Apo, Mindanao, Phillipine

Islands, 6000 ft., Sept. 14 (C. S. Clagg). Type in the Museum of Comparative Zoology.

Graptomyza setigloba n. sp. (Plate 10, Fig. 10)

Male. Length 6.5 mm.

Head: vertex and front polished, vitreus blue black, the latter with a semicircular crease or depression on each side, the convex edge of which it turned to the mid-line. Just above the antennæ the face, also vitreus, becomes light-brownish yellow and this is the color of all the remainder of the face and cheeks. Face descending into a long pointed cone, covered with a very few long pale bristles. Pile of occiput and front pale; of the vertex black. Eyes with very sparse pale pile. Antennæ, except for a narrow dorsal black band, entirely brownish yellow to yellowish orange outwardly. Arista long and slender, pale colored, ten rayed, the rays on the outer half only. The third joint is very long and broad and flat. It is pendulous and practically descends to the lowest level of the eyes. The apical bristles of second and third joints black. Occiput excavated, its margin not visible from lateral profile. *Thorax:* shining bluish black on the central dorsum, the humeri, suture, calli and the scutellum, except its brown central ellipsoidal depression, all shining clay yellow or brown. Pile of thorax and scutellum pale brassy, the bristles black. *Abdomen:* pale subtranslucent yellowish brown, marked with black. On the posterior border of the second segment there is a black triangle, the base on the border, the three angles of which are extended somewhat as narrow lines, the two antero-lateral faces of the triangle quite concave. Third and fourth segments largely black, the narrow anterior portions of these segments pale and the black of the third segment nearly meeting the second segment medially, but obtusely rounded off. The lateral margins of second, third and fourth segments narrowly black. Whole abdomen unusually globose. The bristles thick, semi-decumbent and black in color. Some short, pale pile on the basal half of second, third and fourth segments and the ventrally directed lateral fringe of pile is pale. *Legs:* brown, the femora and tibiæ pale yellowish brown, the bases of the former and the tarsi very dark brown to black. *Wings:* pale yellowish. Stigma brown.

Two males, Mt. Apo, Mainit River, Phillipine Islands, 6000 ft., Sept. (C. S. Clagg). Type in the Museum of Comparative Zoology. Paratype in the author's collection.

Microdon aurigaster n. sp.

Male. Length 9.5 mm.

Head: entire insect, except antennæ, tibiæ and tarsi, dark shining brown, nowhere blackish. Antennæ light orange brown, elongate, third joint a bit longer than first and three times length of second. Arista short, concolorous, quite thickened at base; no pedical. Vertex somewhat swollen, its pile, that of front and face depressed and golden and rather long. Face broad, transversely rugose and grossly punctate. Eyes sparse, short, pale pilose. *Thorax:* whole dorsum short, thick, greatly appressed golden pilose, visible only from the right angle, but with bands standing out at other angles as a transverse sutural band and a prescutellar band. Of these bands, only one-half (the right or left half) may be seen at one time. Scutellum short, inconspicuously golden pilose, with two small close set spines. Squamæ and halteres brown, the former with a golden fringe. *Abdomen:* apical corner of second abdominal segment, side margins of third, its narrow posterior margin and the whole of the fused remainder brilliant golden pilose, the pile much appressed and set as if it were flowing on each side in diagonal and opposed directions. *Legs:* pile of femora pale, the surface of hind femora deeply and grossly punctate. The tibiæ and tarsi light orange brown, remarkably densely covered (for tibiæ) with long golden bristles. Hind tibiæ in the middle and the thickened hind femora basally with diagonal cicatrices. *Wings:* on basal anterior border cream yellow, posteriorly grey; the yellow continuous apically, to bend down as a yellow spot towards the tip where on either side the wing (basally and apically) is a little darker grey; wing else where light grey. A spur is present from third longitudinal vein but nowhere else. The terminal section of the fourth longitudinal vein forms a most pronounced and prominent outward bulge.

One male, Bolivia, Province Sara (Steinbach). Type in the Museum of Comparative Zoology.

Eumerus ergator n. sp. (Plate 10, Fig. 3)

Allied to *Eumerus deceptor* Cur. from which it is separated by the yellow colored pile of the front instead of white and the snow white, white-pilose terminal hind tarsi, besides minor differences. Like *deceptor* the scutellum is obtusely dentate.

Male. Length 11 mm.

Head: front and vertex quite rounded. Eyes almost touching at a point just below ocelli, escaping it by a distance equal to that between the upper ocelli. Face gently receding below antennæ, faintly concave. Cheeks narrow. Color everywhere shining brassy brown and everywhere, including eyes, very densely long yellow pilose but not golden. Antennæ light yellow. First joint very short, second twice as long, third large and evenly rounded, as long as broad. Arista yellow at base, thickened, blackish apically. Sides of the face parallel, slightly wider about oral margin. The aspect of the head strongly suggests a species of *Pipiza*. *Thorax:* pleuræ, scutellum and abdomen everywhere brilliant brassy and clothed with long, nearly erect, brassy pile. *Abdomen:* sides of abdomen and apex slightly copper. Sides of segment, with small, postero-lateral, inwardly pointed, yellow pollinose spots lying in a conspicuous trench or concavity. Third segment with larger similarly colored spots, directed obliquely forward to median line but widely separated and with straight median edges. Fourth segment without such pollinose spots but with a coppery impression still more obliquely directed, lying on each side. *Legs:* femora and basal two-thirds of hind tibiæ dark, golden brown with brassy pile; base of hind tibiæ, remainder of tibiæ and tarsi, except for the apical three tarsal joints of mid and hind tarsi, varying shades of light yellowish brown. The apical three joints of mid and hind tarsi are snow white with snow white pile. Hind apical tarsi without any dilatation suggestive of *E. peltatus* Meijere. *Wings:* uniformly pale brownish. Sub-apical cross vein remarkably angulated, both angulations spurred. Angle of distal cell quite obtuse. Spurious vein not prominent.

One male, Mt. Apo, Mindanas, Phillipine Islands, Mainit River, 6,500 ft. Oct. 23 (C. L. Clagg). Type in the Museum of Comparative Zoology.

Cerioides delicatula n. sp. (Plate 10, Fig. 1 and 2)

This is very similar to *Cerioides bezzi* from which it differs in the longer abdominal pedicel, abbreviated yellow band on posterior border of third segment, slightly longer antennæ, annulate hind femora and other minor differences. It traces to *bezzi* in Curran's key to the genus.

Female. Length 13 mm. including antennae.

Head: front and face and vertex black, marked with yellow and punctate. On either side of vertex there is a small spot connecting each eye corner with the occiput, a narrow longitudinal stripe beginning just below the ocelli, two diagonal ones just above antennæ, two lunate spots on either side of antennæ, a slightly larger spot below this one and between the latter are two diagonal spots which fall just beneath the antennæ. Finally there are four short facial stripes, the inner two running diagonally from the direction of antennæ and converging to a point above oral margin, the outer two diagonally running from eye margin to lowest point of oral margin. The cheeks are yellow, interrupted by a brown triangle. The yellow face markings may be bordered by brown. The face is gently convex above the oral margin in profile. Pedicel of antennæ practically absent. First joint almost as long as last two, yellowish at base, blackish apically. Second and third about equal, the second black, the third brownish. Style pale. The vertex is slightly raised and the front bears a grooved depression which might perhaps be likened to an X. Occiput black and punctate, except about the cheeks. *Thorax:* and scutellum dull black, thickly punctate. Humeri, a narrow sutural stripe not confluent in the middle and the narrow posterior edge of the scutellum light yellow. Halteres, knob and pedicel ivory white. The pleuræ are black and punctate except for a long narrow diagonal yellow stripe reaching to the dorsal suture and a shorter cuneiform yellow spot behind and in front of the metanotum. *Abdomen:* black, everywhere thickly punctate, the middle of the second segment brownish, the post border of this segment completely and of the third segment incompletely in the center with narrow pale yellow bands. First segment half as long as second, third a trifle shorter than fourth and first two segments a trifle longer than third and fourth, if viewed laterally. The yellow bands encircle the venter and the sides of the last ventral segments are emarginate. The first two segments are very slender, and the last two suddenly swell at base of the third into a compact subglobose body amazingly suggestive of certain wasps. The third and fourth segments are thus fused and the fourth bears faint whitish interrogation marks. *Legs:* brown, marked with light yellow, the basal and apico-dorsal and medial parts of the first femora, last two fore and mid tarsi, base and ventral surface of mid femora and a basal annulus of hind femora are light yellow. Legs punctate. *Wings:* margined with yellow, a darker spot apically and a smaller one about the stigma.

One female, Camerouns, Mete (G. Schwab). Type in the Museum of Comparative Zoology.

Cerioides multipunctata n. sp.

Allied apparently to *Cerioides tredecempunctata* Brun, to which it traces in his key. It differs in the reddish color of abdomen, additional spots on thorax, besides minor differences.

Male. Length 15 mm. including antennae.

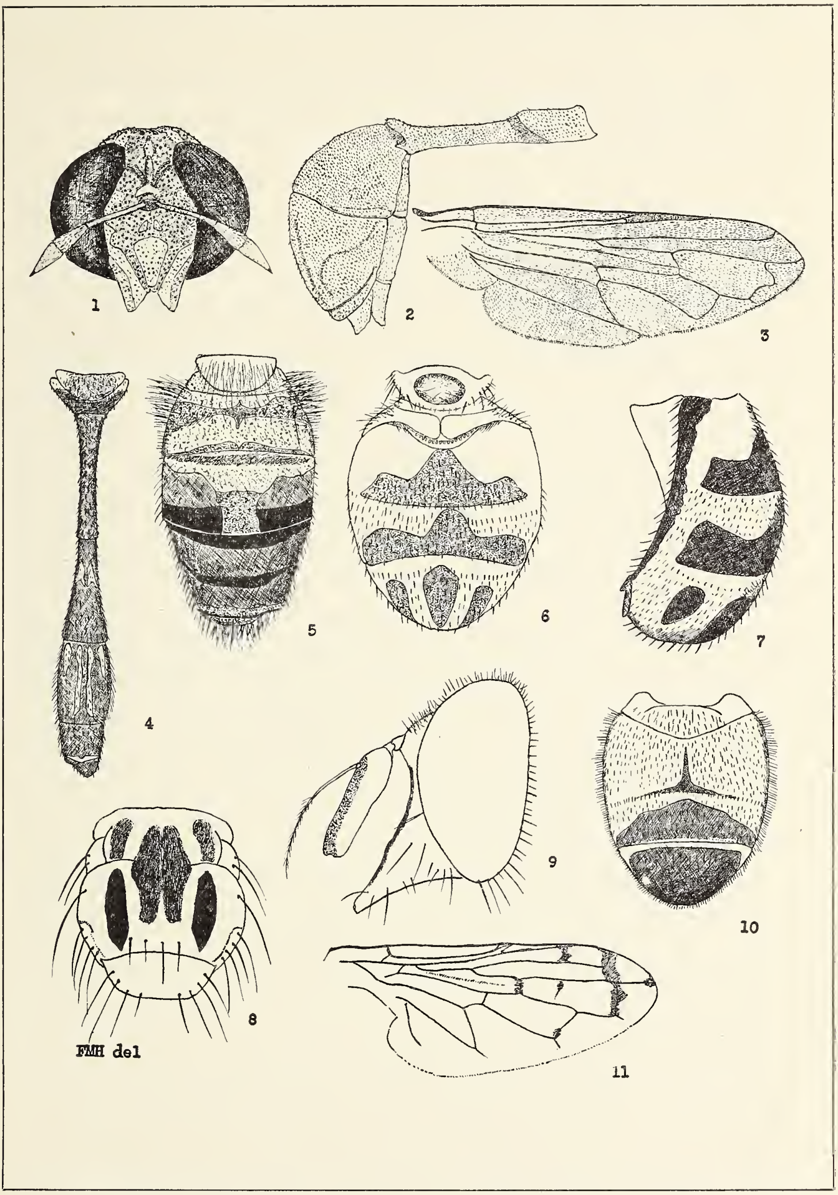
Head: eyes touching for distance of front, which is short. Vertical triangle very swollen, yellow, confluent with the swollen and thickened upper occiput. Face pale yellow. A median black stripe, red on its lowest part, encircles the base only of the antennal process and sends out a black diagonal downward projecting spur toward but not reaching the eye. Cheeks yellow, separated from face by a wide black stripe, the middle of which is a reddish stripe. Antennæ pedicel as long as first and second joint, the first barely longer than second. The second and third subequal, the color reddish brown; first and second joints slightly darker than the third; style whitish. *Thorax:* black, ground color of pleuræ black.

A spot on suture, narrow sutural stripe medialward, post-lateral stripe to scutellum, scutellum, except narrow base, humeri, mesopleuræ, metapleuræ, spot on upper sterno and pteropleuræ pale yellow. Squamæ and halteres pale yellow. *Abdomen:* outer basal angle of first abdominal segment noduliform, conspicuous postal borders on third and fourth segments, a narrow one on second pale yellow. Remainder of abdomen light brownish red, except the first segment, the remainder of which is black, and there is also a small median black spot posteriorly on the second segment. Fifth abdominal segment wholly reddish. *Legs:* reddish or light brown. Basal half or third of femora, bases of tibiæ yellow. *Wings:* with anterior border of brown.

Two males, Koolos, India (Carleton). Type male in the Museum of Comparative Zoology. Paratype in the author's collection.

Explanation of Plate 10.

1. *Cerioides delicatula* n. sp. (face)
2. *Cerioides delicatula* n. sp. (lateral view of abdomen)
3. *Eumerus ergator* n. sp. (wing)
4. *Baccha banksi* n. sp. (abdomen)
5. *Pseudovolucella apimima* n. sp. (abdomen)
6. *Graptomyza flavorhyncha* n. sp. (dorsal view of abdomen)
7. *Graptomyza flavorhyncha* n. sp. (lateral view of abdomen)
8. *Volucella pallidithorax* n. sp. (dorsum of thorax)
9. *Graptomyza flavorhyncha* n. sp. (profile of head)
10. *Graptomyza setigloba* n. sp. (abdomen)
11. *Chrysogaster gewgaw* n. sp. (wing).



Hull — New Species of Syrphidæ.

THE NESTING HABITS OF *BOMBUS MEDIUS* CRESSON, THE MEXICAN BUMBLEBEE.

BY PHIL RAU,

Kirkwood, Missouri.

Specimens of this bumblebee were collected at flowers at Cordoba and Jalapa in the State of Vera Cruz. At Tamazunchale, S. L. P., four nests were found among the dense growth of weeds in an abandoned banana field; these were pointed out to me by Mr. Olivarez, the manager of the El Sol Tourist Courts. Two of these nests were dug up on the night of July 7, 1940. Since Dr. T. H. Frison of the Illinois Natural History Survey (who kindly identified the bumblebees for me) writes that nothing is known of the life history of this species, the data of these two nests are herewith presented.

Both colonies were in slight cavities in the ground which evidently had been rodents nests, containing masses of fine roots, bits of narrow stems evenly cut, parts of leaves, and excrement of mice. There were no special galleries leading into the nests, but the comb was brought to view by brushing away the surface material to a depth of an inch and a quarter to an inch and three quarters.

When disturbed, the bees let out a steady, musical hum which, while not as loud as that of our Missouri *B. americanorum,* could be heard from a distance of ten to twelve feet. Their sting, while quite painful, is not so severe or lasting as that of its American relative. The workers of *B. medius* are smaller than those of *B. americanorum,* but the queens are almost equal in size.

An examination of the two nests, designated as A and B, revealed the following data. Nest A had one old queen, with wings badly frayed, and nest B had two queens, an old one with the tips of the wings badly damaged, and a young one with perfect wings and portions of the pubescence of a lighter, cleaner yellow. There were no males in either nest.

The number of workers in these colonies (and it is presumed that all the workers were at home, since the nests were taken at night) were 27 in Nest A and 63 in Nest B.[1]

The number of empty cocoons from which workers had emerged numbered 39 and 84 respectively. These figures are highly interesting from the standpoint of mortality of the workers, for we find that the colony with 27 workers had actually given birth to 39, and the colony with 63 workers had produced 84. The two colonies therefore had lost 12 and 21 workers respectively. Worker bumblees must brave the vicissitudes of enemies and inclement environmnt in their foraging expeditions, and one expects a certain portion of the population to fare ill, but whether the figures given above are much or little one cannot tell, since there is little comparative data at hand. However, in a population study of one *B. americanorum* colony made at the end of the season in Missouri, the mortality was much less than in these nests, for out of 137 workers born in the colony during the season, 131 survived until near the end of the season.[2]

The pupæ and quiescent larvæ within cocoons numbered 17 in Nest A and 69 in Nest B, and young feeding larvæ (usually a small number of larvæ within a ball-like mass of pollen-paste) numbered five (2 in one mass and 3 in the other) in Nest A, and three (all in one mass) in Nest B.

The eggs were placed in small clusters in hollow spaces in the interior of the pollen-paste balls. These were without openings, and measured roughly about one-quarter inch in diameter, and were attached to cocoons and other objects in the nest. They were designed to serve as food for the tiny larvæ when they hatched from the eggs. In Nest A were four such masses, containing 8, 7, 6 and 4 eggs respectively. In Nest B were two balls, containing 2 and 6 eggs.

The total potential populations of these nests, including queens, workers, larvæ and eggs, were 75 and 145.

As is usual with bumblebees, pollen and nectar are stored in vats made of wax-like material; both are also stored in old cocoons from which the bees have emerged. Sometimes the cocoons are enlarged for this purpose by placing an

[1]13 of Nest B emerged from their cocoons in my jars during the following few days.

[2]Entom. News, 52: 70-74, 1941.

addition of this wax-like substance on the rim of the cup. Thus in Nest B, 16 empty cocoons which had been used at one time or another as storage vats had had their capacity increased by extensions which varied from one-eighth inch to three-fourths inch. Two old cocoons completely filled with honey were tightly sealed with lids of wax. The largest pot, constructed entirely of wax, was in Nest B, and measured one inch in height by a half-inch in diameter. In both nests were several of these cocoon-vats that had remnants of pollen or honey, and in some cases they were half full of food at the time the nests were taken. In both nests some of the old cocoons had been partly bitten away, evidently by the workers, but why it had been done or what the bits of material had been used for is not known.

There were no males in the nests, neither were there any parasites or messmates, except for an unknown moth larva and an unknown moth cocoon among the cocoons.

On the whole, except for the tendency to slightly larger colonies, the life history of *Bombus medius* differs but little from that of our Missouri *Bombus americanorum.*

A NOTE ON THE LIFE-CYCLE OF *TETRAOPES FEMORATUS* LECONTE (CERAMBYCIDÆ)[1]

By R. W. Williams,

University of Illinois

While making a study of the bionomics of the common milkwood beetle, *Tetraopes tetrophthalmus* (Forst.), during the summer of 1940 at Urbana Illinois, I found, on August 11, a fully developed Tetraopes larva tunneling through the center of the horizontal root of the common milkweed, *Asclepias syriaca.* This larva was identified at the United States National Museum as being different from those thought to be *T. tetrophthalmus.* Unfortunately the species could not be determined since investigators had never associated larvæ similar to this one with an adult beetle. Since *tetrophthalmus* and *femoratus* were the only species of Tetraopes seen during my observations I believe that this single specimen was a representative of *femoratus.* The size of the individual would also warrant this conclusion since the adult of *femoratus* is the largest species of *Tetraopes* found in the state. This specimen was 23 mm. in length. Larvæ of *T. tetrophthalmus,* which were found during the fall of 1939, ranged from 13 to 19 mm. in length.

The first adult of *T. femoratus* was seen on July 23. It seemed highly improbable that eggs could have been deposited and the larvæ from these eggs could have reached a fully developed condition within a period of twenty days or even a month, assuming that the adults were present earlier. These facts, therefore, seem to indicate that at least some individuals of this species may spend two or more years in the larval condition about the roots of milkweed. Since the roots of these plants are perennial the larvæ would have a

[1]Contribution No. 220 from the Entomological Laboratories of the University of Illinois.

continuous food supply to make a two-year developmental period possible. If the larval stage does actually last more than twelve months it should be possible to find larvæ at any time during the year. Although it may be a possibility to find these larvæ at any time the probability is very small, at least in the vicinity of Urbana, Illinois, which is very near the eastern limit of the range of this insect. Only 38 adults of *T. femoratus* were seen during the summer. A conservative estimate of the number of adults of *T. tetrophthalmus* seen during this period would be 8,000. An average of one plant out of three was found to be infested by this latter species. It can, therefore, be shown mathematically that there would be one chance in approximately 630 of finding a plant infested with *T. femoratus.* This again would be a conservative figure. The duration of the larval stage of any one individual is not known, however, it seems probable that it would be at least 23 months.

A NEW *STIZUS* FROM UTAH, WITH NOTES ON THE OTHER NORTH AMERICAN SPECIES (HYM.: SPHECIDÆ)

By Richard Dow

Reading, Mass.

Stizus iridis, sp. nov.

Male.— Length about 20 mm. Yellow (Amber Yellow of Ridgway), with the following exceptions: mandibles dark ferruginous at apex with a ferruginous line along the interior margin; supra-antennal area with inconspicuous dark spots on each side; a broad transverse black band across the vertex including the ocelli, with an anterior extension along the median frontal groove; occiput with two black or ferruginous bands which connect the sides of the vertex with an extensive black area surrounding the foramen; antennæ with the posterior surface of the scape, the pedicel, and the flagellum ferruginous, the flagellum shading to black above and to orange toward the apex; pronotum with a black transverse band anteriorly; disk of mesoscutum and anterior margin between posterior lobes of pronotum black, either marked with two narrow yellowish longitudinal stripes (holotype), or two large spots of reddish brown (paratype), or simply black (paratype); dorsal surface of propodeum with a narrow black fascia along the anterior margin, wider and with a posterior median projection in the paratypes; sutures of propodeal area marked with black lines (partly obsolete in the holotype) which meet on the posterior surface; posterior surface with a black line extending anteriorly along the median groove; proepisterna black except for a small spot near the lateral angle of each front coxa; mesosternum with a large black maculation, medially interrupted in both paratypes, and ferruginous in one of them, emarginate (holotype) or narrowed anteriorly, but posteriorly with only a narrow separation (along the ridge representing the mesopleural suture) from a dark spot near the ventral end of the meso-metapleural suture; remainder of mesopleura, except dorsal portion of mesepisterna, suffused with orange; meso-metapleural and metapleural-propodeal sutures marked with black lines; lateral areas of metasternum black; all coxæ black at base, at least anteriorly; remainder of legs partially suffused with orange; veins and membrane of fore wings yellowish basally, and somewhat fuliginous in the region of the first submarginal and marginal cells, the latter with a dark streak in the anterior half; hind wings yellowish; anterior face of first tergite more or less ferruginous, with a black basal area which (in the holotype and one paratype) has a narrow median projection and broad extensions at the sides (the other paratype has only a median projection which is shorter and does not reach the dorsal surface); apical and to some extent the lateral margins of all tergites orange; basal margins of tergites 2-5 orange or black (always black on tergites 4-5), each with a triangular median projection of the same color; sternites variously marked with orange and black.

Head (in facial view) broader than long, the posterior margin nearly straight; inner margins of eyes nearly straight, slightly converging anteriorly, nearest to each other where they reach the clypeus; clypeus emarginate both anteriorly and posteriorly (fig. 1), the peak of its convexity (seen in profile) anterior to the middle; supraclypeal area posteriorly three times as broad as long, the sutures defining the frontal shield (*Stirnschildschen*) not distinct; antennal sockets separated from the eyes and from each other by somewhat less than their transverse diameter; space between the antennal sockets with a low ridge, carinate posteriorly; supra-antennal area with a broad median impression which extends posteriorly and encircles the anterior ocellus; posterior ocelli smaller than the anterior ocellus, separated from the eyes by one and a half times their diameter, and from each other by twice their diameter; latero-posterior margins of each posterior ocellus bordered by an impressed line which continues posteriorly in a medially concave curve to the vertical face of the occiput; genæ (in lateral view) rather narrow, wider below. Mandibles with a small tooth near the apex. Antennæ long enough to reach the posterior face of the propodeum; segments 9-12 much shorter than the four preceding, 9 about

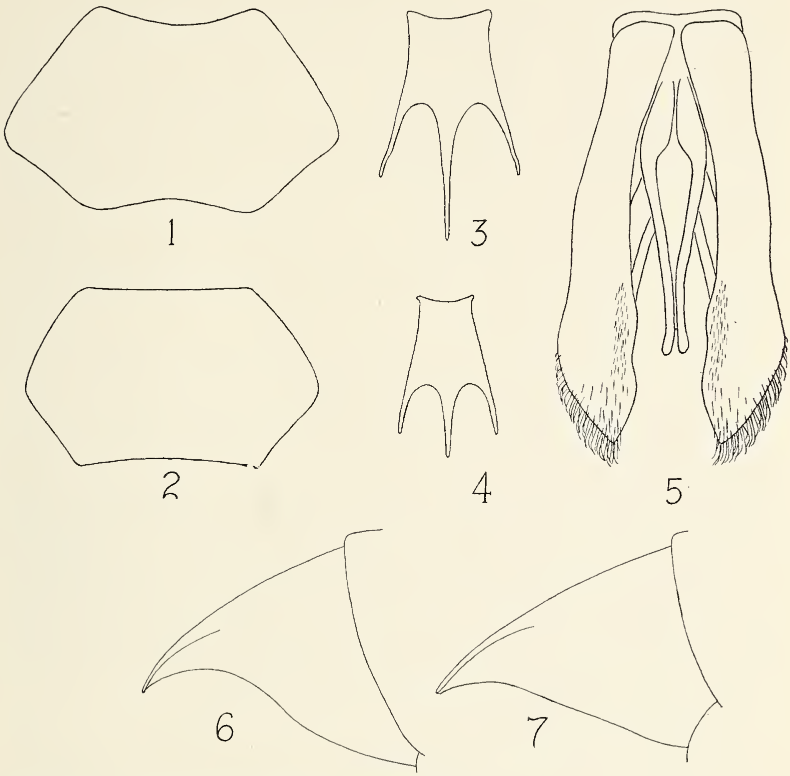


Figure 1. Clypeus of *Stizus iridis*, sp. nov.
Figure 2. Clypeus of *Stizus occidentalis* Parker (holotype male).
Figure 3. Eighth sternite of *Stizus iridis*, sp. nov.
Figure 4. Eighth sternite of *Stizus occidentalis* Parker (holotype male).
Figure 5. Male genitalia of *Stizus iridis*, sp. nov.
Figure 6. Sixth tergite of *Stizus brevipennis*, lateral outline.
Figure 7. Sixth tergite of *Stizus texanus*, lateral outline.

two-thirds as long as 8, 13 tapering to a round end and not emarginate within; tyloids present as linear carinæ on segments 6-13, that on 5 very short, practically a tubercle.

Thorax (in dorsal view) somewhat rectangular; pronotum not elongate; parapsidal furrows not extended to the posterior margin of the mesoscutum, each represented by a slender carina with an extremely fine longitudinal impression; sutures defining the propodeal area strongly impressed; meso-metapleural suture sinuous, but not strongly curved anteriorly; hind angles of the propodeum tumid. Fore wings 17-18 mm. long, about four times as long as the distance between the posterior lateral angles of the mesoscutum, the first transverse cubital vein practically straight. Legs slender.

Abdomen large and elongate; first tergite with a flattened anterior face, in dorsal aspect roundly angulate anteriorly, the concave sides (as seen from above) parallel towards the base, diverging posteriorly.

The puncturation is fairly coarse and dense over most of the body. The clypeus and supraclypeal area, however, are very finely punctate, and anterior to the black band across the vertex are two areas with coarse, well-separated punctures.

The pubescence is pale and generally distributed, but longer, or at least more conspicuous, on the posterior half of the clypeus, the sides of the supraclypeal area, the anterior portion of the supra-antennal area, the vertex and the adjacent occiput, the lower portion of the genæ, the lower portion of the mesopleura, the mesosternum, the posterior angles of the propodeum, and the first tergite.

Female.— Unknown.

Types.— Holotype, Museum of Comparative Zoölogy, Cambridge, No. 23397. One paratype, U. S. National Museum, No. 55828. One paratype in the author's collection.

Type locality.— Rainbow Bridge National Monument, San Juan County, Utah.

Distribution.— Holotype male and two male paratypes taken at the type locality, July 16, 1935, by Professor C. T. Brues, who kindly supplied the following notes.

"The specimens of the new *Stizus* were collected in the canyon about half a mile above Rainbow Natural Bridge near the camp established for visitors. Close to the open space in which the camp is situated are cliffs that form one of the cavelike hollows characteristic of the red sandstone of this region. In the early morning, over the steep talus slope to one side of this 'cave,' still in the shadow of the high cliff on the east, great numbers of these wasps were circling and darting about. In their erratic flight they would scarcely ever pause, and it was only after considerable effort that I finally secured three specimens. They did not appear at all wary and had it not been for the very insecure nature of the steep slope and loose rocks, they would have been taken quite easily. The wasps soon disappeared, long before any sunshine reached the spot. There was practically no vegetation on the slope where the wasps were observed."

Remarks.— The present species of *Stizus* is the fourth of the genus (as now restricted) to be described from North America. Of the remaining three it is most closely related to *occidentalis* Parker, a member of the *ruficornis* group. The male of the new species, like that of *occidentalis,* has the first transverse cubital vein practically straight, not evenly curved toward the apex of the wing. If the female should prove to have a scutellar pit (as it does in *occidentalis*), *iridis* may be assigned to the *ruficornis* group without question.

The types of *iridis* have been compared with the holotype male of *occidentalis,* which differs in the following structural details. In the holotype of *occidentalis* the clypeus is evenly convex in profile; it has a wider emargination anteriorly and the posterior margin is practically straight (fig. 2). Lateral to each posterior ocellus of the holotype of *occidentalis,* there is a longitudinal shining impression, about one-third the diameter of the ocellus in width; it extends posteriorly for a distance about equal to the diameter of the ocellus, but does not descend the vertical face of the occiput. Behind the anterior ocellus there is no circular impression. Linear tyloids are present on antennal segments 7-13, instead of 6-13 as in *iridis;* on the right antenna they are all conspicuous, but on the left less so, particularly on 7 and 8. In dorsal aspect the thorax appears more rounded anteriorly, and more pointed behind. The parapsidal furrows are represented by simple impressed lines. The posterior angles of the propodeum are less convex than in *iridis,* and the sutures defining the propodeal area are not strongly impressed. The first tergite is distinctly rounded in dorsal aspect, and has a less sharply marked anterior face. Other structural differences occur in the eighth sternite (figs. 3 and 4) and the parameres of the genitalia (compare fig. 5 with Parker's fig. 29).

The author discovered another genitalic character while comparing his paratype of *iridis* with two males of *occidentalis* kindly loaned by Dr. C. D. Michener. In *occidentalis* the compressed shaft of the digitus, when viewed laterally, is rather uniform in width, but in *iridis* its ventral margin is strongly emarginate.

Stizus occidentalis Parker

1929. *Stizus occidentalis* Parker, Proc. U. S. Nat. Mus. 75 (5): 9, pl. 4, fig. 29. ♂, ♀.

This species was described from two specimens: a male from "San Diego County," California, collected by Coquillett, and a female from Florence, Arizona. As a result of the present author's recent trip to California, six additional specimens were located in various collections. This material, which considerably extends the known range, indicates that *occidentalis* is a desert species of the Lower Austral Region, and suggests that the holotype collected by Coquillett may really have been taken in what is now Imperial County, formerly the eastern part of San Diego County.

CALIFORNIA: Panamint Mts., Inyo Co.; May 29, 1937; N. W. Frazier, 1 ♂ [California Academy of Sciences]. Wild Rose Canyon, Panamint Mts., Inyo Co.; elevation, 3000 ft.; flying about flowers of *Prosopis chilensis* in noonday sunlight; May 28, 1937; C. D. Michener; 2 ♂, 1♀ [C. D. Michener]. Furnace Creek, Death Valley; on *Pluchea sericea;* May 1, 1927; P. H. Timberlake; 1 ♀ [University of California Citrus Experiment Station]. Eight miles south of Needles; on *Acacia greggii;* June 4, 1938; P. H. Timberlake; 1 ♀ [University of California Citrus Experiment Station].

Stizus brevipennis Walsh

1869. *Stizus brevipennis* Walsh, Amer. Entomologist **1**: 162. ♂.

1875. *Larra brendeli* Taschenberg, Zeitschr. f. d. Ges. Naturwiss. **45**: 361. ♂.

1879. *Megastizus brevipennis* Patton, Bull. U. S. Geol. Survey Terr. **5**: 345. ♂, ♀.

1887. *Megastizus brevipennis* Cresson (pars), Synopsis: 278.

1892. *Stizus brevipennis* Handlirsch, Sitz. Akad. Wiss. Wien, Math.-nat. Cl., **101** (1): 174, pl. 1, fig. 13, pl. 2, fig. 28, pl. 3, fig. 15. ♂, ♀.

1895. *Stizus brevipennis* Fox, Proc. Acad. Nat. Sci. Philadelphia **1895**: 266-268. ♂, ♀.

1941. *Megastizus brevipennis* Snodgrass, Smiths. Misc. Coll. **99** (14): pl. 19, figs. A-G. ♂.

The only published information relative to the prey of the North American species of *Stizus* is a brief note by F. X. Williams (1913, Kansas Univ. Sci. Bull. 8 (4): 198) to the effect that *brevipennis* "hunts in a manner quite similar to [*Tachytes*] *mandibularis*, examining the stems of *Helianthus*, etc., as she flies and finally finds her prey, a large *Xiphidium*." Dr. Williams has informed the author (*in litt.*) that the grasshopper in question is "a large short-winged adult ♀ of *Xiphidium*, now known as *Conocephalus*. It has a long, rather straight, ovipositor." In the selection of Orthoptera as prey, *brevipennis* agrees with the Old World species of *Stizus*, which, with two doubtful exceptions, have thus far been reported to capture either grasshoppers or mantids.

The male of *brevipennis* is very distinct from that of *texanus*. Besides the characters given in the accompanying key, the genitalia are entirely different. The females of these species are less readily distinguished, and as the pygidial character given by W. J. Fox does not appear to be valid, the present author has substituted another character of the sixth tergite which is quite satisfactory.

In the following list of specimens examined by the author, the record for Indian Head, Maryland, is by far the most surprising. It would certainly appear to be in error were it not for the occurrence of the species in central Florida.

FLORIDA: Cape Barrancas; C. Willard; 1 ♀ [M.C.Z.].

Gainesville; July 7 *to* 22, 1918; P. W. Fattig; 5 ♂ [U.S.N.M.].

ILLINOIS: 2 ♂ [A.M.N.H.].

IOWA: Mount Pleasant; July 1920; 1 ♀ [U.S.N.M.].

KANSAS: 1 ♀ [U.S.N.M.]. Douglas Co.; 900 ft.; F. H. Snow; 1 ♂ [U.S.N.M.]. Riley Co.; July 9 *and* 31; Popenoe; 1 ♀ *and* 1 ♂ [U.S.N.M.]. Dickinson Co.; August; Bridwell; 1 ♀ [U.S.N.M.]. Wellington; H. R. Watts; 1 ♀ [U.S.N.M.].

MARYLAND: Indian Head; August 23, 1902; Bridwell; 1 ♂ [U.S.N.M.].

MISSOURI: St. Louis; July 1911; P. Rau; 1 ♀ [U.S.N.M.].

NEBRASKA: Cambridge; July 26, 1921, August 2, 1921, *and* August 22, 1923; A. P. Morse; 1 ♀, 1 ♂ [M.C.Z.], *and* 1 ♂ [Richard Dow].

OKLAHOMA: Ardmore; July 11, *and* August 18, 1905; C. R. Jones; 1 ♂ *and* 1 ♀ [U.S.N.M.].

SOUTH DAKOTA: Springfield; August 27, 1926; H. C. Severin; 1 ♂ [M.C.Z.].

TEXAS: Belfrage [collector]; 1 ♂, 1 ♀ [U.S.N.M.]. San Antonio; H. B. Parks; 1 ♂ [U.S.N.M.].

WISCONSIN: Milwaukee; August 12, 1907; S. Graenicher; 1 ♂ [M.C.Z.].

Stizus texanus Cresson

1872. *Stizus texanus* Cresson, Trans. Am. Ent. Soc. **4**: 222. ♂, ♀.

1879. *Megastizus texanus* Patton, Bull. U. S. Geol. Survey Terr. **5**: 345. ♂, ♀.

1887. *Megastizus brevipennis* Cresson (pars), Synopsis: 278.

1892. *Stizus texanus* Handlirsch, Sitz. Akad. Wiss. Wien, Math.-nat. Cl., **101** (1): 176, pl. 1, figs. 6, 14, 15, pl. 2, fig. 29, pl. 3, fig. 16. ♂, ♀.

1895. *Stizus texanus* Fox, Proc. Acad. Nat. Sci. Philadelphia **1895**: 267-268. ♂, ♀.

In the American Museum of Natural History there is a female of *texanus* from Tucson, Arizona, a locality considerably west of the previously known range of the species. Though the head and thorax are normal in coloration, the abdomen is remarkable for the extent of the yellow maculations. Whereas the lateral spots on tergites 3 and 4 are usually well separated in *texanus,* in this specimen they are united medially to form broad continuous fasciæ, the first of which is deeply emarginate anteriorly, but the second less so. There is also a broad fascia on tergite 5 which covers most of the exposed portion of the sclerite. Even the yellow spots on sternites 2, 3, and 4 are exceptionally large.

The following records are of specimens examined by the author.

ARIZONA: Tucson; "Creosote bush assn."; August 6, 1906; G. von Krockow; 1 ♀ [A.M.N.H.].

TEXAS: 2 ♂ [M.C.Z.]. Lincecum [collector]; 1 ♀ [M.C.Z.]. Alpine; June 4, 1927 [?]; 1 ♂ [U.S.N.M.]. Cotulla; June 21, 1906; H. Caley; 1 ♂, 4 ♀ [U.S.N.M.]. "Dallas"; Boll; 9 ♂, 9 ♀ [M.C.Z.] *and* 1 ♂ [Richard Dow]. Laredo; May 16, 1924; 2 ♀ [U.S.N.M.]. San Antonio: May 27, 1937; 3 ♂ [U.S.N.M.].

In the following key to the known forms of *Stizus* occurring in North America, the author is following the division of the Stizini proposed by J. B. Parker in 1929 (Proc. U. S. Nat. Mus. 75 (5): 7-11). According to this classification, *Stizus unicinctus* Say belongs in the genus *Stizoïdes* (equivalent to the *tridentatus* group of Handlirsch, Berland, and Arnold), and the genus *Bembecinus* includes the forms with a concave propodeum. The name *Megastizus* is applicable to *Stizus brevipennis* and *texanus,* but whether these species form a group worthy of subgeneric rank is a question the author prefers to leave undecided until he has studied more material from other regions.

1. Males .... 2.
   Females .... 5.
2. Antennæ without longitudinal carinæ on segments 9 and 10. Seventh tergite with large ventral lobes.......... 3.
   Antennæ with longitudinal carinæ on segments 9 and 10. Seventh tergite without large ventral lobes .... 4.

3. Anterior margin of clypeus laterally with blunt teeth, its shallow nearly straight emargination with two low projections. Narrowed apex of seventh tergite broadly rounded; ventral lobes of seventh tergite broad, about twice as long as wide, broadly triangular at apex. Apex of seventh sternite broadly triangular, the more heavily sclerotized portion spear-shaped. Median spine of eighth sternite borne on a spear-shaped projection much narrower than the basal portion .... *brevipennis* Walsh

   Anterior margin of clypeus evenly rounded. Apex of seventh tergite narrowed into a flattened truncate projection with a small but distinct median emargination; ventral lobes of seventh tergite slender, nearly three times as long as wide, narrowly triangular at apex. Seventh sternite narrowly triangular, truncate at apex, the more heavily sclerotized portion of similar shape. Median spine of eighth sternite on a broad triangular projection ....*texanus* Cress.

4. Posterior margin of clypeus practically straight. Antennal segments 7-13 with distinct tyloids. Sides of first tergite (in dorsal view) slightly convex. Thorax conspicuously hairy. Mesopleura, metapleura, and propodeum mostly or entirely black ....*occidentalis* Parker

   Posterior margin of clypeus emarginate. Antennal segments 6-13 with distinct tyloids. Sides of first tergite (in dorsal view) concave. Thorax not conspicuously hairy. Mesopleura, metapleura, and propodeum almost entirely yellow ....*iridis*, sp. nov.

5. Sixth tergite with a pygidial area .... 6.

   Sixth tergite without a pygidial area defined by lateral ridges. Posterior margin of clypeus practically straight. Lateral margins of first tergite slightly convex. Thorax conspicuously hairy. Mesopleura, metapleura, and propodeum mostly or entirely black ....*occidentalis* Parker

6. Anterior margin of clypeus with a broadly V-shaped emargination. Lateral margins of sixth tergite strongly sinuous (fig. 6) ....*brevipennis* Walsh

Anterior margin of clypeus with a shallow rounded emargination. Lateral margins of sixth tergite with the basal three-quarters nearly straight (fig. 7) ....*texanus* Cress.

Acknowledgments.— The author is much obliged to the numerous entomologists and museums whose material he has been permitted to study, and especially to Professor Brues for the privilege of describing the new species and permission to retain one of the paratypes. For assistance in the preparation of this paper, he is greatly indebted to the late Miss Grace A. Sandhouse and to Mr. Karl V. Krombein, both of the Bureau of Entomology and Plant Quarantine.

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A NEUROPTEROUS MYRMECOPHILE, *NADIVA VALIDA* ERICHS.

BY NEAL A. WEBER

University of North Dakota

None of the insects of the Order Neuroptera seem to have been recorded as dwelling with ants in any degree of myrmecophily. This is hardly surprising in view of the predatory nature of these insects. The finding, therefore, of larvæ of a neuropteron living as symphiles with a common and widespread ant was quite unexpected.

While travelling up the Courantyne River, boundary between Surinam and British Guiana, as the guest of the British Boundary Commission, a brief stop was made at Wonotobo Falls July 13, 1936 in about 4° 22′ N. Lat. Here in a small clearing in the virgin rain forest was a temporary depot of the Commission. Some of the medical stores were kept in a plywood Vanesta box of about one bushel capacity. In opening the box to take out quinine I found the box alive with the large and pugnacious ant, *Camponotus* (*Myrmothrix*) *abdominalis* (Fabr.). The cover was sufficiently warped to permit the ingress and egress of the ants. While collecting some of the ants a few small, active insect larvæ of an unusual blue in color were noticed scurrying about among the piles of ant eggs, larvæ and pupæ lying openly on the floor of the box. Some of the ants carried off these blue larvæ in the same manner as they carried their own brood, securely held between the mandibles, and with equal care. The blue larvæ were nearly as active as the ant workers and some ran off by themselves.

There was definitely no hostility between the ants and the guest larvæ; rather the latter seemed to be treated as ant brood.

Unfortunately I had to continue my journey upriver immediately and had time only to place a few of the blue larvæ in a small vial. Strenuous travelling up several hundred miles of rapids and falls prevented study of the material. One larva pupated during the journey and July 28 an imago emerged. Mr. Nathan Banks has kindly determined this as *Nadiva valida* Erichs. (Chrysopidæ) with the note that the

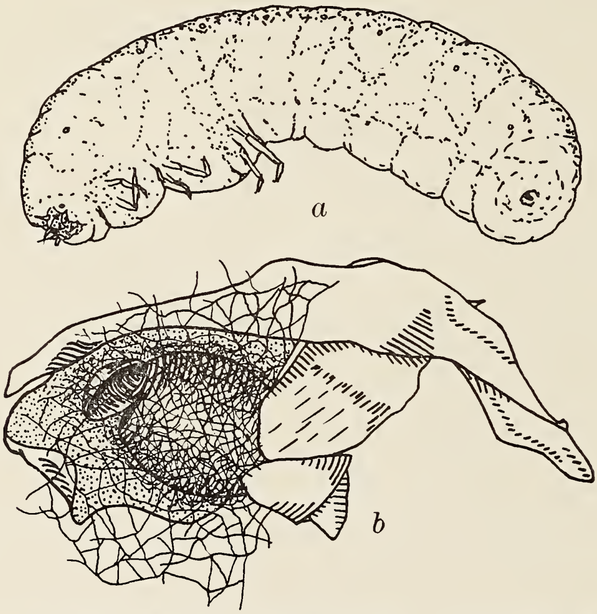

Fig. 1. *a*, Larva of *Nadiva valida* Erichs; *b*, Pupal case of same.

species "was described from the United States but known also from Brazil. It belongs to a peculiar group, the body being broad and heavy; and the venation not as much specialized and inconstant. Allied forms are mostly in South Brazil, Argentina and Bolivia." The larva and neat cocoon are figured below.

A large larva after preservation was 10.5 x 5 mm., the extended and dried pupal envelope 10.5 mm. and the elliptical cocoon 5.5 x 7 mm. The latter was a light straw yellow in color and firmly affixed by yellow threads to crumpled blue paper which covered absorbent cotton. From an even horizontal break or cut in the case one millimeter from an end the imago had emerged.

Camponotus abdominalis is widespread and abundant in the Neotropical Region. The colonies are often very populous while the workers and soldiers are among the most aggressive of ants, the latter inflicting painful bites. The present nesting site is not unusual. I found these ants nesting in Trinidad in such places as old cacao pods, *Nasutitermes* nests (termite-inhabited or not), a disused teapot, a writing desk and a gentleman's cabbage walking stick.

There are some aspects of the relationships between this ant and the *Nadiva* larvæ which would repay study and which could not be worked out in view of the circumstances described above. How were the guests adopted? How do they obtain food? Perhaps, after in some manner acquiring the ant nest odor, the larvæ were adopted. Or were the eggs laid in the ant nest? The young larvæ might have been active and elusive enough to escape the first attacks of the ants and would soon acquire the nest odor. In view of the known predatory habits of Neuroptera larvæ it would not be surprising to find that they fed upon the brood of their hosts. The larvæ are covered with short, stout hairs but with nothing resembling trichomes so what they could give the ants in return is unknown.

METAMORPHOSES OF COMMON CUBAN PYRGINÆ

By V. G. Dethier

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The four most common skippers of the subfamily Pyrginæ found in Cuba are *Goniurus proteus* L., *G. dorantes* Stoll., *Polygonus lividus* Hbn., and *Pyrgus syrichtus* Fabr. The life history of *G. proteus* has been described repeatedly, and the immature stages of Cuban specimens are similar to those of North American specimens. In Cuba the larvæ feed on *Clitorea*, cultivated beans, and all native closely related Leguminosæ. *G. dorantes* feeds on the same plants. *P. lividus,* which in Florida feeds on *Piscidia piscipula,* is found on species of *Lonchocarpus* in Cuba. The larvæ found here differed slightly from those studied by Dyar (1897). For a description of the first instar of *P. syrichtus* the reader is referred to an earlier paper (Dethier, 1940).

Goniurus dorantes Stoll.

Egg. Turtle green. Greatest diameter 1.0 mm. Height .8 mm. Apex patterned with large prominent raised reticulations. These gradually merge into many longitudinal ribs extending to the flattened base.

First Instar. Head height .5 mm.; head width .6 mm. Head shiny piceous to black, covered with few small, scattered, colorless, tapering hairs. Body length 2 to 3 mm. Javel green to bright chalcedony yellow. Few scattered lighter colored spots on body. Few short tapering hairs arising from black tubercles arranged in paradorsal, suprastigmatal, and substigmatal rows. Prothoracic legs fuscous. Shield concolorous with head. Substigmatal area of shield bright orange.

Second Instar. Head height .8 mm.; head width .81 mm. Head shagreened, almost black. Hairs shorter and more numerous. With slight tawny tinge. Body length 3.5 mm.

Light greenish yellow. Many lighter pale greenish yellow spots scattered over the surface of the body. The numerous short scattered hairs arise from these. Slight bleaching of shield in the mid-dorsal line. Numerous short hairs on shield. Prothoracic legs fuscous. Hairs on anal plate black.

Third Instar. Head height 1.2 mm.; head width 1.4 mm. Head more roughly shagreened than before. Pronounced rugosities at apex of vertex. Black. Body length 7 mm. Javel green. Anterior edge of shield ochraceous orange, posterior part fuscous. Remainder of segment orange. No other noticeable changes in the body.

Fourth Instar. Same as above.

Fifth Instar. Head height 2.4 mm.; head width 2.7 mm. Head very roughly shagreened. Apex of vertex with large rugosities, larger near median line. Head fuzzy and downy in appearance due to the numerous short tawny hairs.

Eggs laid on the food plant July 11 hatched July 14. Each instar required from three to four days.

Polygonus lividus Hbn.

Second Instar. Head height .8 mm.; head width .9 mm. Head black, rugose. Few scattered light colored hairs. Body length 6 mm. Dull green yellow. Mid-dorsal line faint, darker green due to transparency there. Thin, irregular, yellowish para-dorsals. Body sparsely dotted with small yellow spots. Anal area suffused with yellow.

Third Instar. Head height 1.2 mm.; head width 1.6 mm. Head slightly more rugose. Not noticeably rougher at vertex than elsewhere. Body length 7 to 11 mm. Markings same as before. General color meadow green. Para-dorsals and spots bright chalcedony yellow.

Fourth Instar. Head height 2.0 mm.; head width 2.4 mm. Head black. Surface broken up into roughly polygonal raised reticulations. Flat scale-like protuberances on apex of head directed away from median line. Not so pronounced as the rugosities in *G. dorantes.* Head very flat-topped. Scattered, very short, colorless hairs. Body length 20 mm. Meadow green. All legs and ventral side of thoracic segments bright chalcedony yellow. Shield concolorous with body. Meadow green mid-dorsal line due to absence of the bright chalcedony yellow spots which cover the rest of the body. Spiracles concolorous with body. Larva nearly naked. Very few exceedingly small colorless tapering hairs.

Each instar required four days.

Pyrgus syrichtus Fabr.

Second Instar. Head height .55 mm.; head width .57 mm. Widest at the level of the adfrontal punctures, nearly flat-topped. Piceous. Body length 3.5 mm. Very light greenish. Legs and spiracles concolorous with body. Shield concolorous with head. Many short, colorless, spatulate hairs scattered over the surface of the body. Hairs on subventral fold and anal plate tapering. All hairs arising from prominent cream colored tubercles.

Third Instar. Head height .87 mm.; head width .90 mm. Head piceous, nearly black. More rugose than in foregoing instar. Adorned with scattered colorless tapering hairs. Length of body 6 mm. Shield smooth, piceous. Faded fuscous mid-dorsal line. Six long, colorless, spatulate hairs on either side of the median line in the anterior border of the shield. The more lateral two are located dorsad and slightly cephalad of the large circular brown spiracle. On the posterior edge of the shield there are two to three very short spatulate hairs, also colorless, on each side of the median line. Prothoracic legs same color as shield. Body same as before, slightly darker green.

Fourth Instar. Head height 1.3 mm.; head width 1.6 mm. Body length 10 mm. Not much change from third instar.

Fifth Instar. Head height 2.2 mm.; head width 2.4 mm. Piceous. Very rugose. No conspicuous protuberances at top of vertex. Dense covering of short tawny hairs. Body length 17 mm. A mid-dorsal and, to a lesser extent, a paradorsal bleaching of the shield. Shield chocolate. Body chrysolite green. Mid-dorsal line faint. Deep chrysolite green. Faint indication of similar narrow para-dorsals. Colorless, slightly spatulate hairs numerous. Arising from white rounded tubercles. Legs fuscous. Spiracles concolorous with body.

Chrysalis. Length 13.5 mm. Head krönberg's green dorsally. Wing pads, mouthparts, and legs scheele's green. Abdominal segments light dull green yellow. Mid-dorsal line suffused with fuscous and scheele's green. Intersegmental areas courge green ventrally. Spiracles black. Numerous long hairs white. Head, thoracic, and abdominal regions hairy. Anterior end rounded. Widest in the region of the posterior edge of the wing pads.

Each instar required three or four days for its completion. Pupation took place July 20, and the imago emerged ten days later. Although small larvæ were unable to survive on the more pubescent species of *Sida,* larger larvæ fed on all the native species.

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NOTES ON TABANIDÆ (DIPT.) FROM PANAMÁ V. THE GENUS *TABANUS*, SUBGENUS *BELLARDIA* RONDANI

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Subgenus **Bellardia** Rondani

Bellardia Rondani, 1863, Arch. per La Zool., Modena, III, 1, p. 81. (with *T. albonotatus* Bell.). Enderlein, 1925, Mitt. Zool. Mus. Berlin, 2, p. 394. (Type, *T. oculus* Walker = *T. albonotatus* Bell.) Kröber, 1932, Rev. Ent., II, 3, pp. 290, 300 (in part). Borgmeier, 1933, Rev. Ent. III, 3, p. 288. Kröber, 1934, Rev. Ent., IV, 2, p. 261 (in part).

Lophotabanus Szilady, 1926, Biol. Hung., I (7), p. 25. Kröber, 1929, Zool. Anz., LXXXIII, p. 120 (14 species, no type). Kröber, in Borgmeier, 1933, Rev. Ent., III, 3, p. 295 (Type, *T. flavibarbis* Macq. 1845). Kröber, 1934, Rev. Ent., IV, 3, p. 295. Bequaert, 1940, Rev. Ent., XI, 1-2, p. 289 (Type, *T. bifloccus* Hine 1925).

The species included in *Lophotabanus* by Szilady (1926) and later authors are, in my opinion, not subgenerically separable from *T. oculus* Wlk., which is the genotype of *Bellardia* Rond. 1863. The only difference seems to be the presence of a closed first posterior cell in *oculus*, but as a number of other species have this cell strongly coarctate, while differing in no other important respect, it would seem best to discard *Lophotabanus* entirely. The limits of the group are not clearly definable, some of the species showing many points in common with *T. sorbillans* Wied., and *T. rubrofemorata* Kröb., species placed by Kröber in *Macrocormus* Lutz and *Bellardia* Rond. I am of the opinion that *T. ferrifer* Wlk., *T. olivaceiventris*, Macq. and other large species with a small black spot on the prescutellum only, show a greater resemblance to a group of large species including *T. fuscus* Wied. and *T. cinerarius* Wied., for which Lutz proposed the names *Chelotabanus* and *Odontotabanus,* than they do to *T. oculus* and *T. albocirculus.* For this reason *T. ferrifer* and *T. importunus* Wied., which both have a small prescutellar black spot, are excluded from the group in the present paper.

The group may be characterized as follows: Medium to large sized flies. Eyes bare, unicolorous or with 2 or 3 green bands. Frons medium to narrow, 6 to 10 times as high as basal width. Frontal callus present, of variable shape. Vertexal tubercle absent or weakly developed. Subcallus pollinose. Antennæ variable, generally with a well marked angle above, rarely with a long tooth. Palpi moderately inflated. Proboscis but little longer than palpi, the labella fleshy. Subepaulet with macrotrichia. Wing venation normal, or with the first posterior cell closed or coarctate. Appendix on upper branch of third vein present or absent. Wings hyaline, smoky, or with clouds on the cross veins. Coloration variable, but the prescutellum and disc of scutellum clothed with dense black pubescence which is more or less completely encircled by light hairs. Abdomen generally with mid-dorsal triangles, sometimes with dorso-lateral spots. In a few species the abdomen is unicolorous. The males of some species have the large facets much larger than the small and sharply demarkated from them, while in others, the facets are not greatly differentiated. All described males seem to have a small tubercle at the vertex.

Key to females.

1. Large stout species, 20 mm. or larger. Legs dark brown, the fore tibiæ darker, unicolorous. Abdomen dark brown, black haired, unicolorous. Frontal callus a slender line ....*de-filippii.*

   Smaller, more slender species, 18 mm. or less. Fore tibiæ bicolored, or abdomen with light median triangles, or frontal callus subquadrangular. ....2.

2. Fore tibiæ prominently white and white haired on basal two-thirds. Frontal callus black. Abdominal triangles pure white. Frons about 10 times as high as wide, narrowest below. First posterior cell narrowly open, rarely closed ....*albocirculus.*

Fore tibiæ brown, the apex black haired, the basal two-thirds pale yellowish or brownish haired. Frontal callus brown or yellow. Abdominal triangles yellowish. Frons 8 times as high as wide, or wider ....3.

3. First posterior cell closed and petiolate ....*oculus*.
First posterior cell narrowly or broadly open ....4.

4. Abdomen with a series of prominent mid-dorsal pale haired triangles. Fore tibiæ light haired basally. Antennæ yellowish brown, palpi moderately inflated basally ....*pseudoculus*.
Abdomen unicolorous, at most with a faint yellowish mid-dorsal stripe. Fore femora, tibiæ and tarsi wholly black, other legs brown. Antennæ black, exceedingly slender, palpi brown, also very slender .... *piraticus*.

Tabanus (Bellardia) de-filippii Bellardi (Figs. 2, 2a, 2b)

1859, Ditt. Mess., I, pp. 57-58 (♀; Mexico). Osten Sacken, 1878, Cat. Dipt. N. Amer., p. 61. Kertész, 1900, Cat. Taban., p. 47. Surcouf, 1921, Gen. Insect., Taban., p. 66. Hine, 1925, Occ. Pap. Mus. Zool. Univ. Michigan, No. 162, pp. 23, 28. Kröber, 1934, Rev. Ent., IV, 3, p. 295.

Four specimens, three from British Honduras (Stan Creek, Feb. 19, 1940, Komp coll., and Benque Viejo, Stanton Coll.) and one from Panama (Buena Vista, Chiriqui Mt., 1000 ft. May, '26, J. D. Smith coll.) have been compared with the specimens mentioned by Hine (l. c. 1925) and agree with them. *T. claurensis* Hine must be exceedingly close to the present species, the characters used to differentiate the two by Hine being largely intensity of color, *claurensis* being black, *de-filippii* dark brown. As I was unable to find any specimens of *claurensis* in the Hine collection, I am unable to state definitely what the differences between the two may be, if indeed they are distinct.

Female.—Length 20-23 mm., of wing 18-21 mm.

Frons, antennæ and palpi as figured. Frontal callus chestnut brown. Antennæ dull reddish, the annulate portion dusky. Palpi yellowish brown, black haired. Eyes green or greenish black in life, unbanded. Frons and face yellowish brown pollinose, the beard sparse, pale brownish. Mesonotum and pleura rich cinnamon brown, clothed with orange brown hairs. In the Panama specimen there is a tuft of dark hair below the wing insertion, like *punctipleura* Hine, but very much more weakly developed. Prescutellum and disc of scutellum densely black haired, with two short white diagonal marks on the mesonotum just before the prescutellum. Posterior margin of scutellum whitish, with long orange hairs. Legs cinnamon brown, the fore pair darker. Wings lightly fumose, darker along the veins. Costal cell yellow. Abdomen dark cinnamon brown, immaculate, black haired above, greyish pollinose beneath. The description drawn mainly from a finely preserved specimen from British Honduras. The Panama specimen is the largest, a little darker, with slightly more slender antennæ and palpi.

Distribution: Mexico to Panama.

Panama records: 1 ♀, Buena Vista, Chiriqui Volcano, 1000 ft., May, 1926 (J. D. Smith).

Tabanus (Bellardia) albocirculus Hine (Figs. 4, 4a, 4b)

1907, Ohio Naturalist, VIII, 4, p. 227 (♀; Tucurrique, Costa Rica); 1925, Occ. Pap. Mus. Zool. Univ. Michigan, No. 62, p. 23. Dunn, 1934, Psyche, XLI, 3, pp. 173-174 (Chiriqui, Panama) (in part). Curran, 1934, N. Am. Dipt., p. 152, fig. 27 (head). Kröber, 1929, Zool. Anz., LXXXIII, pp. 122-123, fig. 5 (♀; Costa Rica); 1934, Rev. Ent., IV, 3, p. 295.

This species is quite variable, both in size and color. Specimens from Chiriqui are largest and darkest, some quite black, and hence most closely agreeing with the type. Specimens from the Atlantic side are also dark, while those from the dry area along the Pacific coast are quite red and rather small. The condition of the first posterior cell is also somewhat variable. Nearly all specimens have it open, a few broadly so, but most strongly coarctate. One specimen from Chiriqui has the cell closed, stalked in one wing, closed at the margin in the other. The wings may be almost glass clear, strongly brown margined along the veins, or quite uniformly fumose. The eye has three broad green bands in life. *T. xipe* Kröber is exceedingly close. I have specimens from the states of Para, Bahia, Goyaz and Matto

Grosso in Brazil which I believe are that species; they average somewhat larger than the Panama specimens, and the structure of the front and callus is slightly but consistently different, as shown in Kröber's and my figures. (Figs. 5, 5a, 5b) Bequaert's record of *T. xipe* from Panama (1940, Bull. Ent. Res., III, 4, p. 449) should certainly be the present species.

Distribution: Costa Rica and Panama.

Panama records: Camp Pital, Chiriqui Prov., July 11-20, 1929 (Dunn); Changuinola Dist., Bocas del Toro; Mt. Hope, C. Z. Oct. 30, 1939, Dec., 1939; Ft. Davis, C. Z. Oct. 30, 1939; Moja Pollo, Chagres River region, May to November, 1940; Venado Beach, C. Z. June 22, 1939; Utevey, near Pacora, May 18, 1941; Pacora, Dec. 21, 1931 (Dunn.).

Tabanus (Bellardia) oculus Walker (Figs. 3, 3a, 3b)

Tabanus oculus Walker, 1848, List Dipt. Brit. Mus., I, p. 157 (♀; Honduras and Colombia); 1854, Op. cit., V, Suppl. I, p. 190. Osten Sacken, 1878, Cat. Dipt. N. Amer., p. 61. Hunter, 1901, Trans. Amer. Ent. Soc., XXVII, p. 146. Bodkin and Cleare, 1916, Bull. Ent. Res., VII, p. 187, (British Guiana). Hine, 1925, Occ. Pap. Mus. Zool. Univ. Michigan, No. 162, p. 23. Bequaert, 1931, Jour. New York Ent. Soc., XXXIX, p. 540-541, fig. 1a. (♀; Yucatan, Guatemala, Honduras, Br. Honduras). Dunn, 1929, Am. J. Trop. Med., IX, p. 501 (Colombia; as *occulatus*).

Bellardia oculus Kröber, 1929, Zool. Anz., LXXXIII, p. 121; 1934, Rev. Ent., IV, 2, p. 261.

Tabanus albonotatus Bellardi, 1859, Ditt. Mess., I, p. 56, Pl. II, fig. 5. (♀; Mexico, Tampico). Osten Sacken, 1878, Cat. Dipt. N. Amer., p. 60; 1886, Biol. Centr. Amer., Dipt. I, p. 55. Hunter, 1901, Trans. Amer. Ent. Soc., XXVII, p. 139. Williston, 1901, Biol. Centr.-Amer., Dipt. I, Suppl., pp. 257, 260. Aldrich, 1905, Cat. N. Amer. Dipt., p. 200. Kertész, 1900, Cat. Tab., p. 38; 1908, Cat. Dipt., III, p. 219. Surcouf, 1921, Gen. Insect., Taban., p. 59. Bequaert, 1925, 13th Rep. United Fruit Company Med. Dept., (1924) p. 206.

Bellardia albonotatus Rondani, 1863, Arch. per la Zool., Modena, III, I, p. 81.

Tabanus bipartitus Walker, 1848, List. Dipt. Brit. Mus., I, p. 158 (♀ ; Honduras) ; 1854, Op. cit., V. Suppl. I, p. 190. Osten Sacken, 1878, Cat. Dipt. N. Amer., p. 60.

A specimen from British Honduras is before me, and as "Honduras" was a type locality for both Walker's names, it may be taken to represent the typical form. This specimen, and another from Panama, have the eyes (revived) with 2 broad green transverse bands and the lower margin green. Four females from Mexico, two of them from Osten Sacken's collection and determined by him as *albonotatus* Bell., and two from Vera Cruz (Crawford), differ from the Honduras and Panama specimens in having an additional short green stripe on the eyes, above the other two, and in the frons being slightly narrower and more convergent. If further material should show these slight differences to be constant or correlated with geographical distribution, *albonotatus* might be retained in a varietal or subspecific sense. Bequaert, (1931, Journ. New York Ent. Soc., XXXIX, p. 541), discussing material from Yucatan and Honduras, remarks that most of his material has the eye two-banded, but that more rarely there is a third band above the other two. The records of Bodkin and Cleare and Dunn probably refer to other species.

Distribution: Mexico to Panama; "Colombia" (Walker).

Panama records: 1 ♀, Camp Pital, Chiriqui Province, July 11-20, 1929 (L. H. Dunn).

Tabanus (Bellardia) pseudoculus sp. nov. (Figs. 1, 1a, 1b)

Female.—Length 13-17 mm., of wing, 12-15 mm.

Frons, antennæ and palpi as figured. Eyes purple, with 2 narrow green bands and the lower margin narrowly green. Antennæ wholly reddish yellow, the first two segments black haired. Frontal callus light reddish brown. Palpi whitish, with black and white hairs. Subcallus, fronto-clypeus and genæ with greyish yellow pollen, the latter with a sparse whitish beard. Mesonotum brown, with grey pollinosity and sparse yellowish pubescence. Pleura grey, yellowish grey haired. Spot on scutellum covering prescutellum and disc of scutellum, completely encircled by yellowish white hairs. Legs light brown, mostly white haired, the apex of fore tibiæ and all tarsi darker and black haired. The fore tibiæ are not prominently bicolored. Wings hyaline, the veins sometimes narrowly brown margined. First posterior cell always narrowly open; appendix on third vein constant, generally longer than the distance from its origin to the furcation of the vein. Abdomen brown, greyish pollinose and black haired. The first to fifth tergites bear small median triangles of yellowish hairs. Venter lighter, wholly yellowish haired, except the last sternite which bears erect black hairs.

Male.—Similar to the female in coloration. Large eye facets distinctly differentiated and demarkated from the small, occupying about half to two thirds of total eye area. Large facets pale tan, small facets purple, with a narrow band and the lower margin green in life. A small tubercle is present between the eyes at vertex.

Holotype ♀, Moja Pollo, Chagres River region, Panama, Dec. 6, 1939; Allotype ♂, same locality, June 12, 1940; 39 ♀ Paratypes, same locality, Dec. 6, 1939, (6) Jan. 19, (2) Jan. 23, (1) Jan. 31, (1) Feb. 16, (8) May 2, (1) May 15, (4) May 27, (4) June 12, (2) June 24, (3) July 8, (1) July 23, (2) Aug. 4, (1) Aug. 18, (1) Sept. 1, (1) and Sept. 7 (2), all 1940. 3 ♀ Paratypes, El Real, Darien, Panama, Feb. 10, 1940. 2 ♀ Paratypes, New San Juan, Chagres River region, Panama June 28 and July 2, 1939. 1 ♀ Paratype, Juan Mina Station, Chagres River region, C. Z. May 9, 1939. 1 ♀ Paratype, Camp Pital, Chiriqui, Panama, July 11-20, 1929 (Dunn). Besides the above, I have numerous females unpinned from Moja Pollo, with dates ranging from March 1940 to March 1941. Holotype, Allotype, and 3 Paratypes to be deposited in the M. C. Z.

This species was confused by Dunn (1934) with true *albocirculus* Hine, from which it may be distinguished by the characters in the key. It flies in company with that species, and appears to be about equally abundant. The relationship between the present species and *oculus* Wlk. appears to be very close, the main differences being the much narrower green bands of the eye, the open first posterior cell and the somewhat broader and parallel sided frons of *pseudoculus*. Ordinarily, little importance could be attached to the venational character, but in this case it appears to be relatively stable, all specimens of *oculus* seen having the cell closed and long petiolate, while in *pseudoculus* it is always very clearly open.

Tabanus (Bellardia) piraticus n. sp. (Figs 7, 7a, 7b)

Lophotabanus fumomarginatus Kröber, 1929, Zool. Anz., LXXXIII, pp. 131-132, fig. 11. Dunn, 1934, Psyche, XLI, 3, p. 174. (nec. *T. fumomarginatus* Hine, 1920, Ohio Journ. Sci., XX, 8, pp. 315-316.).

Female.—Length 13-16.4 mm., of wing 12-15 mm.

Frons, antennæ and palpi as figured. Frons and face dull yellowish brown, beard sparse, brownish. Callus orange yellow. First two antennal segments yellow, black haired, the third nearly black. Palpi dull brownish yellow, black haired. Proboscis blackish, the labellæ fleshy, more than half total length of proboscis. Eyes bare, dark greenish black, unicolorous in life.

Mesonotum orange brown, sparsely brown haired. Pleura and coxæ somewhat more greyish. Prescutellum and disc of scutellum with a prominent large spot of black pilosity, completely encircled with pale golden hairs. Legs light brown, dark haired, the fore femora, tibiæ and tarsi darker; the tibiæ not bicolored. Wings quite smoky, either rather uniformly so, or with the veins broadly brown margined. First posterior cell broadly open and no vestige of an appendix on the third vein. Abdomen orange brown in ground color, clothed with dark and light brown hairs, the latter forming an exceedingly faint, broad mid-dorsal stripe or series of broad connected triangles, which are only visible in perfect specimens with light of proper incidence. Beneath, the abdomen is somewhat lighter with sparse light hairs.

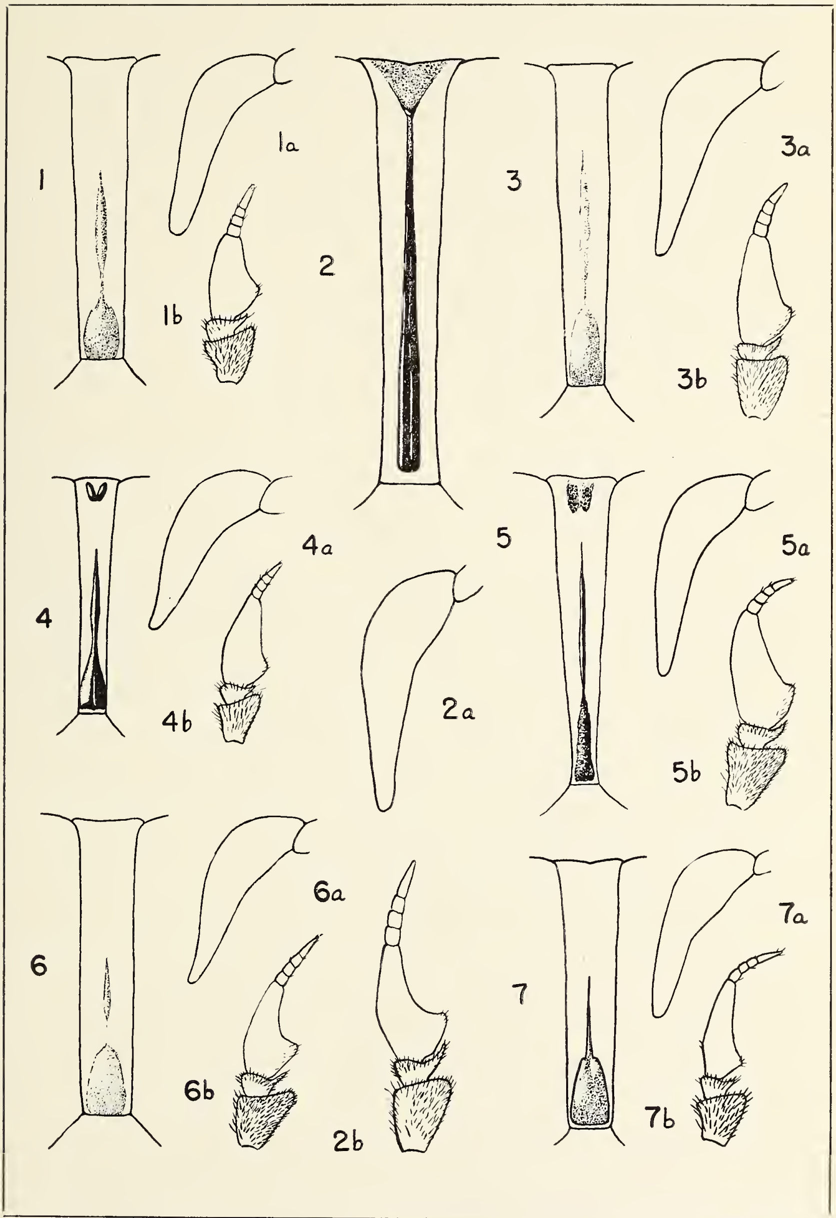
Holotype ♀, Old Cruces trail, Canal Zone Forest reserve, Nov. 19, 1939; Paratypes, 2 ♀, same data; 8 ♀, Cruces trail and C. Z. forest reserve, July 8, Oct. 11, Oct. 23, and Nov. 6, 1939; 3 ♀, Barro Colorado Is., C. Z. Nov. 10-13, 1939; 1 ♀, Barro Colorado Is., Oct. 20 (M. Bates, coll.); 1 ♀, Camp Pital, Chiriqui Prov., Panama, July 12, 1929 (L. H. Dunn coll., det. as *fumomarginatus* Hine); 7 ♀ Rio Pequeni, Panama, Aug. 21, 1940; 1 ♀ El Valle, Coclé Prov., July, 1939. Holotype and 3 paratypes to be deposited in the Museum of Comparative Zoology, Harvard University, other paratypes to be deposited in U. S. N. M. and author's collection.

I have compared the present species with a paratype of *fumomarginatus* Hine in the Hine collection, and believe it to be abundantly distinct. *Fumomarginatus* is larger, 18 mm., stouter, and with a broader frons and different antennæ. Specimens of the present species in the Hine collection are labelled *unipunctatus* Bigot, but in Hine's MS notes there is a statement that *unipunctatus* Bigot = *jilamensis* Hine. Specimens of *jilamensis* before me from Lancetilla, Tela, Honduras, (Figs. 6, 6a, 6b) agree perfectly with Hine's description, and are practically topotypes. They differ quite markedly from the present species in the shape of the frontal callus and antennæ, in the rather prominent mid-dorsal abdominal stripe, and in the green banded eye. On the other hand Kröber (1939, p. 133), stating that the type of *unipunctatus* is a poorly preserved specimen, uses the name for specimens from French Guiana, which appear to be different from *jilamensis* Hine, *fumomarginatus* Hine, and the present species. Kröber's *fumomarginatus*, from Costa Rica, is with little doubt the present species. In view of the reported condition of Bigot's type, it is still possible that Hine and Kröber were wrong, and that the present species is really *unipunctatus*, but since anything approaching certainty in the matter is at present impossible, it seems better to describe the present species as new. The specimen mentioned by Osten Sacken (1868, Biol. Centr.-Amer., Dipt., I, p. 56) from Bugaba, Panama, may well have been this species.

Explanation of Plate 1

Figs. 1, 1a, 1b. *T.(B.) pseudoculus* n. sp. Paratype.
Figs. 2, 2a, 2b. *T.(B.) de-filippii* Bell.
Figs. 3, 3a, 3b. *T.(B.) oculus* Walk.
Figs. 4, 4a, 4b. *T.(B.) albocirculus* Hine.
Figs. 5, 5a, 5b. *T.(B.) xipe* Kröber.
Figs. 6, 6a, 6b. *T.(B.) jilamensis* Hine.
Figs. 7, 7a, 7b. *T.(B.) piraticus* n. sp. Paratype.

Figures are of frons, palpus and antenna, and are all drawn to the same scale.



Fairchild — Tabanidæ of Panamá

SOME NEW SPECIES OF SYRPHIDÆ

BY FRANK M. HULL

University of Mississippi

This paper presents descriptions of some new species of syrphid flies chiefly from the neotropical regions. All types, except as otherwise stated, are in the author's collection.

Habromyia rectilinea n. sp.

Easily recognized by a pair of mesonotal vittæ, sutural fascia and post-sutural spots, all yellow pollinose; abdomen with three pairs of narrowly separated spots and linear fascia. Related to *magnifica* Bigot.

Female. Length 14 mm. Head: eyes bare, the front black, the side margins golden pollinose with yellowish pile. The pile along the greater part of the front is erect, short, and black with some yellow hair intermixed upon the upper third of the front. Pile of the vertex and immediately behind blackish, elsewhere the occipital pile is thick, bushy and golden. The face and cheeks are light, subtranslucent orange. The sides of the face are broadly obscured with pale, shining yellow pubescence over which is sparse, silky, yellow pile. Antennæ orange brown, the first joint black-rimmed apically, the pile of the first two joints black, the arista thick and yellow. *Thorax:* dull black with a prominent widely separated pair of yellow vittæ confluent with a transverse vittæ lying before the base of the scutellum. The median vittæ also confluent, though narrowly, with transverse sutural fascia. In addition, the humeri and a large longitudinal spot before the post calli are of the same yellow. Scutellum dull brownish, the rim shining with a transverse impression before it, the base blackish, the pile black except upon the margin. *Abdomen:* broad, with narrowly interrupted, basal, transverse bands of orange brown. First segment with a complete, though narrow, circle of red-brown, elsewhere black. Second segment with transverse, somewhat oblique, subbasal, orange spots narrowly separated in the middle. The fascia reaches the lateral margin and extends over it from the anterior corners almost to the posterior corners. Third segment with a less wide but complete transverse fascia indented medially, lying on the base of the margin and reaching the anterior corner. Fourth segment similarly marked as the third and its posterior margins as well diffusely orange. Fifth segment wholly orange brown, except for a small, triangular, basal black spot. Pile of abdomen short, appressed, black on the black area, erect golden on the orange areas, except on the apex of the abdomen where it is quite flat and appressed. *Legs:* pale orange, golden pilose, the hind femora brownish dorsally on all except the basal third; its dorsal pile near the apex and a ventral row of setæ, which reach from base to apex, black. *Wings:* with brown anterior border.

Four females, co-types, from Rio Songo, Ost Bolivia, 800 meters (Fassl). Co-types in the Vienna Museum and the author's collection.

Sphaerophoria guttulata n. sp.

Fourth segment with widely interrupted basal and apical fascia; the fifth marked with five spots. Related to *robusta* Cur.

Female. Length 5 mm. *Head:* face and cheeks and lower part of front, except a median vittæ, pale yellow. Vertex and a wedge-shaped vittæ to base of antennæ shining black. First two antennal joints pale yellow, with black pile; third light orange, narrowly blackish above. *Thorax:* mesonotum strongly shining brassy, with a pair of narrowly separated, obscurely brownish vittæ. Humeri, all of notopleuræ to suture, almost the whole of mesopleuræ, a large spot on upper half of sternopleuræ, the upper half of pteropleuræ, all of metapleuræ and the whole of the scutellum, except its very narrow corners, pale yellow. *Abdomen:* orange brown, marked with black; first segment black, sides and corners narrowly yellow; second segment black, within its middle a broad, transverse, orange fascia not reaching the sides. Third segment similar, the middle fascia still wide, occupying perhaps more than half of the segment and reaching the sides somewhat posteriorly on less than half of the width. Fourth segment light orange with a black triangle in each anterior corner and an oval laterally pointed, widely separated, black fascia-like spot on the posterior margin. Fifth segment with a large, oval, basal, median spot and a pair of subapical submarginal, small, transverse spots, black. *Legs:* entirely pale yellow, the posterior tarsi a little darker. *Wings:* hyaline, stigma pale yellow.

Holotype: one female, Black Foot, Idaho, June 17, 1933 (Louise Ireland). In the collection of author, received through the kindness of Dr. James.

Volucella spectralis n. sp.

Related *tricincta* Bigot through the flattened scutellum, but very different. The apical third of the wing is brown, most of the costal cell and the basal part of stigmal cell yellow.

Female. Length 5 mm. Head: dark brown, the vertex considerably protuberant with black pile at the top, a raised protuberance in the middle of the lower part of the front with a flattened area on either side. The face is flattened on either side of the rounded tubercle, with a small white pubescent rounded spot on each eye margin and a larger one just beneath the antennæ. The cheeks are brown; a yellowish-brown stripe in front. The antennæ are rather short, light brown, the third joint somewhat pointed on the apical half, the pale arista with seventeen rays. *Thorax:* mesonotum brassy black, the humeri and post calli and the pleuræ brown. Mesonotal pile black in the middle, pale elsewhere, with a row of seven long prescutellar black bristles besides other black ones on margins and pleura. Scutellum translucent, brownish-yellow, quite large and inflated, flattened on either side and this flattened area microrugose, margined with three pairs of slender, black bristles; the dorsum has both pale and black pile. *Abdomen:* shining, mahogany-brown, the first segment and two large, narrowly separated spots on the base of the second segment are yellowish. The median vittæ of the second segment continues to bisect the first segment. *Legs:* femora and tibiæ dark mahogany-reddish brown and black pilose. The tarsi light brownish yellow with black pile *Wings:* apical third brown, base of the sigmal cell yellow, the costal and first basal cell lighter yellow; anterior cross vein narrowly infuscated, a light cloud of brown on lower part of origin of the third vein.

Holotype: One female. Brazil, without further data.

Volucella clara n. sp.

Similar to *pallens* Wied., the pattern of abdominal spots is different, the face is shorter; the arista with thirteen rays.

Female. Length 6 mm. *Head:* ocellar triangle is dark brown to black; the vertex and front and face and cheeks light, brownish-yellow; the pile is wholly light shining yellow. Facial tubercle is quite low and broadly rounded, densely pilose but the face is almost bare above the tubercle and below the antennæ except for some pale pubescence. The antennæ are orange, the arista pale yellow at base, the rays and the apical portion blackish; with eleven longer rays and three shorter basal ones. *Thorax:* translucent reddish-brown; originally appears to have been light, shining clay-yellow with several shining light reddish-brown vittæ; pile copious, subappressed and long and wholly pale golden; all scutellar and thoraic bristles are light golden. No differentiated bristles before the scutellum; scutellum with three pairs. The lower part of the mesopleura and pteropleuræ and all but the upper ends of the sternopleuræ and metapleura are shining black; metanotum black. *Abdomen:* short, broad, almost round, considerable wider than the thorax and somewhat discolored. The first segment is light translucent brown; the second of the same color but with a conspicuous, black, posterior, marginal fascia from side to side and narrowly connected in the midline with a narrow median vitta of black. The median vittæ narrowly reaches the basal margin of the segment. The pile of the second segment is black on the black areas and light yellow elsewhere. The third segment and the fourth, while discolored, appear to be almost wholly light reddish, shining brown with, on the outer posterior marginal fourth on either side, black fascia that reach the lateral margin and are somewhat larger upon the third segment. The pile on the black area of the third segment is black but over the entire remainder of the third segment and all of the fourth segment is dense and erect and light yellowish-brown. *Legs:* light, brownish-yellow, pale pilose, except for a distal blackish-brown spot upon the anterior and posterior tibiæ and the blackish terminal joints of the tarsi.

Holotype: one female, Sao Paulo, Y. Piranga, Lange de Moretes, (Brazil). April 8, 1936.

Volucella parana n. sp.

Related to *dimorphia* Cur.; legs dark brown, their bases paler; femoral pile, including apex, black. Marginal and apical scutellar pile black.

Male. Length 6 mm. *Head:* eyes, densely, quite long, dark brown pilose. The vertex is black with long, black pile. Front and face pale yellow, with long, similarly colored pile. The cheeks are shining brown. The antennæ are elongate, light brown, the third joint slightly concave in the middle; arista with thirteen rays. *Thorax:* mesonotum shining, almost black and pale pilose anteriorly and narrowly before the scutellum, but broadly black pilose elsewhere and over the pleuræ and notopleuræ. The scutellum is light, brownish-yellow, translucent and rather large, and inflated and covered on the posterior half with dense, long, black pile. The basal scutellar pile is pale yellow, the marginal bristles black, the ventral fringe black. *Abdomen:* quite translucent, dark brown; middle of the first segment broad, large, the middle basal areas on the second segment and a diagonal, rather small, elongate and irregular spot on the sides of the third segment translucent and pale yellow. The pile of the abdomen is chiefly pale basally in the middle but with black pile all along the lateral and posterior margins of the second segment and broadly over most of the third segment. Most of the pile of the fourth segment is long, quite sparse and pale. *Legs:* dark brown and subtranslucent, the bases of the femora diffusely lighter brown and that of the hind femora diffusely yellowish All of the tibiæ dark brown and together with the femora, black pilose. There are just a few pale hairs on the base of the hind femora. First three joints of fore and middle tarsi whitish, of hind tarsi yellow, all with pale pile; the remaining joints are pale brown with dark pile. *Wings:* apical third of wings brown, paler over the posterior margin and in the end of the bulbous and closed submarginal cell. There is a prominent dark brown spot at the end of the subcostal vein, rather broad and continued basalward over the submarginal cell to the origin of this cell and is continued posteriorly over the first basal cell to fill out all of its apical end and to margin the other side of the anterior cross vein.

Holotype: One male, Parana, Brazil. April 20, 1917.

NOTES ON NEARCTIC TABANINÆ. PART III. THE *TABANUS LINEOLA* COMPLEX[1]

By Cornelius B. Philip

Hamilton, Montana.

Among the taxonomic problems needing review, anticipatory to preparation of a catalog of Nearctic species of Tabanidæ, is the recurrent question of variation in the common *Tabanus lineola* Fabr. Relatives of this species with pale abdominal stripes, lately have been referred to *Neotabanus* Lutz (not Ricardo) (synonym, *Tæniotabanus* Kröber), although the group has not been considered of generic rank by Kröber (1934), Stone (1938) or Bequaert (1940b). Osten Sacken early pointed out, and Bequaert (1940a) reiterated "the *Tabanus* with trivittate abdomens . . . are among the most difficult insects to deal with."

Hine (1906) attempted analysis of North American species "with a uniform middorsal stripe . . ." Tinctorially, also included were such species as *acutus* Bigot and the *nigro-vittatus* relatives with unibanded, unextended eyes. There is little structurally to define *Neotabanus,* and *nigrovittatus* was also keyed with *lineola* in this category by Bequaert (1940b). The name might have more taxonomic utility if restricted to the close *lineola* relatives having the characteristic, multiple eye-banding, and extended outer angles of the eyes (most noticeable in the females) in addition to the abdominal stripes. Such species as *T. productus* Hine and *T. texanus* Hine form troublesome intergrades. The former has the characteristic eye-banding, laterally produced head, and a somewhat *dorsiger*-like abdominal pattern which belie the *Stenotabanus*-like antennæ and wing spurs; *texanus* has a single, narrow purple eye band like *nigrovittatus.* Some *T. sagax* O. S. and rubbed

[1]The studies on which this paper is based were completed at the Museum of Camparative Zoology, Harvard University, during tenure of a Fellowship from the John Simon Guggenheim Foundation.

specimens of a few other species also complicate reliance on the abdominal stripes, so that maintenance of *Neotabanus* even as a subgenus appears to be only a matter of arbitrary taxonomic convenience as discussed elsewhere (Philip, 1941). Those undertaking assignment of *Neotabanus,* furthermore, will be faced with clarification of the puzzling description of the head of *trilineatus* Latr., the genotype species.

The Neotropical fauna of this group shows more variation than the Nearctic, as reflected in the numerous specific names proposed by various students particularly in Europe. Only a few of these names are recognizable at present. Bequaert (1940b) has provided useful copies of some of these scattered descriptions, while Kröber reports personal study of many of the European types. Until all the pertinent types can further be studied by a competent student, particularly those of Bellardi, any review such as the present will have to rest on tentative opinions, interpretations, and comparison of available materials, using both sexes wherever possible.

The Nearctic *T. lineola* of authors is a variable complex, and material at hand appears to provide at least 5 forms and possibly more if sexes could be correctly associated. Were it not for evidence of differing males, these forms in part would justify Bequaert's opinion that neither the color of the femora and scutellum, nor the "appendix to the fork of the third vein offer reliable specific characters." An enumeration of these variants will show the necessity for some qualification of this opinion, however. The shapes of palpi and colors of areas of enlarged facets in identical series of males are too variable unfortunately, to be of much supplemental, diagnostic aid.

Independently, Fairchild (unpublished) has come to conclusions regarding significant, diagnostic characters in the group very close to those of the author. Since a consideration of specific trends in both the Nearctic and Neotropical faunæ is necessary for a rational treatment of either, it is a pleasure to acknowledge personal collaboration with Fairchild in arriving at an agreement on the systematic arrangement in best accord with present, available information. An unfortunate paucity of information regarding the intermediate Mexican fauna hinders complete clarification of overlapping.

Until the question of specific and subspecific or varietal status of certain forms and groups can be more definitely established, and the doubt removed regarding the application of certain names, there is little to be gained in questioning whether *occidentalis* L. should replace *lineola* Fabr. as here recognized or to what form this early name should apply.

Tabanus lineola Fabr. *s. str.* The original description is inadequate in certain crucial characters, and unfortunately, the probable type is represented at the Kiel Museum by only the thorax, wings, and first 2 abdominal segments. From among a series of forwarded specimens, Dr. O. Schröder selected one with a reddish margined scutellum as closest to what remains of the type. The legs were originally described as "pedes nigri tibiis ferrugineis", indicating black femora. If the type really had a red scutellum originally, this would best fit *schwardti* below, and Maquart's (1838) reference to hairy eyes in the male suggests presence of this form among early material. But since Fabricius described the prescutal lobes as "ferrugineo" without mentioning the scutellum, the brown now present may be due to a translucency sometimes seen in worn, and pest-destroyed specimens where only the integument remains. In the absence of certainty, it seems best for the present not to change the figured conception of Stone and Bequaert, though the discussions of both were more inclusive than their figures indicate.

What I take to be the males of this form from Michigan and Arkansas (reared by Schwardt) have the areas of enlarged facets in the upper ⅔, pale buff grey, hairs very short and sparce ("ostensibly bare" for key purposes), the thorax and scutellum subshiny cinereous, the vestiture sparce, all 3 pairs of femora infuscated to the knees, the pale middorsal stripes narrow, the sublateral yellow ones, reduced and broken, the intervals extensive brown, not black, and giving a suggestion of the suffused, less contrasting pattern seen in *scutellaris* described below. The abdominal stripes of males from the Gulf Coast are more contrasting and regular.

The female has a convergent, narrow front, its height about 6 to 7 times its basal width (in the key the frontal index has been expanded to 1:5 to include the questioned group discussed later). The scutellum, fore and much of the hind femora are blackish or cinereous, the mid-pair are variable. The abdomen is usually reddish laterally, especially in worn specimens, but in a considerable series from Michigan, Ontario and New York, a melanistic variation occurs which resembles the Neotropical *plangens* Walk. (? *modestus* Wied.) except that the wings of the latter are distinctly fumose especially along the veins, the dorsum of the thorax has a more metallic sheen due to irridescent hairs, and the hairs on the entire fore femora are deep black.

Stone informs me specimens of this form in the National Museum are from Mich., Ohio, Me., Conn., N. Y., Pa., Del., D. C., Md., Va., and N. C. I have seen it also from Ont., Mass., Ga., Fla., Tenn., and La.; a single but undoubted specimen bears an early label of Douglas Co., Kans., which may be a mislabel in the absence of any others in a large amount of recent material from that state. It appears to be most abundant along the Atlantic Coast. I also have seen a typical female in Bequaert's collection from Cuba. Since *T. bellardii* Szil. from Cuba is described with "front three and a half times as broad as its lower breadth" and "brown antealar swelling and scutellum", Bequaert (1940b) must be mistaken in this synonomy. The description of *T. cubanus* Szil. is inadequate for judgment but the "furca with a sharp appendix" and comparison with *trilineatus* suggest a Neotropical relationship. In all the Nearctic specimens of the various forms I have seen a short spur on one wing of only one specimen. The "carneis" scutellum and posterior legs preclude the synonomy of *T. carneus* Bell. On the other hand, the front of the type of *T. commixtus* Walk. from Mexico in the British Museum is said by Oldroyd to agree exactly with Stone's figures of *lineola* and, since the femora are blackish, the only difference in the description is the yellow rather than white middorsal stripe. The actual occurrence of the typical form in modern Mexico remains to be verified, however.

T. lineola subsp. *scutellaris* Wlk. Possibly the most familiar to North American students is this form with reddish scutellum and femora, frontal index (♀) 1: 3½-4½, eyes of the male with very fine, scattered hairs (also "ostensibly bare"), the slightly enlarged facets confined to the upper half and not flattened on the disc, and the male abdomen with a brownish suffusion, the stripes somewhat obscured. This is the male described by Osten Sacken (1876) and both sexes by Hine (1903) ; it also is the form reared by the author (1931) in Minnesota and later in Montana, as well as probable by Hart (1896). The sublateral reddish or yellow, abdominal lines are usually irregular, composed of a series of trapezoidal or rhomboidal, connecting spots. In a series of pallid California specimens of both sexes, these lines are often obliterated, the lateral yellow being continuous onto the venter. In occasional Northern specimens irregular cinereous spurs or shadows may show basally on the femora while in others even the fore coxæ are yellowish. The inner faces of the fore femora are customarily shining brown with black pile, but the outer surface is pale pollinose and pilose.

Though the characters of *scutellaris* would suggest specific distinction from typical *lineola* and even its close Nearctic variants, intergradation of *stenocephalus* and certain other Neotropical forms prevent more than subspecific separation at present, as will be discussed by Fairchild in a future communication.

The type of *scutellaris* is now not present in either the British or Hope Museums with other Saunders types. The described reddish scutellum and "tawny" legs are in agreement with this form which Stone (1938) recognized as a variety of *lineola.* The type data "Bolton, North America" probably refer to a person in part, not a locality according to Oldroyd as some other Saunders specimens carry the label "D. Bolton".

It occurs entirely across the continent in southern Canada and the northern states, the southern records including D. C., W. Va., Ohio, Ill., Iowa, Kan., Colo., Utah, Nev., and Calif. as far south as Los Angeles. I have seen a female each from Utah and Montana with femora somewhat infuscated approaching the following.

T. vittiger subsp. **schwardti** nov.

The writer originally intended to retain this provisionally under *lineola,* but Fairchild has indicated the evident relationship of this and *nippontucki* below with Neotropical variants of which *vittiger* Thomsen appears to be the prior name, although no males yet are available from the Galapagos Islands.

This is the form chiefly reared by Schwardt (1931), and at once distinguished from *scutellaris* males by the large head with much enlarged upper eye facets occupying fully three quarters of the total eye area, and with more pronounced hairs. Furthermore, the palpi are often less blunt and abdominal pattern more contrasting like the females; the fore femora and to a less extent the hind and mid pairs are infuscated. Except for such infuscation of the femora, the females closely resemble those of *scutellaris.* For this reason, the male which is the most distinctive sex is used as type.

Holotype ♂, 12.5 mm. Area of enlarged facets chocolate brown (yellow in some paratypes), flattened across disc, hairs distinct, and more dense than in typical *lineola,* vertical tubercle small, even with upper eye level, brownish pilose. Face white, palpi creamy with white and occasional black hairs, blunt apically (pointed in many paratypes). Antenna red, annuli black, first segment not unusually swollen, plate obtuse angulate and very moderately excavated. Thorax quite hirsute, including some pale purplish, appressed hairs dorsally and the usual, rather indistinct lines; posterior half of the scutellum reddish. Wings hyaline, no stump. Fore femora, basal two thirds of hind, one fourth of mid-femora, and distal half of fore tibiæ and tarsi cinerous to blackish. Abdominal stripes distinct and contrasting, the median even and white, the sub-lateral irregular and yellow, the 4 intervals dark brown rather than black. Venter yellowish with dusky spots in the middle of the first 2 sternites and edges of all; black hairs only on last two.

Allotype ♀, 13 mm. In essential agreement with the holotype except for the usual sexual characters. Eyes extended laterally and the characteristic eye pattern (relaxed) usual for the group, front subparallel in upper third, convergent below, index 1: 4.8, the basal callosity very deep brown, quadrangular, a little taller than wide, the median callus small and hardly connected. The antennal plate narrower and browner distally, the thoracic lines a little more distinct, the dark abdominal lines blacker posteriorly than in the holotype.

Knoxville, Tenn., Sept. 20 (♂) and 25 (♀), 1934. In light trap. In the collection of the author through kindness of W. W. Stanley.

Paratypes.—16 ♂, 16 ♀, Fayetteville and Washington Co., Ark., (reared), H. H. Schwardt; ♀, Drew Co., Ark., Aug. 20, 1928, "W. R. H."; ♀, Ark. Co., Ark., July 18, 1928, D. Isley; 2 ♀, Wash. Co., Ark., May 31 and June 10, 1929, D. Isely; ♀, Hunt, Ariz., Aug. 28, 1919; ♀, New Boston, Tex., May 15, 1906, C. R. Jones; ♀, College Station, Texas, Oct. 19, 1919, H. J. Reinhard; 2 ♀, Brownsville, Texas, June and July, F. H. Snow; ♂, 3 ♀, State College, Miss., Apr. 12, May 7, 11, and 17, 1939, Smith, Jackson, Macon, and Shivers; ♀, Everglades Exp. Sta., Fla., July 10, 1938, W. C. Stehr; ♀, Atlanta, Ga., June 17, 1935, P. W. Fattig; 2 ♂, Falls Church and Great Falls, Va., June 8 and 30, 1917, C. T. Greene; ♀, Wash., D. C., June 25, 1913, R. C. Shannon; ♀, Beltsville, Md., Sept. 3, 1916, W. L. McAtee; ♂, Plummers Is., Md., Mar. 9, 1905, at light, H. S. Barber; ♂, ♀, Newark and Dana Landing, Del., July 5, 1938 and June 13, 1935, Donald MacCreary; ♀, Melrose Highlands, Mass., July 8, 1908, D. H. Clemons; 2 ♂, Wooster, and Marietta, Ohio, July 23 and Aug. 4, 1938, C. H. Martin; 2 ♂, 5 ♀, Montgomery Co., Kan. 798′, 1916, R. H. Beamer; 4 ♂, 3 ♀, Kiowa Co., Kans., July 1-5, 1923, R. H. Beamer and C. L. Woodruff. In the collections of the U. S. Nat'l. Mus., Calif. Acad. of Sciences, Mus. Comp. Zool., Ohio State Museum, Universities of Arkansas, Mich., and Kan., L. L. Peckuman, G. B. Fairchild, H. H. Schwardt, T. H. G. Aitken and the author.

In reared or fresh specimens, the vestiture of the scutellum sometimes obscures the reddish margin, but seldom completely.

Since Schwardt (1931, 1936 and fig. of egg mass) observed 2 generations in Arkansas, it may well be that there are biological differences in different species of the *lineola* group. *Scutellaris* and *lineola* s. str. are the only other Nearctic forms which have been reared; the data are too few for comparison, although the adults have a similar long seasonal occurrence in Calif. in contradistinction to the following form (*nippontucki*) in that area. Pupal differences have not been discernable.

T. vittiger subsp. **nippontucki** subsp. nov.[2]

As indicated above, this is a southwestern variant which, in both sexes, resembles *schwardti* but is much more pallid and frosty appearing, the femora not usually infuscated basally, and the thoracic lines more obscure.

Holotype, ♂, 12.5 mm. Head large, eyes brown, upper area of enlarged facets extensive occupying ¾ the total area, distinctly hairy, vertical tubercle narrow and reduced. Frontal triangle yellow pollinose extending onto the cheeks along the eye margins. Remainder of face and cheeks whitish pollinose and pilose. Palpi pale creamy, whitish pilose, the apical segments plump and with a decurved nipple. Antennæ red, scapes not enlarged. Thorax frosty pollinose and pilose, a little darker above with only suggestions of 2 sublateral dorsal lines; prescutal lobes and apical half of scutellum pale reddish. Wings hyaline, venation normal; halteres pale yellow darker on the stem. Front legs with inner faces of femora, apical half of fore tibiæ, and all tarsi dark brown, remainder of legs pale yellowish, the hind tibial fringe predominantly whitish on the basal ⅔. Abdomen pale yellowish above and below the dark mesal pair of lines faded brown, the sublateral ones obsolescent, with few black hairs in evidence. The mid-stripe broad, and widened on each hind border. The sublateral pale lines indistinctly step-like and irregular.

Westmoreland, Calif., July 20, 1933, M. Cazier. In the U. S. Nat'l. Museum No. 56087.

Allotype, ♀ 12 mm. Head and its appendage shapes and eye pattern of the usual *lineola* type, frontal index 1:4.5, convergent below but parallel in the upper third. Callosity brown, narrowly separated from the eye margins, the median callosity short and narrowly joined to the basal. Subcallus yellow pollinose, face and cheeks whitish pilose and

[2]The unorthodox name was applied in manuscript on Dec. 8, 1941 (the day after "Pearl Harbor"), and is of barbaric derivation to commemorate recent events associated with "Nippon", and a style of sneak air attack used even by horseflies.

pollinose. Antennæ red, scapes normal. Palpi pale yellow, attenuated, covered with pale hairs, and a few black ones on the apical segment. Thorax pale yellowish pilose and pollinose above with 3 indistinct dark lines posteriorly, scutellum broadly pale reddish behind; pleuræ, chest and coxæ whitish pilose and pollinose. Wings hyaline, venation normal. Halteres pale yellow. Legs pale reddish, fore pair brown on the inner faces of the femora and blackish beyond the middle of the tibiæ, the hind-tibial fringe predominantly white on the basal two thirds. Abdomen very pale, inconspicuously gray and reddish lined above, the pale middorsal line widened on each incisure, the sublateral gray lines irregular in a *schwardti*-like arrangement. Venter pale reddish, with an indistinct, darker, mid-ventral band in certain lights; black hairs only on terminal sternite.

Westmoreland, Calif., 5-20-31, R. M. and G. E. Bohart. In the collection of the author through courtesy of Dr. T. H. G. Aitken.

Paratypes—3 ♂, Westmoreland, Calif., July 20, 1933, M. Cazier; ♂, same data as allotype but May 15; 2 ♂, Coachella, Calif., May 13, 1917, E. P. Van Duzee; ♂, ♀, Brawley, Imperial Co., Calif., Aug. 9, 1914, J. C. Bradley; ♀, same data but Aug. 10; 3 ♂, same place May, 1911, June 1 and 6, 1912, J. C. Bridwell; ♂, El Centro, Calif., June 25, 1917 (Bishopp No. 7392); ♂, El. Centro, Calif., April; 4 ♂, ♀, Sommerton, Ariz., June 2, 1938, C. C. Deonier (Bishopp No. 27,815); ♂, Yuma, Ariz., April, 1937, R. M. and G. E. Bohart; ♂, Ehrenberg, Ariz., Aug. 25, 1938, F. H. Parker. In the collections of the U. S. Nat'l Museum, Museum of Comp. Zoology, T. H. G. Aitken, G. B. Fairchild, J. C. Bequaert, and the author. Part of these males were assigned to *T. truquii* Bell. by Stone (1938).

There is some variation in size, and palpal shapes, while the upper eye facets in some males are contrasting yellow rather than brown. Four males from New Mexico and Texas appear to belong here because of the bleached body pattern, but approach *schwardti* in having darker shadows on the bases of the hind femora.

In south central California, where this intermingles with *scutellaris*, the latter also is somewhat pallid, and the females are very close, but separated as given in the key. The writer hesitated to describe this variant because of its likely extension into Mexico and the possible application of an earlier name. Lack of adequate Mexican material gives no assurance that this is not the case, but the form is distinct from any Neotropical material studied by me or by Fairchild.

Discovery of the correct male of *vittiger* is needed to justify assignment of *nippontucki* as a subspecies. The fronts of the females and femoral colors are in agreement, but the wider, all reddish antennæ, whitish hind tibial fringe, and different abdominal pattern with wide middorsal stripe (widened on the incisures somewhat as in *maya* Beq. and some other Neotropical species) may set this apart as more complete information is forthcoming. These remarks apply equally to differentiation from *guatemalanus* Hine which Fairchild also associates with *vittiger.*

T. amplifrons Kröber. The female from Brownsville, Texas, assigned to *T. truquii* Bell. by Stone (1938) has the parallel-sided front, small yellowish callosity, dark scutellum, reddish femora, and other characters of Kröber's species, as well as of Hine's (1906) Guatemala *truquii,* and certain other Neotropical specimens recognized by Fairchild. The associated males from Brownsville, Uvalde, and Galveston have hairy eyes with fairly uniform facets, but they show the peculiar contrast to the females of dark femora and somewhat enlarged scapes of Bequaert's (1940b) *T. trilineatus* and Hine's *T. truquii.* These sex differences are not in accord with other species of the *lineola* complex.

I have also seen a confusing series of males from Galveston which differ only in having uniformly reddish legs and small antennal scapes. Whether these belong here or are a different variant is uncertain at present.

There appears also a good possibility that an earlier name from among the now unplaced Neotropical ones eventually may be found to apply.

Separation of *amplifrons, scutellaris, schwardti,* and *nippontucki* still leaves a somewhat heterogeneous group of flies in *lineola s. lat.* which are susceptible of only unsatisfactory analysis in the absence (1) of unquestioned association of males with divergent females, (2) of the real identity in the restricted sense of Bellardi's[3] and other pertinent types, and (3) of definite information of what extension from the Neotropical fauna has taken place through Mexico. In other words, while additional variants in the southern United Staates are still evident, any further restriction of Nearctic "lineola" at the present time involves the danger of confusing, rather than clarifying the complex, except to point out such elements for reference for the future reviewer when adequate information is available. Among such observed elements divergent from *lineola s. str.* may be mentioned the following.

Tabanus truquii Bell. has been variously applied to hairy-eyed variants found in Texas and the Southwest. The males were considered by Stone (1938) and Bequaert (1940b) to have areas of greatly enlarged facets, and Bellardi describes eyes of both *truquii* and *carneus* as "superne minute, inferne minutissime *reticulatis*", hairy in the former with dark scutellum and femora, but bare in *carneus* with flesh colored scutellum and posterior legs (his statement "tibiarum basi nigris" is not clear). *Schwardti* appears closest to *truquii* except for the red scutellum and its unknown occurrence in Mexico. On the other hand, since the relative differentiation of large and small facets in Bellardi's description is still speculative, *truquii* might also apply to *amplifrons* which must extend through Mexico. The question of application of this name to any Nearctic form will have to await further clarification of the Neotropical species, but it cannot apply to an immediate variant of *lineola* s. str. as also recognized by others.

Less divergent is the large, yellowish, evenly lined variant seen from Miss., La., and Tex., labelled and figured by Hine (1906, 1907) as *T. quinquevittatus* Wied. The name cannot apply as discussed later. The hairs and pollinosity of the venters and middorsal stripes are much more intensely yellow than in any other form. The fronts of the females are relatively wide, the eye facets of the males are markedly differentiated but the hairs reduced; the scutellums and femora are dark. While the wide fronts undoubtedly support tinctorial separation from typical *lineola,* the uncertain

[3]No response regarding Bellardi's types was elicted from the Turin Museum on repeated requests in prewar correspondence.

position of a certain intermediate specimens and possible application of some Neotropical name make it inadvisable to provide a name for this as yet, although its distinctness tinctorially is as marked as certain species now differentiated from *nigrovittatus* for example.

Questionably associated with the typical form is a considerable series of flies from Florida and neighboring states, the females of which have slightly wider fronts (about 1:5) and almost square through small callosities. The sides of the abdomen are often broadly reddish, the lateral dark stripes missing or obsolescent. The males of this and the typical form differ only in the regularity and width of the abdominal stripes, particularly the sublateral ones, duller pollinose thoracic dorsums, and possibly greater extent of the enlarged facets.

A portion of the complex thus still remains in unsatisfactory condition with no immediate hope of clarification, but it is confidently believed the recognition and separation of the preceding species and subspecies will at least narrow the problem. A key is here offered, not only to separate these recognized forms, but to call attention to other problematic variants for at least a part of which names may already be available when the Neotropical relatives have been adequately reviewed.

1. Males 2
   Females 8

2. Scutellum and thorax concolorous, dark 3
   Scutellum reddish on the posterior margin 6

3. Upper eye facets markedly enlarged, glabrous or imperceptibly hairy 4
   Upper eye facets but little enlarged, normally plainly hairy (Texas) 5

4. Middorsal abdominal stripe chalky white .... *lineola* Fabr.
   Middorsal and sublateral stripes yellow..*lineola* subsp.?

5. Femora infuscated; scape somewhat enlarged .... *amplifrons* Kröb

Legs concolorous, reddish; scape normal .... sp.?

6. Upper eye facets little differentiated, bare under a hand lens; legs predominantly reddish .... *lineola* subsp. *scutellaris* Wlk.

Upper eye facets much enlarged, plainly hairy; legs variable 7

7. Femora of at least fore and hing legs predominantly infuscated; body colors contrasting .... *vittiger* subsp. *schwardti* nov

Legs, at least 2 hind pairs, concolorous pallid, and faded; southwestern flies .... *vittiger* subsp. *nippontucki* nov.

8. Scutellum and thorax concolorous, dark 9

Scutellum reddish on posterior margin; sublateral abdominal stripes markedly irregular 11

9. Front narrow, height 5 to 7 times its basal width .... *lineola* Fabr

Front broader, seldom more than 1: 4.5 10

10. Frontal margins parallel, index about 1:4; sublateral stripes irregular .... *amplifrons* Kröb.

Front convergent below, index 1: 3.5 to 4.5; sublateral stripes mostly even and regular, or lateral dark lines missing .... sp. or subsp.?

11. Legs predominantly reddish 12

Femora of at least fore and hind pair infuscated or cinereous .... *vittiger* subsp. *schwardti* nov.

12. Body markings contrasting; outer hind-tibial fringe mostly black; front usually evenly convergent from vertex .... *lineola* subsp. *scutellaris* Wlk.

Body color faded in appearance, the middorsal stripe not especially paler than the sublateral ones; hind-tibial fringe mostly white; frontal margins rather bowed in the middle .... *vittiger* subsp. *nippontucki* nov.

T. *quinquevittatus* Wied. Discussion of this species is here appended since it has been considered as one of the *lineola* group although the writer disagrees with this assignment in the restricted sense. The type female now in the Vienna Museum, together with the type male and "?" female of *costalis* Wied. were loaned to me through courtesy of Dr. Max. Beier. All were greased and the venter of the male completely obscured by an extraneous coating, but the natural condition was nicely restored by a cleaning in acetate. The "? *costalis*" female is *lineola*-like with clear wings and the entire antennæ and hind femora reddish, the front narrow as in the typical form, but not being a type cannot have nomenclatorial influence, in spite of 2 such labels in different hands on the specimen. Doubtless the "Savannah" ♂ referred to by Osten Sacken (1878, p. 228) as *quinquevittatus* was confused with the *costalis* type.

After cleaning of the two types, it is obvious they are conspecific with *vicarius* Walk. (1848, as considered by Stone (1938). This would place *quinquevittatus* as the prior name for this common species, if the "type" is Wiedemann's original specimen. In all points including size, the original Latin description agrees with this better than with a small *lineola*-like specimen to which complex Hine and Stone questionably referred the name. Omitted reference to a yellow costal cell cannot, however, be inferred by his comparison of the wing with "*T. dorsigero*" which supposedly has entirely hyaline wings. It is doubtful if even so careful a student as Wiedemann could have been expected to associate the sexes of his specimens seven years apart in their original condition.

The chief doubt on the authenticity of this specimen, however, is the locality which is written on 2 of the 3 labels as "Savannah" with no mention of the published reference "Mexico". Dr. Beier assures me that the original labels and specimen have remained associated, and that "Savannah" is the locality entered in the Museum "genannte Buch", so that one is led to question if Wiedemann may not have thought he was publishing the country in which Savannah was located at this early date. The geography of North America over a century ago, and especially the extent of Mexico, was quite different than it is today. In consequence of, rather than in spite of, Osten Sacken's remarks (pp. xv and 229) on the Wiedemann types, I am inclined to agree that this must be the original specimen. There is some satisfaction in returning the species to the excellent dipterist by whom it was first recognized, and thus obviating use of another of the inadequately described Walkerian names which Osten Sacken considered so distasteful.

The synonomy therefore includes *costalis* Wied. (not Lichtenstein), *vicarius* Walk. (partim), *baltimorensis* Macq., and *floridanus* Szil.

Structurally indistinguishable from the species are *nigrovittatus* Macq., *fuscicostatus* Hine, and *mularis* Stone, so that differentiation depends on tinctorial characters—chiefly the intensity of yellowing of the callosity, palpi, face, pleuræ and costal cells, and differences in the abdominal pattern. Variations in these characters make some specimens difficult to assign, and the situation is somewhat analogous to the *lineola* complex without the structural differences in the males for support of separation. Variation in distribution of black and faint to more prominent sublateral red on the abdomen of certain specimens suggests that *mularis* may be a melanistic phase of *quinquevittatus*.

SUMMARY

The *Tabanus lineola* complex in Nearctic America is discussed, and the following forms recognized: *lineola* Fabr. *s. str.* and subsp. *scutellaris* Wlk., *T. vittiger* subspp. *schwardti* nov. and *nippontucki* nov., and *T. amplifrons* Kröb. For an adequate conception of these, associated males were essential. *T. quinquevittatus* Wied. is considered the prior name for *T. costalis* Wied. (not Licht.) and *T. vicarius* Wlk., thus removing it from the *lineola* complex.

My special thanks are due Drs. G. B. Fairchild and Alan Stone for helpful suggestions and loan of pertinent material, and to Drs. J. H. Beamer, T. H. G. Aitken, Walter Stanley, Ada L. Oleson, and many others for additional specimens.

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CORRECTION

In Psyche, vol. 48, p. 124, line 25, "motor fibers" should read **"motor association fibers."**

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AN ANNECTENT GENUS OF CIMICOIDEA FROM BALTIC AMBER (HEMIPTERA)

By Robert L. Usinger

University of California, Davis, California

Among the Hemiptera in the Haren collection of Baltic amber insects submitted to me for study by Dr. F. M. Carpenter were five anomalous specimens of the superfamily Cimicoidea. Although bearing a superficial resemblance to certain Miridæ in body form and general facies, closer study disclosed several aberrant characters which suggest relationship with the Microphysid-Anthocorid complex. Actually these specimens do not fit any family as recognized at the present time and hence must assume a place among the annectent Cimicoidea made famous in recent years by Bergroth (1924, 1925), McAtee and Malloch (1924, 1926), and China and Myers (1929). Fortunately, some of these specimens are so beautifully preserved that structural details are more readily observed than would be the case with pinned specimens. The points still to be desired would be an unobstructed dorsal and ventral view, a clear view of the veins of the hind wings and a cleared dissection of the male genitalia. All other features show up as clearly as though the specimens had been mounted in Canada balsam.

Electrocoris new genus

Elongate-oval and moderately robust in body form, suggesting a Bryocorine Mirid at first glance. Head scarcely to moderately deflexed, the upper surface evenly arcuate from base of vertex to apex of clypeus and the gula well developed, as long or longer than buccal opening. Eyes broadly contiguous with pronotum. Ocelli distinct, located laterally on vertex well back near posterior corners of eyes. Antennæ inserted laterally immediately in front of eyes, relatively short and stout, the first segment shortest, third twice as long as first, second three times as long as first, and the last segment longest, one-fifth longer than second, the last two segments nearly as thick as basal

FIG. 1. *Electrocoris brunneus* Usinger. Allotype, no. 4540, Mus. Comp. Zool.

segments. Rostrum curving downward and backward but not appressed to under surface of head and thorax and not fitting into a rostral groove; slender and reaching between middle and hind coxæ; first segment shortest, membranous, and concealed in all but one specimen where the beak is completely exserted; second segment half as long as third, the third and fourth segments subequal.

Pronotum about one-third longer than head on median line, moderately declivous, the disk distinctly punctate, its sides depressed and lateral margins roundly carinate and feebly sinuate. Posterior margin straight. Scutellum two-thirds as long as pronotum, scarcely elevated except at base, subequilateral, with acute apex.

Hemelytra well developed, the membrane exceeding tip of abdomen by one-sixth the total length of hemelytra; clavus and corium regularly punctate, with short hairs arising in the punctures; commissure of clavus half again as long as scutellum; corium feebly convex and interrupted along middle by a straight emboliar suture reaching three-fourths of distance to apex;

costal margin moderately arcuate, the edge rounded and uninterrupted, there being no trace of a cuneus or cuneal fracture. Membrane with four distinct, uninterrupted, longitudinal veins, the three inner veins arising from inner half of straight apical margin of corium and running slightly outward or toward the apex of membrane; fourth vein arising at outer fourth of apical margin of corium, curved inward basally and running parallel to other veins apically. Venation of hind wings obscured except in one badly spread specimen. The hamus and decurrent vein are apparently absent though the other veins are perfectly distinct.

Under surface convex, finely punctured and pubescent; ostiolar canals short but distinct, the edges feebly elevated, straight or slightly arcuate and located close to inner posterior margins of metapleura adjacent to hind coxæ. Abdomen with spiracles of segments two to seven clearly visible sublaterally, the posterior margins of segments three to six very straight and complete, that of second segment slightly sinuate but complete, reaching lateral margins. Seventh segment short and concave posteriorly in the male, leaving the strongly sclerotized eighth segment broadly exposed, the eighth segment twice as long as seventh at middle and the ninth segment or genital capsule enormously developed, convex, one-third as long as all the rest of the abdomen. The male capsule is apparently symmetrical and must completely enclose the ædeagus and parameres because only the convex capsule is visible in a perfectly clear side view. In the female the seventh segment is greatly enlarged, being half as long as the rest of the abdomen with its sides rather strongly rounded laterally and then nearly straight until rounded apex. This plate is not cleft and completely conceals the female genitalia.

Legs relatively stout and finely pubescent. Femora feebly incrassate, tibiæ cylindrical. Tarsi more slender, three-segmented, the first segment very short, second and third subequal. Claws slender and apparently without arolia.

Genotype: *Electrocoris brunneus* n. sp.

Electrocoris is unique in possessing distinct ocelli, an apparently three-segmented rostrum, three-segmented tarsi, four free longitudinal veins in the membrane without cross-veins or cells, a large and apparently symmetrical male genital capsule, an entire, unbroken corial margin without trace of cuneus, and a large, uncleft seventh abdominal sternite in the female without trace of an ovipositor. It runs directly to the Microphysid-Anthocorid couplet in China and Myers' key (1929) but does not fit either of these. All of the alternative characters given in this couplet are variable except the one concerning the symmetry of the male genitalia. *Electrocoris* fits the Microphysidæ in this critical character but agrees with the Anthocoridæ in all of the supplementary characters given.

Pachymerus senius Germar and Berendt (1856) may pertain to *Electrocoris* as indicated by the introductory paragraph of the original description. "Dies kleine, wenig über eine Linie lange Thierchen, erscheint in der Gestalt des Kopfes, des Halsschildes und der Fühler fast wie ein Capsus, und hat besonders mit Capsus capillaris im Umriss Aehnlichkeit, aber die deutlichen Nebenaugen zeigen, dass es in die Familie der Lygaeoden gehört." It is perfectly true that relationship with the Lygæidæ is indicated, not only by the presence of ocelli, but also by the absence of a cuneus and the presence of four free longitudinal veins in the membrane. However, the Lygæidæ differ fundamentally from the Cimicoidea in general in the possession of abdominal trichobothria and well developed arolia of an entirely different type from the arolia seen occasionally in the Cimicoidea. That *Electrocoris* has no abdominal trichobothria is indicated by several specimens in which the finest abdominal hairs are clearly visible. Lygæidæ likewise differ from *Electrocoris* in possessing a distinctly four-segmented, ventrally appressed rostrum, well developed bucculæ, more distinct and differently formed ostiolar canals, and a deeply cleft seventh female sternite which usually accommodates a well developed ovipositor.

There is also a possibility that the much discussed but little understood genus *Joppeicus* may be related to *Electrocoris*. Originally described as an Aradid by Puton (1881), *Joppeicus paradoxus* was later moved to the Lygæid subfamily Oxycareninæ by Bergroth (1898), and thence, as a separate family, Joppeicidæ, back to the Aradoideæ (Reuter, 1910). Mr. China (1933) reëxamined the species and again moved it to the Lygæoidea, this time as a separate family related to the *Clerada* group of Lygæids. I have never seen *Joppeicus* but, from a review of the literature including Bergevin (1911), its most important characters are: ocelli distinct, rostrum three-segmented, membrane with four free longitudinal veins, ostiolar canals absent, tarsi two-segmented, claws without arolia, spiracles two to seven ventral, seventh abdominal sternite cleft in the female. No mention is made of trichobothria. Obviously, *Electrocoris* is not to be confused with *Joppeicus*, but the systematic position of the latter should be studied carefully in any review of hemipterous phylogeny.

Electrocoris brunneus new species

Figure 1

Male. Body clothed with a rather short pubescence. Head moderately declivous, the gula about as long as buccal opening. Antennæ robust, proportion of segments one to four as 5:15:11:16. Legs relatively stout. Color of body uniformly light brown. Length 3.12 mm.

Female. Similar to male except for the genitalic differences described above, the slightly longer apical antennal segment (proportion of segments one to four as 5:15:11:18), and the shorter, more robust body form (length 2.51 mm. in the allotype and approximately the same in two partially obscured paratypes).

Holotype (4639), allotype (4640), and one paratype (4641), Museum of Comparative Zoology, Harvard University; and one paratype retained in my collection.

Electrocoris pubescens new species

Female. Body clothed with a relatively longer, fine, dense pubescence. Head only feebly declivous, the gular region over twice as long as buccal opening. Antennæ relatively slender, the proportion of segments one and two, 4::18, the apical segments broken off. Legs and particularly tarsi slender. Color of hemelytra dark brown, of body beneath, dark brown or nearly black with posterior margins of ventral segments pale. Length 2.5 mm.

Holotype (4642), female, Museum of Comparative Zoology, Harvard University.

Pubescens, though obviously related to *brunneus*, is strikingly distinct, the longer and denser pubescence, more porrect head, and darker color immediately setting it apart. Both of these differ from the possibly congeneric *senius* Germar and Berendt in which, according to their figure, the scutellum is longer than either the pronotum or the commissure of the clavus and in which the antennal and tarsal segments are differently proportioned.

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BLASTICOTOMIDÆ IN THE MIOCENE OF FLORISSANT, COLORADO (HYMENOPTERA SYMPHYTA)

By Robert B. Benson

British Museum, London

Among the fossil sawflies discovered at Florissant, Colorado, in Miocene beds was one described by Brues (1908) as being a very peculiar Tenthredinid, which he placed in a new genus and called *Paremphytus ostentatus*. At the same time he confessed that he had "not been able to locate the specimen with any degree of satisfaction." Rohwer (1908, p. 526) is also struck by the remarkable wing-venation of this insect, which he placed in the Tenthredinid subfamily Phyllotominæ.

Neither of these authors was familiar with the Blasticotomidæ which are only known now to occur in the palæarctic region and neither of them therefore recognized the remarkably similar wing-venation of the fossil *Paremphytus* and the living *Blasticotoma* (*cf.* Brues 1908, fig. 6 and MacGillivray 1906, fig. 44). The placing of *Paremphytus* in the Blasticotomidæ is further supported by its apparently argid-like antennæ as in that family.

Brues says: "Antennæ stout and thick and possibly with the last joint long as in *Arge* and its allies. However, this character is not very plainly to be seen on the specimen. . . . The similarity of the antennæ to those of Arge *et al.* is very striking, but it is possible that the last joint is in reality several closely united ones."

Unfortunately without the claws of the insect it is impossible to tell whether *Paremphytus* is likely to be synonymous with either of the two known recent genera of Blasticotomidæ, *Blasticotoma* or *Runaria*. Living members of the family now represent five known species and one subspecies. *B. filiceti* Klug is known in Europe and also as a distinct subspecies in east Asia including Japan. The four other species are limited to Japan and east Asia. As these insects are not often found on the wing even in districts where the larvæ are known to occur, living representatives of the family may yet be found in North America. The only described larva, that of *B. filiceti* Klug (Meijere 1911, p. 86, pl. v, figs. 1–12), is without abdominal legs and bores in a fern-stem, producing a peculiar irregular ball of froth about the size of a walnut on the side of the stem. The presence of the insect in a district is usually most easily detected by these balls of froth.

The representation of this family among the Florissant fossils is specially interesting because of the extreme rarity of the adults of the living species and suggests that they may have been more common as well as more widely distributed in Miocene times.

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NOTES ON NEARCTIC NEUROPTERA

By F. M. Carpenter

Since the publication of my revision of the Nearctic Hemerobiidæ and related Neuroptera,[1] several collections of these insects have been sent to me for identification. Notes on the most interesting and unusual species are included here. I am indebted to the entomologists mentioned below for the opportunity of examining this additional material.

Family Hemerobiidæ

Kimminsia involuta Carp.

In the Cornell University collection there are four specimens (♂ ♀) of this species collected in North Carolina ("N.C.") by F. Sherman, Jr. *Involuta* has previously been known only from western Canada, Idaho, Wyoming and Colorado. In all probability these specimens were found in the mountainous (western) part of N. Carolina, the insect fauna of which has several other species and genera in common with that of the north-western states.

Megalomus mœstus Banks

Several specimens (♂ ♀) were collected in the Black Hills, South Dakota (July 20, 1939) by D. J. and J. N. Knull (Ohio State University collection). The most eastern record of *mœstus* has previously been at Laramie, Wyoming.

Sympherobius angustus (Banks)

One female was collected in the Chirichua Mts., Arizona (July 15, 1939, D. J. and J. N. Knull); it is the first record of *angustus* in that state.

Sympherobius arizonicus Banks

The ♀ type has previously been the only specimen of this insect known to me. In the Ohio State University collection there are three additional specimens from the Santa Rita Mts.,

[1] Proc. Amer. Acad. Arts and Sciences, 74:193–278, 1940.

Arizona (June 8 and 24, D. J. and J. N. Knull). Unfortunately, all of these are females, so that the male genital structure is still unknown.

Sympherobius occidentalis (Fitch)

One specimen of this rare insect has been collected in Indiana Dunes State Park, Indiana (July 27, 1940) by R. L. Wenzel (Field Mus. collection); this is the first record in that state.

Family Sisyridæ

Climacia areolaris (Hagen)

A number of specimens were collected at the Deschutes River, near Richmond, Oregon (July 28 and 31, 1939, Shuh and Gray); and others have more recently been collected near Tower, Minnesota (University of Minnesota collection). These records greatly extend the range of *areolaris*, which has not previously been reported west of Michigan in the north or New Mexico in the south. It will probably turn up locally across northern United States.

Family Berothidæ

Lomamyia banksi Carp.

A female collected at Buffalo, Texas (June 29, 1941, D. J. and J. N. Knull) is the first record in that state.

Lomamyia longicollis (Walker)

A male of this little-known insect is contained in the Uni-

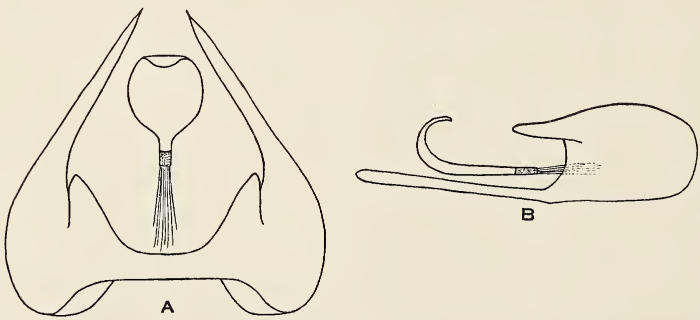

Fig. 1. *Lomamyia longicollis* (Walker) ♂, tenth abdominal tergite and ædeagus. A, dorsal view; B, lateral view.

versity of Kansas collection; it was found at Iuka, Mississippi (July 14, 1930) by R. H. Beamer (University of Kansas collection), and is the only male known to me in addition to the type in the British Museum. Since the male genitalia of this species have not previously been described, I include here (Fig. 1) a drawing of the 10th abdominal tergite and ædeagus. The tergite is similar to that of *tenuis* Carp., but lacks the anterior and posterior dorsal lobes. The ædeagus also resembles that of *tenuis*.

THE LYCÆNIDÆ OF THE BAHAMA ISLANDS (LEPIDOPTERA, RHOPALOCERA)

By Harry K. Clench

Cambridge, Mass.

So little has been written about the *Lycœnidœ* of the Bahamas that it was thought advisable to publish some account of the species of this family that are known to occur there.

Due to a lack of complete information, it has been impossible to work out distributions among the islands of the group. As a result, this paper will be limited almost entirely to a systematic list of species, with such locality data as are available.

The history of the recorded Bahaman *Lycœnidœ* may be summed up as follows: E. M. Sharpe (1900, pp. 199–200), in her account of a collection made on New Providence Island, listed three species; M. Bates (1935, pp. 189, 195, 197, 198) mentioned an additional four as occurring in the Bahamas, but gave no specific localities; and lastly, the author (1941, p. 3; 1941a, p. 407) added two more, bringing the total number known for the region to eight. An additional five in this paper raise that number to thirteen. This figure compares, now, more favorably with the sixteen species of Cuba.

Of the thirteen Bahaman species and races in this family, two species and three races are indigenous. The latter, quite naturally, show affinities with both Florida and Cuba, but appear to be more strongly connected with the latter.

The specimens upon which this paper is based are contained chiefly in the collection of the Museum of Comparative Zoölogy. The general arrangement follows Bates' 1935 paper, "The Butterflies of Cuba."

Genus Eumæus Hübner

1. Eumæus atala Poey

Eumenia atala Poey, 1832, no. 3, 3 figs.
Eumœus atala: Bates, 1935, p. 189.

I have seen but two Bahaman specimens, both badly worn. Insofar as can be determined, they do not differ from either Floridian or Cuban specimens.

Distribution. Great Abaco Island (Mathiew's Point, July 9, 1904). Also from Cuba and Florida.

Genus **Strymon** Hübner

2. **Strymon martialis** Herr.-Schäff.

Thecla martialis Herrich-Schäffer, 1864, p. 164.
Strymon martialis: Bates, 1935, p. 192.

This species is allied to the following, but the blue on the upper surface will at once distinguish it.

Distribution. New Providence Island (Mar. 12, 1934, Armour Exp.); Andros Island (Mangrove Cay, Aug. 1, 1904, O. Bryant); Cat Island (Arthurs Town, July 21, 1935, W. J. Clench); Conception Island (Feb. 12, 1934, Armour Exp.); Great Inagua Island (Feb. 1934, Armour Exp.).

S. martialis is also reported from Florida and Cuba. Bates' statement that it is found in "most parts of the West Indies" is open to question.

3. **Strymon acis armouri**, new subspecies

UPPERSIDE:

Both sexes brownish black. *Fore wing* in the female with a rather indefinite central patch of jet black. Male with a more definite and smaller central patch of the same color, in this case the scent pad, located on the outer end of the cell. *Hind wing* with the anal lobe orange, capped by a thick, short white bar. Between the lobe and the lower tail is a second, thinner, white bar, and between the two tails is a third. Basal to the second of these bars is a small, frequently obsolete, patch of white scales. Basal to the third bar is a patch of orange scales. The tail at Cu_1 is the shorter, as is customary in the genus, and both that and the one at Cu_2 are black, tipped with white. *Fringe* of both wings white, except at the anal lobe and the costal part of the outer margin of the hind wing which are brown.

UNDERSIDE:

Both sexes similar. Ground color grayish tan, rather dark. *Fore wing* crossed by a diagonal, rather thin, straight white line, basally bordered with black. This line runs from a point on the costa, two-thirds from the base, to Cu_2, about 3 mm. in from the outer margin. The inner marginal area from here is slightly grayer than the rest of the wing. *Hind wing* with a marginal white streak running from M_3 almost to 2A. Anal lobe black, surmounted by a white area. Between 2A and Cu_2 is a patch of gray and blue scales. Between Cu_1 and Cu_2, set back from the margin, is an orange patch, most intense basally. Adjoining this, in the Cu_2-Cu_1-M_3-M_2 interspaces are smaller orange patches, each of which is bordered outwardly with a small amount of white. Basal to these orange areas is a black line, parallel to the margin, and running from outer angle to Cu_2. Marginal to this, near the outer angle, is a heavy white band, a continuation of the white bordering of the orange patches, mentioned above. Between the orange patches and the white bar (the former merging into the latter toward the outer angle), and the outer margin is a strip of gray. Outward of this strip is a thin, thread-like line of white, running the whole length of the outer margin. From the center of the costa runs a continuation of the white line on the fore wing. It proceeds straight to a point on Cu_2 just basal to the large orange spot, where it angles sharply inward for a short distance, then downward, touching at 2A just basal to the patch of blue and gray scales, then inward again, reaching the inner margin at the center. Throughout its whole length it is basally bordered with black. Near the inner margin, and just marginal and parallel to the last segment of this line, is a black streak which basally limits the white patch next the anal lobe. In the basal area are two white spots, small, occasionally almost obsolete, which lie parallel to the body line. *Length of fore wing* as in the typical.

Holotype, male, Rum Cay, Bahamas, Feb.-March, 1934 (Armour Exp.).

Allotype, female, Arthurs Town, Cat Island, Bahamas, July 16, 1935 (W. J. Clench).

Paratypes, one female, same data as holotype; two females, same locality and collector as allotype, July 8, 16, 1935.

Holotype, allotype and two paratypes, M.C.Z. no. 25848. One paratype in the author's collection.

Remarks. This subspecies differs from typical (Florida) *acis* in the narrower post-discal white lines on both wings, and in the reduction of the orange patch on the under surface of the secondaries. This orange in typical *acis* is large and unicolorous, while in *armouri* it is much reduced and lighter marginally. The two basal spots on the secondaries below are usually smaller than in the typical form. Drury (1770, p. 2, pl. 1, fig. 2) gave in his description the locality "New York," undoubtedly false. No Cuban examples have been seen.

This subspecies is named for Mr. Allison V. Armour, of the yacht "Utowana," through whose efforts a large part of the museum's Bahaman butterflies were obtained.

4. **Strymon mæsites** Herr.-Schäff.

Thecla mœsites Herrich-Schäffer, 1864, p. 165.
Strymon mœsites: Bates, 1935, p. 194; Clench, 1941, p. 3.

Specimens from Florida and the Bahamas might each represent undescribed races, but they would at best be insignificant, and, for the present at least, it is better to leave them all under one name. *S. mœsites* is a close relative of the continental *telea* Hewitson (1873, Illustrations of Diurnal Lepidoptera. Lycænidæ, p. 143, pl. 57, figs. 350, 351 (not original description)), and is in all likelihood only subspecifically distinct.

Distribution. Cat Island (Arthurs Town, July 16, 1935, W. J. Clench). Florida and Cuba, and also Puerto Rico have been cited as localities for this species. It is found very likely in Hispaniola as well.

5. **Strymon columella columella** Fabr.

Papilio columella Fabricius, 1793, p. 282.
Tmolus salona: Sharpe, 1900, p. 200.
Strymon columella: Bates, 1935, p. 194, fig. 15.

Mexican specimens belong to a separate subspecies (*istapa* Reak.) according to Field (1939, p. 346).

Distribution. New Providence Island (Nassau, June 1897, C. J. Maynard; Feb. 1933, J. C. Greenway; Feb. 1, and Mar. 12, 1934, Armour Exp.); Southern Eleuthera Island (Feb. 1934, Armour Exp.); Conception Island (Feb. 12, 1934, Armour Exp.); Rum Cay (1934, Armour Exp.); Long Island (Clarence Town, Feb. 20, 1934, Armour Exp.; Simm's, July 16, 1936, H. D. Russell and R. A. McLean).

Typical *columella* is widely distributed throughout the West Indies and Florida.

6. Strymon angelia dowi Clench

Tmolus angelia: Sharpe, 1900, p. 200.
Strymon angelia dowi Clench, 1941, p. 4.

S. dowi is quite distinct from the Cuban race (typical *angelia*), having a lighter ground color, and nearly lacking the fulvous on the upperside of the secondaries in the male.

Distribution. New Providence Island (Nassau, June 1897, C. J. Maynard); Cat Island (Arthurs Town, July 14–16, 1935, W. J. Clench); Long Island (Simm's, July 7, 1936, H. D. Russell and R. A. McLean); Mariguana Island (Feb. 25, 1933, Armour Exp.). All types.

The typical form is found in Cuba, Puerto Rico and Jamaica. It will in all probability turn up in Hispaniola when that island is more thoroughly explored.

Genus Hemiargus Hübner

7. Hemiargus hanno filenus Poey

Polyommatus filenus Poey, 1832, no. 13, 3 figs.
Hemiargus filenus: Bates, 1935, p. 196, fig. 16.

Judging by the available data, *filenus*, in the Bahamas, is restricted to the more southerly islands. However, more extensive collecting may turn it up in the northern part of the group. It seems strange, nevertheless, that records of it are absent from New Providence Island, and Cat Island, the two islands most thoroughly known.

Distribution. Long Island (Clarence Town, Feb. 1934, Armour Exp.); Great Inagua Island (Feb. 1934, Armour Exp.).

Specimens from Florida, Cuba, Jamaica and Hispaniola seem to agree with those from the Bahamas, and together form the Antillean race of *hanno*.

8. Hemiargus catilina thomasi Clench

Hemiargus catilina thomasi Clench, 1941a, p. 407.

This race differs from the typical (Florida) form in the reduction and graying over of the white bands on both wings below.

Distribution. Cat Island (Arthurs Town, July 16, 1935, W. J. Clench; Russell's Creek, July 16, 1935, W. J. Clench);

Rum Cay (1934, Armour Exp.); Great Inagua Island (Feb. 1934, Armour Exp.).

9. Hemiargus catilina ammon Lucas

Lycæna ammon Lucas, 1857, p. 612, pl. 16, figs. 7, 7a, 7b.
Hemiargus ammon: Bates, 1935, p. 197.

This record is founded upon a single and very badly damaged specimen. Though positive examination is very difficult, it doesn't appear to differ from typical Cuban specimens.

Distribution. Long Island (Simm's, July 16, 1936, H. D. Russell and R. A. McLean).

This subspecies of *catilina* is found also in Hispaniola and Cuba.

10. Hemiargus bahamensis, new species

UPPERSIDE:

Male. Both wings blue. *Fore wing* with a thin black marginal border, faintly thicker at the apex. *Hind wing* with a single black spot between veins Cu_1-Cu_2, and a suggestion of another between Cu_2-2A. *Fringe* of both wings white, darker at the ends of the veins.

UNDERSIDE:

Male. Ground color uniform gray-brown. Markings characteristic of *catilina*, but hardly distinguishable, due to the darker ground color, and almost complete absence of the white which usually surrounds them. In addition, the three spots in the basal area of the hind wing, usually jet black, have here lightened to the color of the ground, and can hardly be distinguished from it. On the *fore wing* there is a submarginal line of white, rather thin, contrasting sharply with the dark gray-brown which surrounds it. On the *hind wing* there is a corresponding white line, slightly thicker, which runs from costa to inner margin, as does that of the fore wing. On the outer margin, near the anal angle, are two black spots, irrorated heavily with metallic blue green scales on their outer margins. The one in Cu_1-Cu_2 is capped by a thin curved line of orange, while the smaller one adjacent to it is capped by a similar line of white. *Length of fore wing* 9 mm.

Holotype, male, Crooked Island, Bahamas, March 1, 1934 (Armour Exp.), M.C.Z. 25737.

Remarks. This species belongs to the group in the genus *Hemiargus* that includes *catilina* Fabr., and its races, and *dominica* Möschl., though it is quite different from either. It bears a certain resemblance to *dominica* in the reduction in color of the basal spots, but there the similarity ceases. *H. dominica,* like *ammon,* is very light, with scattered brown markings, while *bahamensis* is dark, with the markings scarcely apparent. It is, perhaps, closest in appearance to *thomasi*, the Bahaman race of *catilina.* However, it can be distinguished readily by the pure white (though thin) lines, one on each wing, below, and in the reduced color of the basal spots, which are in *thomasi* jet black, as in the other *catilina* races. The reduction of the orange lunule below also seems characteristic of *bahamensis.*

Genus **Brephidium** Scudder

11. **Brephidium isophthalma** Herr.-Schäff.

Lycæna isophthalma Herrich-Schäffer, 1862, p. 141.
Brephidium isophthalma: Bates, 1935, p. 198.

Bahaman specimens seem to agree with those of Cuba.

Distribution. New Providence Island (Nassau, June 1897, C. J. Maynard).

12. **Brephidium barbouri**, new species

UPPERSIDE:

Male. Fore wing dark brown with a reddish discal tinge. Base of wing blue. *Hind wing* dark brown, with a basal blue area as in the fore wing, but more extensive. The veins in this blue area are obscurely pencilled with dark brown. A row of inconspicuous dark spots adorns the outer margin. *Fringe* of fore wing brown, faintly whitish towards apex; that of hind wing white.

UNDERSIDE:

Male. Fore wing with the base, outer margin and apex dark gray; disk ruddy brown. A submarginal row of white dashes parallels the outer margin. In the disk is an interrupted, badly dislocated, double white line, and a double dash at the end of the cell. *Hind wing* dark gray brown. Obscure white dashes and white scaling are scattered over the entire surface with the same general pattern as found in *isophthalma* and *exilis* Boisd. At the base is a narrow area of greenish scaling. There are seven spots on the outer margin, the anal one and apical two all metallic green, the remaining black, with a convex line of green irroration in each. Between these spots and the outer margin is a thin line of dull orange, which extends basally between the spots for a short distance. Basal to the row of spots is a faint and rather indefinite whitish line.

Holotype, male, Great Inagua Island, Bahamas, Feb. 1934 (Armour Exp.).

Paratype, male, same data.

Holotype and paratype, M.C.Z. no. 25738.

Remarks. This species differs from the related *isophthalma* and *exilis* in the absence of a white patch of fringe near the anal angle of the fore wing, and in a darker color below, especially on the fore wing. It also appears to be darker above. Two specimens from Rum Cay (Feb. 1934, Armour Exp.) seem referable to *barbouri.*

This species is named for Dr. Thomas Barbour, director of the Museum of Comparative Zoölogy.

Genus Leptotes Scudder

13. Leptotes cassius theonus Lucas

Lycæna theonus Lucas, 1857, p. 611, pl. 16, figs. 8, 8a, 8b.
Tarucus cassius: Sharpe, 1900, p. 199.
Leptotes theonus: Bates, 1935, p. 198.

Bahaman specimens agree with those found elsewhere in the West Indies and Florida.

Distribution. South Bimini Island (Alicetown, Apr. 1941, R. W. Foster and J. Huntington); New Providence Island (Nassau, June 1897, C. J. Maynard); Southern Eleuthera Island (Feb. 1934, Armour Exp.); Cat Island (Arthur's Town, Aug. 5, 1935, W. J. Clench); Stranger's Cay, Little Abaco Island (July 5, 1904, O. Bryant); Crooked Island (March 1, 1934, Armour Exp.); Great Inagua Island (Feb. 1934, Armour Exp.); Long Island (Clarence Town, July 29, 1936, W. J. Clench and J. C. Greenway); Grand Bahama Island (Eight Mile Rock, Apr. 22, 1936, W. J. Clench); Rum Cay (1934, Armour Exp.); Watling's Island (Feb. 17, 1933, J. C. Greenway).

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SOME NEW OR LITTLE KNOWN NEARCTIC NEONYMPHA [1]

(Lepidoptera: Satyridæ)

By V. Nabokov

The capture in Arizona in June 1941 of what struck me as an undescribed species of *Neonympha* suggested certain investigations, the results of which are given in this paper. A study of about a hundred specimens labelled "*henshawi* Edw.," which I accumulated from different sources, revealed that two pairs of gemmate species, one pair unnamed, the other neglected, occurred in Arizona. Confusion has been due not so much to some chance obscurity in a great entomologist's description 66 years ago, as to the indifference and consequent lack of precision in regard to this section of *Neonympha* on the part of those who wrote after him. Somehow lepidopterists have never seemed overeager to obtain these delicately ornamented, quickly fading Satyrids that so quaintly combine a boreal-alpine aspect with a tropical-silvan one, the upperside quiet velvet of "browns" being accompanied by an almost Lycænid glitter on the under surface. There exists very little information concerning such things as the number of broods, possible seasonal variation, limits of distribution, allied Mexican and Central American forms, haunts, habits and early stages.

What follows is an attempt to set down the peculiarities of these four insects as a tentative basis for further research that would amplify the comparatively meager facts at my disposal. A definition of the species most usually confused with *henshawi* Edw. and a full description of its typical race, with comparative descriptions of two other races are followed by comparative descriptions of the three other species, listing their distinctive characters in the same order. The species to be discussed are:

Neonympha dorothea n. sp. (referred to by Edwards as

[1] Published with the aid of a grant from the Museum of Comparative Zoölogy of Harvard College.

"some specimens" etc., in conjoint description of *henshawi* Edw., 1887, Butt. N. Am., III, *Neonympha* I; reproduced from a female in Edwards' collection as "*henshawi* Edw., male," by Holland, 1898, and later editions, Butt. Book, Pl. 25, fig. 8, upperside.)

Neonympha maniola n. sp. (presumably figured, as "*henshawi*," by Wright, 1905, Butt. W. Coast, Pl. 25, fig. 226 a, b, c, male, upperside, female, both sides).

Neonympha pyracmon Butler (1866, Proc. Zool. Soc., London, p. 499, female; 1867, Proc. Zool. Soc., London, Pl. 11, fig. 11, female, underside; Godman, 1901, Biol. Centr. Am. Rhop., II, p. 658; III, Pl. 107, figs. 11, 12, male, both sides, mislabelled "*hilaria*"; Weymer, 1911, in Seitz, Rhop. Am., p. 223).

Neonympha henshawi Edwards (1876, Trans. Am. Ent. Soc., p. 205, female; Godman, 1880, Biol. Centr. Am., Rhop., III, Pl. 8, fig. 27, female, underside, mislabelled "*pyracmon*"; Edwards, 1887, Butt. N. Am., III, Pl. 1, figs. 5–8, both sexes, both sides; Maynard, 1891, Mnl. N. Am. Butt., p. 108, female; fig. 35d, female, hind-wing underside).

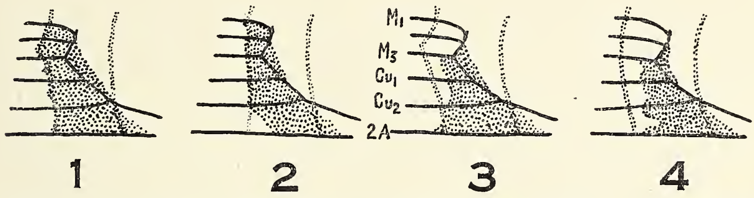
Neonympha dorothea n. sp.

Sharing with the other three species such upperside characters as: brownish ground color in male, with more or less diffuse fulvous red; fine fulvous margin, mainly subanal in secondaries; androconial mark in male primaries; præterminal dark spots in secondaries of both sexes; and such underside characters as: more or less fulvous ground color of primaries; small discal button-spot on both wings; four transverse lines, to wit: first discal, crossing cell R + M; second discal, curving round cell (its course in primaries dependent upon specific outline of termen); subterminal, mostly striate in primaries (less adjusted there to differentiation of termen) and mostly incomplete and deformed in secondaries; præterminal, mostly punctate in primaries, and embossed with serrate silver in secondaries where it forms a silver W in Cu_1, passes through two double ocelli in M_3 and M_2 placed within a cinereous irroration, and produces two pairs of V-shaped dashes in M_1 and R_s.

Distinguished from its three congeners as follows: Primaries apically short and rather bluntly rounded, with straight termen;

secondaries evenly rounded in both sexes, with very slight sinuation in female; præterminal spots rather blurred.

Androconial mark: medium sized, with fairly smooth outer edge coinciding, except in Cu_2 where it retreats basally, with second discal line as seen through wing; consisting of 5 patches (shading in 2A not included), adjoining cell and separated by



FIGS. 1–4. Scheme of androconial patches in Neonympha. 1, *N. maniola*; 2, *N. dorothea*; 3, *N. henshawi*; 4, *N. pyracmon.*

veins, as follows: rhomboid, with sides slanting basally subparallel to cubitus, in Cu_2; two decreasing trapezoids, in Cu_1 and M_3; two wedges in M_2 and M_1; and of short triangle, in cell R + M, against inner side of cross vein, pointing basally and reaching down to about level of Cu_1. (See fig. 2.)

Female upperside: diffusely colored, with slight shadings.

Male and female underside: primaries: second discal line running subparallel to first discal line, curving from costa behind cell to slope down towards subterminal line and thus limiting with the latter a truncate upsilon-shaped area in middle of wing; subterminal line from dorsum up to about Cu_1 running closer to second discal than to termen but then, by retaining a primal course, diverging terminally to reach apex (which would have been costa, had the apex been longer, in which case the subterminal line would have been parallel to a primal, slanting, termen), thus enhancing the impression of the outward slope on the part of the second discal which in reality is subparallel to the straight termen (to which, contrary to the subterminal line, it has become adjusted); secondaries: heavily and completely bordered with dark cinereous which encloses ocelli and silver serration, and expands in M_2 and M_3 where the second discal line is thickly arched inversely to termen.

Neonympha dorothea dorothea n. subsp.

Male: expanse of left fore-wing 20.9 (from base to end of M_1). Upperside: deep brown with lighter veins; some dark fulvous red scales just discernible in between them; cilia fuscous; dark fuscous androconial mark. Primaries very finely edged with fulvous; secondaries more broadly so, but only to about Cu_1 from tornus, with four spots along termen: first one rather indistinct, in Cu_1; second and third subreniform, blotchy, blackish, in M_3 and M_2; and fourth, very weak, in M_1; a fine dark ray (interneural fold) through middle of each reaching the cilia from disc. Underside: primaries: flushed with deep warm red of Erebian ("*callias*") tone over lower part; thickly dusted with yellowish brown and traversed by reddish brown striæ over upper part; lines: chestnut brown; præterminal consisting of very indistinct sequence of dots; small brown discal spot above M_2 near cell R+ M on both wings, buttoning top of androconial mark in primaries (if viewed through wing). Secondaries: discally of darker shade of brown than subcostal and subapical areas of primaries; with some redder striæ and a sprinkling of fluffy hoary scales basally; discal lines: deep chestnut brown; the first irregularly crossing cell R + M; the second from tornus following serrated (on Cu_2) but fairly direct course up to Cu_1 beyond which it strongly thickens and arches inversely to termen in M_3–M_2, then narrows again, abruptly turns outward as if to end at M_1, just above a roughly V-shaped basally pointed combination of two silver præterminal dashes, but really swerves back again and up towards R_s in which interspace it is almost concealed by a second V-pair of silver dashes which seems superimposed. Subterminal line from tornus arches inversely to termen in Cu_2, dips terminally, then shoots up basally along middle of cell Cu_1 where it stops, forming a thickish chestnut brown bar which coincides with the terminal course of the interneural fold. A broad cinereous border heavily stippled with purplish black transverse striæ, merged with the cinereous underside of the fringe and limited inwardly by the arches of the second discal and subterminal lines, occupies the whole outer third (excepting a vineleaf-shaped, as viewed from base, fulvous brown space between second discal and subterminal lines in C_1–C_2), thus completely enclosing the ocelli and other markings to be mentioned. Examined in its action upon the discal and subterminal lines, it may be described as invading the termen from the tornus, with its inward edge causing the subterminal line to arch inversely to termen in Cu_2, then bursting through in Cu_1, diverting basally the broken end of the subterminal line and swelling strongly towards the second discal; beyond Cu_1 it pushes up even farther, touching (except for a few dusky scales in between) the second discal, which its pressure forces to arch in M_3–M_2, and then reaching the termination of R_s. This border, which produces a strong avian or "scaly" effect, encloses præterminally, in M_3 and M_2, two subreniform (twinned) ocelli, jet-black, each delicately rimmed and threaded through with light fulvous so as to form a capital "B" facing the termen, with the interneural folds faintly traced in a paler tint through the dark cinereous irroration; in each black cell of each "B" a bright silver "T" glitters, its stem projecting basally, its crossbar subparallel to the termen and neither stem nor bar touching the rim. The embossed silver of these four "T" marks is supplied by the breaking up of a silver line which starts from about Cu_2 (in continuation and sublimation of a vaguely discernible dark præterminal line from tornus); forms in Cu_1, upon the interneural ray and beneath the end of the subterminal line, a "W" (as viewed from base), where an ocellus, visible as a spot on the upperside, seems to be in the process of being built with the help of the dark pigment which is channelled terminally by the interneural fold from the end of the subterminal line; then traverses the kernels of the spots in M_3 and M_2 and produces farther up the V-shaped pairs of silver dashes already mentioned; the first pair of these suggests the formation of a rudimental fourth spot whose interneural ray looks like a terminal projection of the second discal line. There is a thin bright fulvous margin from tornus to middle of cell Cu_1, running between the cilia and the silver line (incidentally, in regard to these very *Coenonympha*-like markings, it should be noted that the ocelli in the latter genus are formed subterminally, not præterminally as in this section of *Neonympha*).

Female. Exp. 21.5. Upperside pale reddish brown with pinkish tone. Primaries: with faint adumbration post-cellularly and terminally, but on the whole producing a unicolorous impression. Secondaries: evenly rounded, as in male; with dim greyish shade surrounding the rather blurred and formless dark spots (in M_2, M_3 and Cu_1) and slightly deepening towards apex. Underside as in male.

Male, holotype, female, allotype, and two males, paratypes, placed in the American Museum of Natural History. Taken during a brief visit to Grand Cañon, Ariz., South Rim, on June 9th, 1941 (bright cold morning after snow and rain). They were weakly fluttering beside the trail together with a few *Coen. tullia furcae* — almost no other butterflies about. Named in honor of Miss Dorothy Leuthold who kindly kicked up the first specimen. Female, paratype, labelled "Grand Cy., June 11th '30", ex Coll. of C.F. dos Passos, Am. Mus. Nat. Hist.

Neonympha dorothea edwardsi n. subsp.

Male. Exp. 20.2. Upperside: brown tint somewhat lighter, with much greater amount of duller fulvous red diffused in both wings. Secondaries: spots reduced to two, in M_3 and M_2 (visible also in Cu_1 in some specimens). Underside: striæ somewhat more abundant and conspicuous on both wings. Primaries: pale fulvous brown with light reddish wash in lower part; præterminal line quite clear as a row of dots. Secondaries: fulvous brown; beyond second discal line correspondingly paler than in *dorothea dorothea*. Cinereous border somewhat less developed, i.e. not approaching as close to arched but slightly thinner second discal in M_3 and M_2, thus leaving a narrow but distinct stretch of ground color in between.

Female. Exp. 20.7. Upperside pale reddish brown but lacking the pinkish tone of *dorothea dorothea* — a slight but distinct character connecting it with transitions to the fulvous southern race or races.

Male, holotype, labelled: "Gila Co. Ariz. June 1902, O. C. Poling", ex A. G. Weeks Coll., Museum of Comparative Zoology, Cambridge, Mass.; female, allotype, "Ariz. 1892, C. J. Paine", Mus. Comp. Zool. Paratypes: 3 males "Gila Co. Ariz. June 1902, O. C. Poling", ex A. G. Weeks Coll., Mus. Comp. Zool.; 2 males and 1 female "Ariz. 1892, C. J. Paine", Mus. Comp. Zool.; male and female, from "Ariz[a]", wrongly labelled "*Henshawi* M" in Edwards' hand, ex Edwards' Coll., Carnegie Museum (it is the female of this pair that Holland figures as "*henshawi* Edw., male" with the remark "much like *N. gemma*, but considerably larger and decidedly reddish upon the upperside"; 1 male "Water Cañon, N. Mex., 5,000 ft. August '81,

F. H. Snow" ex Edwards' Coll., Carn. Mus.; 1 male "Fort Wingate (N. Mex.), June '23, Marloff Coll.", Carn. Mus.; 2 males "Colorado" (one "Coll. Hy Edw."), 1 female "Colorado, Coll. Hy Edw.", Am. Mus. Nat. Hist.

(I should have preferred taking as holotype the male from Edwards' collection were it not for the awkwardness of having such a vague locality as "Ariz[a]" for the type of a race.)

Neonympha dorothea avicula n. subsp.

Male. Exp. 17.6. Upperside: primaries, fuscous, less brown than *dorothea dorothea*, with the dark fuscous androconial shading standing out very clearly; two large bright fulvous red patches in Cu_1 and M_3 and a similar bright tint along the veins involved in this area. The fulvous is so conspicuous and the fuscous so vague (and so much lighter than the sexmark), that the eye is inclined to accept the former as ground color. Secondaries: somewhat darker than primaries with only a slight suggestion of fulvous red in disc and two indistinct præterminal spots in M_3 and M_2. Underside: ground color of both wings a dull dunnish brown, very different from the rich and contrasting shades in *dorothea dorothea*, and of a remarkably even appearance owing to the almost total lack of (brown) striæ, which are only faintly discernible about the costa and base of both wings. Primaries: lines very faint, with the first discal hardly differentiated from the striæ; but the discernible directions of the lines are naturally those of the species. Secondaries: first discal indistinct; second discal thickening and arching strongly, of a duller brown than in *dorothea dorothea* or *edwardsi*. Cinereous border as dark and rich as in typical race, but pressing against second discal in M_3–M_2 completely, without even the presence of a few dusky scales in between. Ocelli a trifle smaller than the smaller size of the insect might justify; silver serration and brown bar well developed; terminal fulvous line broader anally than in *dorothea dorothea*.

Female. Exp. 18.5. Upperside of a very *Cœnonympha*-like appearance stressed by small size and fulvous tone which slightly deepens in primaries in area corresponding to that limited by the discal lines beneath, but not showing any definite bands or lines, only a pale fuscous border merging with a similar shading along the costa. Secondaries: with a slight sinuation in termen unimpairing their "dorothean" roundness and correspondence to primaries; well shaded with greyish; light fulvous in disc and beyond that slightly irrorated with the trans-wing shadows of the heavily striated cinereous border beneath. Underside: rather more contrasty than in male. Primaries: yellowish with faint fulvous red flush over lower part; marked as in male. Secondaries: as in male except for a slight olivaceous brown deepening of the dull ground color.

Male, holotype, female, allotype, and female, paratype, all three labelled "Fort Davis, Texas, 3.VI.40", female, paratype, exp. 20.5, same label, with the addition "6,500 f.". All these ex Coll. C. F. dos Passos, Am. Mus. Nat. Hist.

The fixation of these three definite racial points, *dorothea dorothea, dorothea edwardsi* and *dorothea avicula* is, I think, unavoidable, but one does not care to indulge in pursuing this course and giving names to the various transitions which occur between them, especially as some of these variations seem to be seasonal. It will be noted that the holotypes of all three races were taken in June. Fifteen smallish specimens, twelve males, three females (Carn. Mus.), from Paradise, Ariz. taken by Poling late in the season (August-October) represent a certain transition from *edwardsi* to *avicula*; another kind of transition between the same is represented by two males from Silver City, South New Mexico, ex coll. dos Passos, Am. Mus. Nat. Hist.

Neonympha maniola n. sp.

Male. Primaries: more elongated apically than in *dorothea* with slightly slanting termen; in color like *dorothea edwardsi* with similar diffuse fulvous red. Secondaries: termen slightly sinuate; distinct præterminal spots, in Cu_1 (small), M_3 and M_2 (only the last two in most specimens), rather broadly aureolated with diffuse pale fulvous unlike any *dorothea* race.

Androconial mark: large, broader throughout than in *dorothea*, with larger, differently shaped patches and slightly jagged outer edge projecting on veins and interneural folds; postcellularly pushing against second discal as seen through the wing; consisting of 5 patches: broad trapezoid, in C_2; two slightly decreasing trapezoids, in Cu_1 and M_3; two wedges in M_2 and M_1; and of a triangle, in cell R + M, twice as long as in *dorothea*, pointing basally and reaching down to about level of Cu_2. (See fig. 1.)

Male underside: primaries: rather bright fulvous of a uniform tint (in some specimens the lines are almost erased), only slightly yellower along costa and subapically, and very weakly striated; second discal, in correspondence to termen, after sloping terminally from costa turning basally in middle of cell M_2, then sloping downwards towards first discal line, subparallel here to subterminal line which starts from dorsum slightly closer to termen than to second discal and further up slopes apically though rather less so than in *dorothea*. Secondaries: producing in contrast with brightly and evenly fulvous primaries a curious "Manioloid" or "Hipparchian" effect, being thickly dusted all over (even between second discal and subterminal in some specimens) with greyish scales and abundant dusky striæ over a dull brownish ground. Cinereous border reduced to a suboval patch in middle of outer third, weakly pigmented (in some specimens scarcely noticeable amid the general suffusion, although essentially of a different, probably cilian, origin, tint and texture than the dull grey, probably basally originated, scales over the rest of the wing); this patch not as finely or evenly striated as in *dorothea*, the striæ not much darker or less brown than in the rest of the wing, and surrounded completely and cloudily by the ground color with a yellower glimpse of same also visible within, around the ocelli, as a diffusion or germination of their rims. Second discal line of the *dorothea* type but more vaguely deviated basally in M_3–M_2, owing to weaker development of cinereous irroration; less abruptly projecting outwards in M_1 and clearer in R_s, but producing the same impression of passing underneath the second pair of silver dashes as in *dorothea* and thus not connecting with the second discal of primaries; bar of subterminal very weak.

Male, exp. 20.5, holotype, "Cochise Co., ex Coll. A. G. Weeks, slide 454", Mus. Comp. Zool.; paratypes: 2 males, labelled "Chiricahua Mts., (one: 7.VI.08, V. L. Clemense), ex Coll. H. C. Fall", Mus. Comp. Zool; 2 males "Chiricahua Mts. (22.VI.33, D. K. Dunkan; 25.VI)", ex coll. C. F. dos Passos, Am. Mus. Nat. Hist.

This, I think, is the "*henshawi*" figured by Wright who gives color photograph of male and female upperside and female underside (folded) from specimens taken in Sta Rita Mts., Pima Co. with the remark: "It can scarcely be considered as belonging to the West Coast fauna and has but little, if any interest for us." The female figure is only slightly differentiated from the male, with primaries upperside fulvous red, diffusely bordered with fuscous, and secondaries evenly fuscous with the fulvous aureoles of the male merely enlarged and deepened in tint to form an interrupted lunulate belt; underside (with allowance for a greenish blurring of the color process in the figure) very similar to the Chiricahua males.

I have felt somewhat reluctant to fix this as a species, as there are no females in any of the collections I have examined. *Maniola* is closely allied to *dorothea*; but granted that androconial mark, wing shape, behavior of second discal and subterminal lines, and certain peculiarities of scaling, such as disclosed by the cinereous irroration, constitute specific characters in this group (if they do not, then one arrives at the absurd conclusion that there is only one "good" species, *gemma* Hübner, with ab. *pyracmon*, ab. *henshawi*, ab. *maniola*, ab. *dorothea* etc. not even as races, for they occur together in different combinations) I cannot very well see how *maniola* can be placed alongside the *dorothea* races described, which all have a system of common characters quite inapplicable to *maniola*.

The third species, *pyracmon* Butl., is newly added here to the fauna of North America, although for many years specimens, labelled "henshawi" in collections, have been coming from Arizona. The Biol. Centr. Am. figure of "*Pyracmon*" female underside, totally different from Butler's figure, refers obviously to a form of *henshawi*, while the beautifully executed portrait of *pyracmon* male, with underside, is designated as "*hilaria*" (an error corrected in the text). Butler's figure of the underside is coarsely colored, being, with the other butterflies on the plate, too dusky and though illustrating, as it purports to do, a female, produces a wrong impression, simulating a male. Thus, *pyracmon* is pretty well concealed from the collector. However, a careful examination of Butler's text and figure convinces me that the Biol. Centr. Am. does illustrate the male of Butler's species, and with this figure the Arizonian insect tallies nicely. Unfortunately, I have not been able to obtain Mexican specimens or to get a photograph of the type from England.

Butler's original description, in Victorian Latin, runs thus:

"Euptychia Pyracmon, sp. n. female. Alæ supra fuscæ, linea post alarum medium posita fusca, extus rubro marginata, anticarum subintegra, posticarum lunulata: anticæ margine postico paulo fuscescente, ciliis cinereis: posticæ margine apicale paulo fuscescente, margine anali rufescente, maculis tribus (or two. V. N.) submarginalibus nigris, interna minima: corpus cinereofuscum; antennis supra fuscis, subtus albidis, præ flavescentibus, cinereo fasciolatus. Alæ subtus ochreæ cinereo variæ, fasciis duabus mediis irregularibus ferrugineis: anticæ linea submarginali undulata apicem non attingente (this character cannot be constant. V. N.): posticæ linea submarginali lunulata argintea, apud marginem analem intus ferrugineo marginata, ad apicem maculas duas binas argenteas formante, maculis duabus mediis marginalibus nigris, macula permagna subanali cinerascente: corpus ochreo cinereum. Exp. alar. unc. 1 14/16. Hab. Oajaca (Mexico). B. M.

Closely allied to *E. gemma* from which it differs in being much larger, having the apex of the fron wings subangulated and the outer margin of the hind wings sinuated; the wings above reddish in some parts, with much larger marginal black spots; below the central streaks are more distinct, reddish and different in outline."

The last distinction is a mistake, *gemma* showing the same peculiar serrate projections of the second discal, secondaries underside (a character carried to a still further extent in the closely allied *pephredo* Godman [1901, Biol. Centr. Am. Rhop., II, p. 657; III, pl. 8, fig. 12, mislabelled "gemma"] which thus stands towards *hilaria* Godman [1901, Biol. Centr. Am., II, p. 658] in the same way as *pyracmon* does towards *henshawi*); otherwise the description is reasonably clear and has been repeated in a condensed form 45 years later by Weymer who alludes to the male too — at least I think he does, because of two details, the "reddish" aureoles in secondaries upperside, and the "dentate" lines in secondaries underside; but his reference to the sexmark as being "large" is extremely unfortunate (though in keeping with the general mess Weymer makes of the *Neonympha*).

Pyracmon from a North American pair may be described thus:

Neonympha pyracmon Butl.

Primaries: with full evenly rounded termen; secondaries: termen sinuate, with slight projection on Cu_1 in both sexes, but the wing comparatively small and round (i.e. not as developed as in the next species).

Male upperside: velvety brown, i.e. of a smoother and lighter color than *maniola* or *dorothea*, with dull cinereous, instead of fuscous, cilia. Secondaries: second discal visible as a wavy dark fuscous line margined outwardly with fulvous red; præterminal spots rimmed with the same bright hue (very different from the pale aureoles of *maniola*); clot of similar fulvous red tint above Cu_2, corresponding to triangular diffusion of subterminal bar beneath.

Androconial mark: short and narrow, much smaller than in *dorothea*, with deeply sinuate outer edge, its crests traversed by the veins; only just reaching second discal at these points; consisting of three patches (in Cu_2, Cu_1 and M_3) decreasing upwards, roughly trapezoid in shape but with outer sides deeply scooped; and of a very slight crescent (instead of triangle) in cell R + M with its convexity against cross vein and reaching down to about level of Cu_1. (See fig. 4.)

Female upperside: less differentiated from male than in *dorothea*, with similar to male but broader red rims, red blot and red margin to wavy second discal on warm brownish ground in secondaries; primaries with distinct reddish second discal.

Male and female, underside: both wings smooth greyish ochreous with a suggestion of olivaceous and very sparse striæ. Primaries: lines running subparallel to each other and termen; all three comparatively thick, of a clear fulvous red on both wings; præterminal dots blended into a continuous fulvous red line. Secondaries: lines, especially second discal, extraordinarily developed, continuous, broad, clearly displaying their mellow fulvous red tint; second discal so strongly toothed outwardly in its bold course (essentially of a different, direct, type than in *dorothea* or *maniola* where its outward deviation in M_1 causes the eye to miss its connection with the second discal of primaries) up to costa, where it connects with the second discal of primaries, that it interferes with the marginal markings as it projects terminally along veins Cu_2, Cu_1, M_2,

M_1 and R_s as if attracted by the metal of the præterminal serration; on Cu_2 its projection practically unites with the swerve of the subterminal line, thus forming a kind of roof over the W of the silver line, the bar being transformed here into a fulvous red triangular blot. The palish cinereous patch with a fulvous red diffusion of the aureoles, is in contact with the second discal because of the latter's development terminally, not because of its own basally as it is in *dorothea*; it is weakly dusted rather than striated with dark scales and produces a smoother, slightly opalescent effect due perhaps to the proximity of the florid second discal line.

Male, exp. 19.8, plesiotype, "Palmerlæ, Cochise Co., July '05" Am. Mus. Nat. Hist.

Other specimens: male and female (exp. 19.6) "Globe, Gila Co., Sept. 11", ex Coll. C. F. dos Passos, Am. Mus. Nat. Hist.; male "Paradize, Ariz., Poling", Carn. Mus.; male "C. J. Paine Coll.", Mus. Comp. Zool.; male "Cochise Co." ex Coll. W. C. Wood, Am. Mus. Nat. Hist.

It remains to tackle the fourth species. In 1876 W. H. Edwards, working, it may be assumed, in a bad light (note the "plumbaginous"), thus described a new "Euptychia":

"Euptychia henshawi, n. sp. male. Exp. 1.5 inch. Upperside light fuscous, immaculate. Underside of primaries russet, deepest along inner margin, brownish towards costa; crossed by four wavy ferruginous lines, one of which is parallel to the hind margin, midway between cell and margin, one just beyond cell and curving around it to costa, the third crosses middle of cell and the fourth is a demi-line ending at median nervure; there are also four transverse streaks near base of wing. Secondaries grey-brown, slightly russet tinted, crossed by two ferruginous lines, the outer one irregular, wavy towards margin, shaded on its inner side; the outer, near base, rather zigzag than wavy; some fine streaks on basal area; the hind margin ashy brown streaked with dark ferruginous; showing four black eyelets, small, equal, placed near the edge of the wing, in pairs on the upper median and next upper interspaces, each with a plumbaginous streak across the marginal side and through the middle, but not reaching quite across; irregular streaks or slight patches of dull silver in the interspaces both towards outer and inner angle; the margin next inner angle edged with ferruginous. Body above fuscous, beneath gray, the abdomen buff, legs gray; palpi gray with black hair in front; antennæ fuscous, imperfectly annulated with whitish; club fuscous above, russet below.

"Female. Exp. 1.7 inch. Both wings russet in disc, primaries most brightly. The margins fuscous as is also costal edge of primaries; on secondaries the eyelets of underside are indicated by small dark fuscous spots. Underside as in male.

"From Arizona and New Mexico, collected in 1874 by H. W. Henshaw of the Wheeler expedition in honor of whom I name the species, and in 1875 by Lieut. W. C. Carpenter."

The description of the male is worthless for all purposes of determination and I have ignored it in my bibliographical summary. A light fuscous Neonympha expanding 1.5 inch with no markings, red flush or androconial brand might be, for all one knows, an oversized *gemma* — although on the other hand it is possible to argue that the describer was merely in a hurry to get to the interesting underside. The "demi-line" obviously refers to some chance sequence of striæ (and what is further left without comment fits at least seven species of *Neonympha*). Size, ground color of underside and description of lines in secondaries underside apply perhaps better to *dorothea edwardsi* than to the species which I hold to be the true *henshawi* Edw. The words "New Mexico", where *henshawi* is not yet known to occur, suggest that there were some specimens of *edwardsi* (not however the one taken, much later, by Snow) among the series Edwards was examining as he wrote. On the other hand, the description of the lines in primaries upperside and of the cinereous scaling in secondaries underside does not fit *edwardsi* (or any race of *dorothea*) at all: it exactly fits *henshawi*. In fact, if this male were a hybrid between the two, with moreover a strain of *gemma*, it could not have been better described. Such a freak being unlikely, I am forced to dismiss this confused and composite picture altogether as not applying to any known insect.

The description of the female however is that of a fairly recognisable *henshawi* (a form of which was figured as *pyracmon* by Godman four years later) differing from the female of *dorothea* in the two main details cited: "russet in the disc, primaries most brightly" and "small dark fuscous spots" which in *dorothea* are comparatively large and dim. As the tint which Edwards calls "russet" seems to be on the yellow, rather than on the red side (for example, the costal yellowish brown of the primaries underside in *dorothea* or the ground color upperside in female *avicula*), "russet" cannot apply to the pale reddish female of *dorothea edwardsi*, a specimen of which Edwards had. "Underside as in male" merely suggests that when Edwards picked up the fresher female of the two he possessed, a *henshawi*, the general impression he had formed from the inspection of his mixed males was based less on his specimens of *dorothea*, than on those of *henshawi*. But again, the back of an entomologist's mind is not a very sound basis for the deciphering of his descriptions, and so a further accumulation of clues is necessary.

In 1887, 11 years later, Edwards, in one of the finest works on butterflies ever published, gave a lovely plate illustrating his species, the models being a male and female from his collection. These are before me as I write and are not *dorothea edwardsi*. Except that the termen in the female is perhaps not sinuated enough, these figures are admirable. The accompanying description, which is far superior to the original one, will be examined presently. Edwards adds that the resemblance of his species to *gemma* is close in regard to the markings, and describes the egg which Doll sent him from Arizona in 1881, but which did not hatch (thus leaving us in doubt as to which of four possible species laid the dome-shaped turquoise blue ovum Edwards figures). In 1891, Charles J. Maynard described *N. henshawi* Edw. ("Henshaw's Quaker") as follows: "About the size of the type *N. euritris*, but is more reddish or rusty above, a dark band crosses middle of both wings, and there are two black dots in middle of outer border. Beneath finely marked with minute lines between the common bands. On outer portion of fore wings there is a wavy band but no spots. In the middle of hind wing is a whitish space containing four dots in pairs, each with a silver center. Above and below these are silver markings." There is not a shadow of doubt that this blunt description refers to the species (though not to the same specimen) that Edwards figured, and the humble woodcut Maynard gives of the underside of a female right hind wing represents that species quite unmistakably — which is a highly important moment in the nomenclatorial history of this unfortunate butterfly, and which would have prevented me, if nothing else did, from switching the name *henshawi* to the species *dorothea* had I wished to retain the more familiar name for a butterfly which appears to be more widely distributed this side of the border. Godman's mention of "*henshawi*" (II, p. 658) may as well refer to *dorothea*; Weymer's description of "*henshawi*" in what Holland politely calls a "monograph" of the *Neonympha* is much too slapdash and muddled to be taken into any account at all.

But to return to Edwards' description in Butt. N. Am.:

"Male. Exp. 1.5 inch. Upperside dark brown, often with russet over the extra-discal areas of both wings; some examples have an ill defined patch of russet on the median interspaces of primaries, and there is usually a russet edging to hind margin secondaries next anal angle; on the middle of same margin two small black spots not always present; fringes dark grey. Underside either brown or russet, thickly dusted with yellow-white scales, more yellow beyond the discal band of secondaries; the whole surface finely streaked and dotted with red brown; primaries crossed by three wavy red brown lines, two of which enclose the discal band, the other lying nearly midway between the band and margin, often macular; some examples have a demi-line crossing cell to median; the discal lines are continued across secondaries, the outer one often projecting roundly on second subcostal nervule; a short sinuous line an anal angle; on middle of hind margin a large suboval patch, the ground of which is dark brown, sprinkled with whitish scales; within this, in upper median and discoidal interspaces, a pair of velvet black spots, each with an inverted "T" shaped patch of silver; in the interspaces towards outer angle a pair of silver dashes each, and in lower median a silver serration, and a bar in submedian. Body above dark brown, beneath grey brown; legs same; palpi grey with many black hairs; antennæ blackish, annulated with light; club black above, ferruginous at tip and beneath.

"Female. Exp. 1.7 inch.; russet, brown about the margin; spots on secondaries as in male. Underside of primaries russet, of secondaries yellow brown; marked like the male.

"New Mexico, Arizona, Colorado. First taken by H. W. Henshaw of the Wheeler Exploring Expedition, 1874. Morrisson afterwards brought examples from Arizona and B. Neumoegen from Oak Creek Canon, Colorado."

It is evident that here again Edwards had a series of mixed specimens before him. Only the Arizona ones, and not all of them, were *henshawi*. The "patch of russet" coming directly after the "russet" of the first line is not mere repetition, but seems to imply the difference that Edwards might have noticed between Henshaw's specimens with diffuse fulvous and a fulvous patched New Mexican race of *dorothea*. The "not always present" is less an excuse for the "immaculate" of the original description than an impression produced by the contrast between the distinct spots of *henshawi* and the rather dim blotches of *dorothea*. The abundantly streaked yellow underside is *henshawi* all over; so is the continuation of the lines from primaries across secondaries. The "often roundly projecting" refers to specimens of *dorothea*. The "suboval patch" is again *henshawi*. The original description of the female has been slightly revised as Edwards was evidently puzzled at having such different specimens of females. But taken all in all, I think we can distinguish here, through the fade-out of *dorothea*, an elegant and correct delineation of both sexes of the species which in 1887 corresponded to Edwards' final concept of his *henshawi*, the butterfly figured.

An examination of the eight specimens which are labelled, I understand, by Edwards himself, and come from his collection (now in the Carnegie Museum) reveals that five of these are *dorothea edwardsi* while the other three (two males and one female) represent the insect which I here definitely fix as *Neonympha henshawi*. There is no doubt in my mind that the female belongs to the same colony as the two males, and there is a reasonable amount of probability that it is the exact specimen of the original description which in the corresponding passage conveys rather neatly the general impression produced by this remarkably well conserved female. This noted, the following summary of distinctive characters will settle the identity of *N. henshawi*.

Neonympha henshawi Edw.

Typical race: primaries: roughly elongated apically, with slightly concave (fuller in female) slanting termen; secondaries: terminally sinuate, more so in female where they are very developed, with a projection (in some almost caudal) in termen on Cu_1; tornus angulate in both sexes. Upperside: cilia dull cinereous as in *pyracmon*. Male: of a smooth brown tint rather as in *pyracmon*. Primaries: with a cloud of dull fulvous discally (presumably less evident in fresh specimens); M_3 and lower corner of cell R + M outlined in same. Secondaries: with two præterminal spots, very distinct, small, oval, unrimmed; dimly discernible second discal line which is dark fuscous, tinged outwardly with diffuse dull fulvous.

Androconial mark: resembling that of *pyracmon*, but more expanded (conspicuously so in faded specimens) towards dorsum; consisting of three patches: large rhomboid with concave outer edge in Cu_2; a much narrower one in Cu_1, slightly concave outwardly; smallish patch in M_3; and of a crescent rather tending to a triangle but still retaining *pyracmon*'s character, although larger and reaching down in cell R + M to somewhat beyond the level of Cu_1. (See fig. 3.)

Female upperside: primaries rather bright tawny fulvous in disc, otherwise fulvous brown inclining to fuscous towards base and terminally; second discal brownish, distinct; first discal suffused with the brownish shading (but distinct in all other specimens I have examined which thus look more definitely banded than the only female of the typical race). Secondaries: fulvous in disc, fuscous basally, with a fuscous border in which the fulvous aureoles of the two distinct black small oval præterminal spots are broadened basally, and fuse to form an inner band.

Male and female underside: ground color similar on both wings (except for a space between second discal and subterminal in secondaries where it is lighter), of *pyracmon* type, but rather drabber, more yellowish, and regularly striated with browner striæ (except in said space). Primaries: second discal, corresponding to termen, angularly curving around cell R + M from costa (less angularly in some females where it thus resembles *pyracmon*), then sloping towards first discal with its concavity outward, subparallel here to subterminal which runs midway between second discal and termen, all through subparallel to termen, to reach costa. Secondaries: second discal tending, especially in female, to be straight (cp. the primal straightness of its course in *pyracmon* despite the dentations), and distinctly passing in front of the upper V-mark to connect with second discal line of primaries. Cinereous irroration reduced to small weak suboval patch in middle of outer third, speckled rather than striated with darker (dull brownish) scales; completely surrounded by ground color, with broadish yellowish brown diffusion of aureoles within. Subterminal line thin and only slightly curved in Cu_2 with very slight or diffused bar (invisible in most females) not interrupting the line which is thus perceptibly continued up as a slight inner margin of patch (very clear and straight in some females).

Female, lectotype, exp. 21.3, and male, paratype, exp. 20.4, labelled in Edwards' hand, "Henshawi M., Ariz[a]," Carn. Mus. Paratypes: male with same label, Carn. Mus.; two males, no locality, ex Holl. Coll., Carn. Mus.

None of the following specimens examined belong to the type race, and the females fit in especially well with Maynard's description and figured outline: one male, exp. 20.5, "Arizona", ex Coll. C. F. dos Passos; Am. Mus. Nat. Hist.; three females (one exp. 22.9) "So Ariz., O. C. Polling, ex Coll. A. G. Weeks," Mus. Comp. Zool.; one female "Chiricahua Mts., D. K. Dunkan, 24.VI.33", ex Coll. C. F. dos Passos, Am. Mus. Nat. Hist.; one female, "Cochise Co., ex Coll. W. C. Wood," Am. Mus. Nat. Hist.

Two males from Pima Co., "Mud Springs, Santa Catalina, 6.500 f. 17–20.VII.16", Am. Mus. Nat. Hist., and a female, "Cochise Co., C. J. Paine", Mus. Comp. Zool., offer some curious "pyracmonoid" characters. One of these males (exp. 18.7) has a slight rusty broadening of the second discal line in secondaries underside, which thus seems to run closer to the cinereous patch than in typical *henshawi*. The other male and the female show a definite rusty diffusion of this line near costa and another projection where it tends to unite with a rusty (though less red than in *pyracmon*) blot above the silver W.

Two males with Edwards' labels in pencil "*Henshawi* M. Ariz[a]" ex Coll. Holland, Carn. Mus., obviously represent a definite race. There is more dull fulvous red spread over the primaries, so that these might be described as of that color, with dark fuscous sexmark traversed by fulvous veins, and rather pale fuscous shadings terminally and subcostally; second discal line in secondaries broadly margined discally with warm reddish fulvous; aureoles of the same tint. Underside curiously resembling *hilaria* (especially in one of the two specimens) owing to the transverse spaces between the lines being alternately darker and lighter, and rather brightly yellowish between the second discal and subterminal lines of both wings. Six females (2 females "Arizona E. G. Graham Acc. 8157. St. Rita Mts., 5.VII.27", Carn. Mus., 1 female, same region, same collection, "Florida Camp 8.VII.27", Carn. Mus., and 3 females "Huachuca Mts., 6.800 f., 21, 23, 23,VI.36", ex Coll. C. F. dos Passos, Am. Mus. Nat. Hist.), belonging, I think, to the same form as the variegated males, may be described as: fuscous with contrasting warm reddish bands and margins to lines, and with underside very like Godman's figure.

A few words may be added concerning the male armature of the four species under consideration. In *dorothea* the uncus looks straighter and the clasp broader (more arched dorsally and fuller ventrally) than in *maniola*, *pyracmon* or *henshawi*. I do not perceive much difference between the organs *pyracmon* and *henshawi*, except perhaps a slightly thinner uncus in the latter. Of the four species, *maniola* seems to have the narrowest clasp (concave ventrally, with elongated spur). Partly because several superficial characters proved sufficient to easily separate the four species, and partly because the number of specimens representing each was not compatible with a long series of dissection, the examination of the male armature was limited to half a dozen preparations, two of which were made for me by Mr. W. P. Comstock at the American Museum of Natural History. For the genitalia of *maniola* I used a slide prepared in 1934 by Dr. Marson Bates. Judging by the fact that he prepared a slide of *dorothea* too, it seems fair to suppose that he had noticed the difference between these two insects long before I did. Further study might reveal whether the shape of the clasps is constant (it was identical in 3 specimens of *dorothea*), or, if not, what is the specific scope of its variation.

In conclusion, my thanks are due to Mr. W. P. Comstock of the American Museum of Natural History for his invariable assistance and advice, and for the loan of their material; to Mr. C. F. dos Passos for loaning me his specimens; to Prof. Nathan Banks for placing at my disposal the series of the Museum of Comparative Zoology; to Dr. C. T. Parsons of that institution for assisting me in several matters; to Dr. A. Avinoff and Dr. W. R. Sweadner of the Carnegie Museum who not only patiently answered my queries concerning the Edwards series, but did me the exceptional favor of sending me all the "*henshawi*" material of the Carnegie Museum.

BEE-KILLING ASILIDS IN NEW ENGLAND

By Stanley W. Bromley

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While Robber flies have been reported as destructive to honey-bees in Nebraska, Missouri, Texas, Florida and other Southern States, no species has been noted as of economic importance in this respect in New England.

In my observations on the prey of Robber flies in south-central Massachusetts as reported in Psyche, December 1914, p. 192, I mentioned that I had not observed Asilids feeding to any extent on honey-bees, although I listed certain species such as *Proctacanthus philadelphicus* Macq. and *Diogmites* (*Deromyia*) *umbrinus* Loew as partial to worker vespids.

A few years later, however, a situation came to my attention where Asilids were attacking bees extensively. This observation is here published for the first time. The species concerned was *Promachus fitchii* O. S. the famous old "Nebraska bee-killer" whose habits were first described by Fitch in his New York report of 1864.

About a mile and a half south of Southbridge, Massachusetts, lies a large drumlin called Lebanon Hill. Part way up the hill was an apiary of 15 or 20 hives. Adjacent to the bee yard were several dry hayfields which, although mowed yearly, were reaching a condition described as "run-out" by the farmers, because the better grasses were beginning to give way to such plants as ox-eye daisy, sorrel and black-eyed susan; a condition very probably due to white grub infestations. The dominants were, however, still timothy, red-top and some scattered clover.

These hayfields were fairly seething with *Promachus fitchii* and I soon saw that the majority of prey taken by them consisted of worker honey-bees. On July 10–13 (1915) and July 15 (1916) I collected 42 of these flies, both males and females, each with a honey-bee as prey. This represented in all about three hours collecting.

A summary of the records I have collected of honey-bees falling victims to Asilids in New England between 1911 and 1941 follows. These observations were made largely at Southbridge, Massachusetts; Wallingford and Stamford, Connecticut; and nearby areas.

Asilid species	Number of instances of honey-bee prey
Promachus fitchii O. S.	56
Diogmites umbrinus Loew	40
Proctacanthus philadelphicus Macq.	22
Proctacanthus rufus Williston	14
Promachus bastardii Macq.	11
Diogmites discolor Loew	7
Bombomima thoracica Fabr.	2
Bombomima grossa Fabr.	1
Bombomima flavicollis Say	1
Proctacanthus brevipennis Wied.	1
Erax æstuans L.	1

Of these 11 species, *Diogmites discolor* is restricted to the extreme southwest corner of Connecticut, *Proctacanthus rufus* to certain sand plains or washouts along some of the larger streams and rivers, *Bombomima grossa* is decidedly uncommon, and *Proctacanthus brevipennis* is found almost exclusively in level sandy open woods. The remainder are widespread and locally abundant. *Erax æstuans* is probably the most abundant and generally distributed of Southern New England Robber flies.

C. W. Johnson's list of N. E. Diptera (1925) recorded 86 species of Asilidæ in New England. Of this number it may be seen that only 11 species ordinarily kill honey-bees and of these only 3 or 4 at most may kill bees in any quantities. Even with the leading species on the list, *Promachus fitchii*, it would be very rarely that the effect of bee-killing by this insect on a commercial apiary would be felt.

In fact, it would seem quite probable that any possible loss which *P. fitchii* might occasion to bee-keepers would be more than counterbalanced by the control of *Phyllophaga* grubs exerted by the larvæ of this fly. Such benefits, however, would be much less apparent now than thirty years ago due to the decline in the utilization of grass for hay and the abandonment of mowing in many parts of New England as a result of the displacement of the horse by motor driven vehicles.

Promachus fitchii tends to disappear from hayfields after they have been abandoned and an old-field succession of varying stages from grasses to shrubs and trees takes place. So after all, the species begins to lose any significance it might have had as a bee-killer thirty years ago, with the changing times and conditions of more recent years.

NEW SPECIES OF SYRPHIDÆ FROM THE NEOTROPICAL REGION [1]

By Frank M. Hull

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The present study is largely based upon flies in the Museum of Comparative Zoology at Cambridge, and is a continuation of earlier studies made upon these collections through the courtesy of Professor Nathan Banks. Types unless otherwise specified are in the collections of the Museum. Some paratypes are in the author's collection.

Eristalis bequaerti n. sp.

Characterized by the median pair of thoracic vittæ, fused on the posterior half, the pattern and yellow post margins of the abdominal segments. Related to *texanus* Hull.

Male. Length 8 mm. *Head:* the eyes are thickly brown pilose, the front and face black, the sides of both densely whitish pubescent and becoming brownish pubescent towards the middle of the front; a somewhat triangular area in front of the antennæ is left brown to black and bare. The pile through the whole middle of the front is black; on the sides and face white and abundant. Cheeks shining black. The vertical and upper occipital pile is black, the antennæ are dark brownish-black, the arista bare, the eyes touch for a short distance. *Thorax:* the mesonotum is opaque grey, bluish on an area behind the humeri and faintly brownish-grey on the remainder and with four black velvet vittæ. The medial pair coalesces just behind the suture and proceeds singly to the scutellum. Scutellum opaque bluish-black pollinose, the center and apex obscurely light brown. The pile of the whole pleura and broadly across the front of mesonotum is whitish. The notapleural pile and that upon the posterior half of the mesonotum is black.

[1] Published with the aid of a grant from the Museum of Comparative Zoölogy of Harvard College.

Scutellar pile, except for sides and ventral fringe black. *Abdomen:* velvet black marked as follows: a brownish-black shining widely separated transverse central fascia upon the second segment, expanded a little laterally, a more slender, unbroken, shining black fascia across the middle of the third and fourth segments. The posterior margins of second to fourth segments are broadly opaque yellow. Abdominal pile short, dense, mostly erect and whitish to yellow. *Legs:* femora shining blackish, the hind pair considerably thickened in the middle, the tibiæ brownish-black, the basal third of the first pair and a little more than a third of the second pair brownish-yellow; the base of the hind pair is very dark brown. The first three tarsal joints of anterior and middle tarsi are light yellowish-brown; basal three joints of hind tarsi dark brown; remaining tarsal joints black. *Wings:* hyaline and bare, the stigma narrow and dark brown.

Holotype: a male. Villarica, Paraguay, October, F. Schade collector. One paratype, same data. I take pleasure in naming this for Dr. Joseph Bequaert.

Eristalis glabella n. sp.

Related to *fuliginosus* Hull, the arista is largely whitish, the scutellar cuneate spot is differently shaped and the third abdominal segment is almost wholly shining, besides less dense pile upon scutellum and mesonotum.

Female. Length 10 mm. *Head:* the front is shining black with an opaque, eye-marginal, elongate spot on the upper part of the front from the lower end of which a linear band of white pubescence margins the eyes all the way to the cheeks. Face and cheeks shining black, the sides of the former broadly white pubescent and sparse white pilose. The pile of the front and vertex is black with some white pile upon the lower part. Antennæ brown, the third joint oval and rounded apically; the arista bare, pale yellow at base and whitish on practically its whole length. *Thorax:* subopaque black, shining in front of the scutellum and sides of the post calli. The suture is linearly margined anteriorly with whitish pubescence; the humeri is margined anterio-medially with brown pollen and there is a pair of medial, obscure, brown pollinose stripes on the anterior part of the mesonotum. Scutellum opaque black and brown pollinose in an oblique light; it is sparsely black pilose and with a slender, posteriorly-pointed, yellow wedge down the middle narrowly reaching the apex. *Abdomen:* elongate, everywhere black and shining; there is a posterior fascia and medial extension upon the second segment, a medial basal spot on the third segment and the whole of the first segment opaque. The medial vittæ of the second segment from a posterior view is margined with whitish pollen. *Legs:* shining black, the hind femora much thickened in the middle, the anterior fore tibiæ reddish-brown, the hind pair light brownish-red; all of the tarsi are light brown, the hind pair almost orange. Apex of hind tibiæ with a fairly sharp spur. *Wings:* apical half of wings to posterior margin strongly tinged with brown.

Holotype: a female, Summit, Canal Zone, February 24, 1940, A. G. B. Fairchild.

This fly may prove to be the female of *fuliginosus* Hull. However there are a number of dissimilarities as outlined above.

Eristalis thalia n. sp.

Related to *mitis* Curran and *parvulus* Williston. It has no grey spot on the second segment of the abdomen. Thorax brownish-black, black trivittate.

Male. Length 8 mm. *Head:* the eyes are densely long brown pilose, the face front and cheeks are shining black, the sides of the face and front before the antennæ brown. The face below antennæ, and widely on the sides as low as the bottom of the tubercle, is yellowish-white pubescent and long yellowish-white pilose. The pile of the front and vertex is black; of upper occiput mixed black and yellow. Antennæ: first joint brown; others wanting. Eyes not quite touching; they approach one another near the middle of the front. *Thorax:* opaque brownish black, feebly shining along the lateral margins with a narrow, anteriorly attenuated, medial black vittæ evanescent before reaching the scutellum and a similar, slightly wider vittæ on the middle of each half of the mesonotum, obscurely interrupted at the medial end of the suture. The anterior portion of the lateral vittæ is twice as wide as the medial one; the posterior end of this vittæ is pointed. Viewed posteriorly the three vittæ of the mesonotum are separated by two wide yellowish-brown pollinose stripes. Pile of pleuræ and mesonotum, except just behind the suture and upon the posterior half of the post calli where it is black, entirely pale yellow. Scutellum opaque greenish-yellow with the sides, the narrow base and an extremely narrow rim black; its pile is black except upon the extreme rim. Squamæ pale brownish-white with black rim and yellow fringe. *Abdomen:* short, broad, the first segment and upon the second segment a very broad, basally expanded, medial vittæ slightly expanded before the apex and continued at this width over the third segment where it is expanded again apically. Fourth segment wholly black except for its post margin; it has a central, slender, transverse, medially indented, shining black fascia. The black portion only of the third segment has a similar indented shining fascia. Segments two to four have each a wide yellow post margin; the sides of the second and third segment are left broadly light yellow, with in places a brownish tinge. The pile upon the black areas is black and is yellow basally upon the second segment and the corners of the third and fourth. *Legs:* shining black, the bases of the first four tibiæ and the extreme base of hind tibiæ brownish. Hind femora very little thickened, its pile golden except for a few black apical hairs and ventral short and long black bristles on the apical half. The hind tibiæ ends transversely; hind trochanter without special hair. *Wings:* hyaline and bare.

Holotype: a male. Bogota, Department Cundinamarca, altitude 2600 meters (Osorna, collector).

Eristalis antiopa n. sp.

Mesonotal pattern as found in *furcatus* Wiedemann; scutellum slaty black, legs black, abdomen bluish-black.

Female. Length 9.5 mm. *Head:* eyes short, yellowish-brown pilose; the face, cheeks and front are shining bluish-black, the latter yellow just before the antennæ; the sides of the face are broadly silver pubescent and pilose. This pile extends laterally up to the middle of the front. The central frontal pile and occipital pile is widely black throughout. All but the upper part of the front is blackish pollinose, merging laterally into silvery pubescence; the front is bare just above the antennæ and with a narrow, opaque, black vittæ in the middle on the upper part. The antennæ are black, the arista dark brown, bare and white-tipped. *Thorax:* the mesonotum is opaque bluish-black with a median black vittæ proceeding from the base of the scutellum and dividing into two vittæ in the middle of the posterior half of the mesonotum. There are a pair of similar undivided vittæ on either side in the middle running from scutellum to the anterior margin and interrupted at the suture. The posterior section is slightly curved, its lateral sides concave. The mesonotal pile is short and black, the pleural pile white, the scutellum blue-black, faintly shining, its pile chiefly black. The squamæ are white with broad black margin and white fringe. *Abdomen:* black, the second and fourth segment has narrow yellow post margins; the second segment has a basal, posteromedially produced, opaque black fascia which does not reach the sides. It almost touches a rather wide, posterior black fascia which narrowly reaches the posterior corners. The third segment has a similar, narrower, less produced basal fascia and a shorter but equally wide posterior fascia. Fourth segment similar, each fascia still more reduced. Between these black opaque fascia the abdomen is shining metallic greenish-black. *Legs:* shining black, slightly greenish on the hind femora which are considerably thickened in the middle. The extreme base of the tibiæ is dark brown; the first two joints of the middle tarsi are dark brown, the remainder of tarsi black. Hind tibiæ ending transversely; hind trochanters without special hair. *Wings:* hyaline and bare.

Holotype: a female. Villarica, Paraguay (F. Schade); paratypes: two females, same data, one in author's collection.

Eristalis dorothea n. sp.

Related to *scutellaris* Fabricius, this species is characterized by the thick, soft, golden pile of the scutellum and parts of the mesonotum; half of the scutellum yellow; mesonotum with peculiar pattern.

Female. Length 12 mm. *Head:* the eyes are short brown pilose, the face, cheeks and front are black and moderately shining, the sides of the narrow produced face are thickly yellowish pubescent and yellowish pilose. The front is widely shining on the lower half and narrowly yellowish pubescent on the eye margins with an opaque black fascia on the upper half which is a little expanded along the eye margin; viewed obliquely there is a short, linear, yellowish pollinose vittæ on the upper part of the front below the opaque black. There is a rounded protuberance in the middle above the antennæ. Antennæ brown, the third joint blackish, the arista pale brown. *Thorax:* the mesonotum is moderately shining bluish-black with across the middle, just behind and margining the suture, a lateral, evanescent, attenuated, medially club-shaped, opaque black fascia which is medially interrupted. On the anterior half of the mesonotum, anteriorly submarginal, there is a medially interrupted, wide black fascia. Pile of mesonotum yellow on the middle of the anterior half and in front of the suture, and in a narrow band in front of the scutellum in front of and on the post calli; elsewhere the pile is short and black. Pleural pile short and pale. The scutellum is opaque black on the basal half, brownish in the lateral corners, opaque egg-yellow on the remainder; its pile is short, dense and golden with a few longer yellow hairs on disc and rim. *Abdomen:* elongate, slender, apically pointed and shining bluish black; the first segment is opaque black on its posterior and lateral margins and corners. The second segment has a postmarginal fascia, medially indented, laterally attenuated, and a subbasal, medial, rounded, posteriorly acutely filate, opaque black spot. Viewed posteriorly the central portion of this segment is whitish pollinose. The third segment has a similar, slightly wider posterior fascia and no anterior spot. The fourth segment has a post marginal, indented black fascia a little wider sublaterally. Pile of the abdomen very short, chiefly black on the black areas, whitish elsewhere. *Legs:* the femora are brownish-black, the apical half of first four tibiæ diffusely dark brown and growing lighter basally and with pale yellow pile. The hind tibiæ are quite flat, rather arcuate apically and with a very short scoop-like production. Its pile and pubescence is pale. Hind femora greatly thickened in the middle, quite narrow before apex, its pile chiefly brassy; its ventral apical half has many short black spines and some long black bristles. The short black spines reach to the basal third. *Wings:* pale grey, the stigma three times as long as wide, the wing almost wholly villose.

Holotype: a female. Villarica, Paraguay, v (F. Schade).

Microdon barbouri n. sp.

Characterized by the general greenish color, which includes the face, the broad base of the abdomen, and the emarginate scutellum, antennæ black and longer than the face.

Female. Length 11 mm.; antennæ 3 mm. additional. *Head:* almost everywhere brilliant green; golden on either side of the antennæ and eye margins, shining black just before the antennæ with a narrow shallow depression on the lower part of the front, triangular in shape, the apex of the triangles of either side meet just above the shining black area. Pile of face light shining yellow and yellow across the lower part of the front, broadly behind the ocelli and over the whole of the green occiput. There is a band of dense black pile from eye to eye in front of the ocelli and a few black hairs in front of the antennæ. The antennæ are black, the first joint is as long as the last two, the second joint small, the third joint rounded, scarcely flattened with large, elongate subapical pore, its apex bluntly pointed. The arista is brown and thickish except at apex; it is two-thirds as long as the third joint. *Thorax:* mesonotum brilliant, bluish-green, becoming golden in the middle of the anterior half and violaceous just before the scutellum. The pleuræ are green with a golden cast. The scutellum is green with a purplish cast and translucent reddish by a reflected light. The whole pile of the thorax and scutellum is rather thick and moderately long and light golden. Scutellum large, wide and long, emarginate posteriorly; the rounded apical productions are not very far apart; the indentation between is shallow. *Abdomen:* broad, apically pointed, brilliant blue-green; it is golden in the middle of the first segment, still more so along the middle posterior part of the third segment and somewhat golden in the corners of the third segment, where it is continued over on the narrow lateral margins of the fourth segment and again in the anterior corners of the fifth segment. The junction of the gold and blue-green on the sides of the fourth and fifth segments is linearly violet. Pile of abdomen short, appressed, light golden, with on either side a broad, diagonal fascia of black pile on the second to fourth segments. *Legs:* femora golden-green, tibiæ and tarsi light reddish-brown, the tibiæ with faint greenish cast; all of the pile of the legs is thick, long and golden. *Wings:* uniformly tinged with light brown, the apical cross vein bulges outward and is broadly rounded without a spur. The posterior apex of the second posterior cell is similarly rounded.

Holotype: a female. Paranagua, Parana. March 1937. (G. Fairchild collector.) I take pleasure in naming this interesting and beautiful species for Dr. Thomas Barbour, the director of the Museum of Comparative Zoology.

Microdon banksi n. sp.

Because of the shape of the arista this species slightly resembles *pachystylum* Will., but it is quite different in coloration and venation and other details.

Female. Length excluding antennæ 6.5 mm.; antennæ about 2 mm.; wing 5 mm. *Head:* eyes very widely separated, the upper occiput extremely thickened but with rounded posterior margin, the vertex shining brownish-black; the pile just in front of the ocelli, just behind it and again just in front of the antennæ black, elsewhere the pile of the head is wholly shining pale brassy. Along the upper occiput near the eyes the pile appears to be directed towards the eye margins; upon the inner upper eye margins it is directed towards the ocelli; from a point in the middle of the very broad front it appears to be directed in all directions, and opposite this mid-point it is upon the eye margins directed first towards the antennæ and then down ventrally towards the face. About the antennæ the pile is slightly more reddish and upon the face more whitish. Face short, not in the least produced, quite convex, most so upon the lower half, the pile thick, abundant, shining and directed downward but not flattened. Viewed from in front the sides of the face are more equally wide, perhaps barely wider below than across the antennæ. The ground color of the face in front is shining brownish-black. Antennæ elongate, the first joint but little over one-half as long as the third and together with the second and the extreme base of the third reddish-brown. The third joint is black, slightly narrower in the middle, upon its outer surface slightly curved, about twice as thick as the also outwardly curved first joint; arista basally produced from the outer side, very short, and thickened into a basally blunt spear-shaped structure, the tip needle-shaped, the whole arista light reddish. *Thorax:* almost as wide as the head, moderately shining brownish-black with more or less erect black pile except as follows: some pale brassy pile bordering a lunate, shallow depression on each half of the anterior part of the thorax, again narrowly across the mesonotal transverse suture, upon a sublateral stripe along the posterior half of the thorax and again in acute short triangles, one on each side, reaching forward from the posterior margin of the mesonotum. Pile of scutellum wholly erect and pale; its ground color dark blackish-brown, the surface sharply flattened and roughened; without spines or emarginations. *Abdomen:* relatively short, compact, wholly dark blackish-brown, a little lighter upon the first segment; its pile thick, sharp and setaceous, chiefly black and only suberect. Along the posterior margins of the third, fourth and fifth segments there is appressed, golden, quite sparse and scattered pile that is unusually long, it encroaches extensively upon the middle of the fifth segment but is scarcely present in the midline of the third segment. There is a similar patch broadly and outwardly along the posterior margin of the second segment. *Legs:* the femora, except the narrow apices, very shining dark chestnut-brown, the pile over this area black. Apices of all of the femora, whole of tibiæ and tarsi light yellowish-brown, also quite shining; tibial pile chiefly pale on the basal half, but reddish-brown apically. Hind femora very little thickened. *Wings:* broad, and deep, strongly tinged with brown, a heavy stigmal cross vein present; the subapical cross vein on its basal half is rounded outwardly; it joins the third longitudinal vein at right angles, there is a well developed spur from the posterior corners of both the first and second posterior cell.

Holotype: one female. Coast below Pico Turquino, June 20–30, 1936, Cuba 1936, Darlington collector. One paratype female, same data, in author's collection.

I take pleasure in naming this interesting species for Professor Nathan Banks.

In the second female the lunate depressions of the thorax seem to be absent, the pile of the anterior half, at least on the sides, is almost wholly golden, there is a narrow median vittæ of golden pile with a broad heavy stripe of black pile on either side of it interrupted at the suture and the lateral margins on the posterior half seem to be wholly golden pilose, the lateral margins of the anterior half of the mesonotum however are black pilose. The third antennal joint is almost wholly light brownish-red, only the apical third being infuscated.

Volucella osburni n. sp.

Related to *sexpunctata* Loew. There are only twelve bristles on the arista; the profile of the face is different.

Male. Length 8 mm. *Head:* eyes densely brown pilose, the face cheeks and front light translucent yellowish-brown, a little more reddish on the lower part of the face and cheeks; the latter is separated by a narrow black line. The pile of the face is yellow, of the front dense, long and black. In profile the tubercle is low and long. Antennæ orange, the third apex of the joint considerably more narrow than the base. The dorsal rays of the arista are about twelve and blackish; the arista pale yellow. The vertical pile is yellow. *Thorax:* mesonotum and pleuræ shining black, the wide lateral margins of the former including the humeri, the whole of scutellum and a spot in front of the scutellum light, subtranslucent brownish-yellow. All thoracic and scutellar pile is golden. Scutellar margin with three pairs of stiff yellow bristles and none in front of the scutellum. Marginal mesonotal bristles golden. Squamæ and fringe yellow. *Abdomen:* light translucent brownish-yellow, the middle and the posterior border of the first segment, a median vittæ and a lateral, elongate postmarginal fascia on the second segment shining black. Third segment with a similar but much narrower, medial, anteriorly attenuated, vittæ and similar short fascia in the posterior corners. The fourth segment has a still narrower, median vittæ attenuated at both ends and in each posterior corner an elongate vittate spot twice as long as wide. Pile of abdomen everywhere short, thick, erect and golden except on the black areas of the second segment where it is black. There are a few black hairs along the lateral portion of the post margin of the third segment. The whole pile of the fourth segment is long, erect and golden. *Legs:* brownish-yellow, the anterior side of hind femora with an elongate, blackish-brown streak fading on the outer third. The narrow bases of the other femora are slightly blackish; the anterior and hind tibiæ are narrowly blackish at apex; the last two tarsal joints blackish. Pile of legs golden except apically along the tibiæ. *Wings:* hyaline with pale yellow veins and basal half of stigmal cell pale yellow. Stigma brown, twice as long as wide, costal setæ black.

Female. Similar to the male, the black cheek lines are faint or confined to a tiny spot on the eyes. Front pale yellow, the crescentic area along the eyes punctate, the area between the red ocelli blackish, its pile yellow. Mesonotum similar, the wide median black area replaced by light brown. The yellow prescutellar spot may be quite large. Pattern of abdomen similar. The median vittæ upon the second segment is reduced to a slender brownish streak; the first segment may be wholly yellow; the vittæ upon the third and fourth segment are reduced.

Holotype: a male, Villarica, Paraguay, X (F. Schade). Allotype, a female and eight paratypes, all with the same data. I take pleasure in naming this species for Dr. R. C. Osburn.

Baccha nectarina n. sp.

Related to *phœoptera* Schiner; the wings are wholly dark brown, the pattern of the abdomen is different.

Male. Length 17 mm. Wings 13 mm. (longer than the abdomen). *Head:* cheeks and face yellow, the former brownish in front, the latter brownish on either side of the yellow-brown tubercle, and forming apparently two diffuse vittæ. The front is brownish-yellow and brown semicircularly in front of the antennæ which leaves, in front of the semi-circle a light brown spot in the center of which is a large, shining black, rounded callus. The upper part of the front has a subopaque, blackish triangle, almost equilateral, its apex touching the convergence of the eyes. The upper eye margin of the front is linearly blackish. The pile of the face, front and vertex is black, and golden on the whole of the occiput. The antennæ are orange and black pilose; dorsal margin of the third joint brownish-black; the third joint in its longest lateral length about one and one half times as long as deep; arista light brown. *Thorax:* brownish-black with three slender brownish-yellow pollinose vittæ; the outer pair becomes quite slender on the posterior half and expanded on the anterior margin. The lateral margins of the mesonotum including the whole notopleuræ are widely brownish-yellow and are medially margined with brassy-black. The whole of the mesopleuræ except the anterior margin, upper part of sternopleuræ, whole of pteropleuræ, upper parts of meta and hypopleuræ are yellowish-brown. The scutellum is dark brown, the narrow base and rim yellowish; the pile sparse, exceedingly short and black. *Abdomen:* quite elongate and spatulate, increasing gradually to the end of the fourth segment; it is chiefly black and shining, becoming sepia brown over most of the long second segment and the lateral margins and corners of third and fourth segments and upon the middle and posterior margin of first segment except its sides and corners. The ventral, lateral corners of second segment are yellowish. Just before the apex on either side of the second segment there is an obscure, elongate, yellowish-spot and there is a similar, submarginal, basal, posteriorly-pointed spot on the third segment. On the fourth segment there is a similar, submarginal, larger basal spot, each posterior corner of which is produced posteriorly; the lateral corner ends bluntly, the medial corner is carried back and there is a long, slender, curved yellowish-brown line, its outer margin concave. On the fifth segment there are traces of four slender, basally expanded yellowish-brown linear vittæ. The pile of the abdomen is extremely short and sparse and bristly; on the sides of the first segment it is sparse, quite long and fine. *Legs:* chiefly yellow, the middle femora light brown, the hind femora darker brown, its apex narrowly yellow, its pile black. Hind tibiæ black over most of its length; its base and apex are pale, its pile, except on the ventral apex black. The hind tarsi are whitish-yellow with similar pile. *Wings:* deeply tinged with brown throughout, the anal crease is long but quite obsolescent. The apex of the subapical cross vein is recurrent.

Holotype: a male. Villarica, Paraguay, III (F. Schade collector).

Baccha olga n. sp.

Characterized by the sepia-brown stigmal cell, apical spot and small central spot of the wing, the black face and spatulate abdomen. Related to *lanei* Curran and *bigoti* Austen.

Female. Length 10 mm. *Head:* the face, front and cheeks are shining black with a slight bluish tinge; the sides of the front are narrowly covered with pale grey pubescence to above the middle where it extends transversely across in an interrupted band. It is also continued down the eye margins where it spreads out on either side of the face on the lower half, leaving a narrow middle lower stripe bare. Profile of face straight and retreating, its pile and the very few hairs of the front white. Antennæ brown, the third joint blackish-brown, its base and ventral margin narrowly pale yellow. Arista light brown. *Thorax:* mesonotum and scutellum black with a metallic brownish or golden caste, its pile white, and appressed except on the anterior border and except for a few erect hairs in front of the scutellum. Scutellar pile wholly erect; pleuræ white pilose and pubescent over the mesopleuræ, sterno and notopleuræ, the pile of the latter spreading over the anterior edge of the notopleuræ. *Abdomen:* quite spatulate, the second segment very narrow basally, its subbasal width is scarcely more than a third its apical width; the third segment forms almost an equilateral triangle, basally truncate; the third segment is not quite as long as the second, nor the second quite as long as the fourth. The fourth segment is very little narrowed apically. The abdomen is shining black, the anterior corners of the third segment show a trace of reddish-black. Pile of the abdomen appressed and black in the center of the third and fourth segments and extensively white along the sides and base and everywhere white upon the fifth segment except for the posterior middle. *Legs:* black, the anterior femora are dark brown basally, growing paler towards the apex; the apex of the middle femora is light brown, the basal half of the first and second tibiæ and their apices and the narrow base of the hind tibiæ whitish-yellow. The central portions of the first four tibiæ are brown; remainder of hind tibiæ black and black pilose. Front tarsi, first two joints of middle tarsi, apical half of hind basi tarsi and its next two joints whitish-yellow. Remaining tarsi brown. *Wings:* hyaline, the stigmal cell and an elongate marginal spot on the apex of the wing covering the end of the marginal cell, and the end of the submarginal cell as far as the third longitudinal vein, dark brown. There is a dark brown spot, rather narrow covering the furcation of the second and third veins and extending back to cover the closure of the second basal cell. The costal and base of subcostal cells are also brown.

Holotype: a female, Chilibre, Republic of Panama, 1940 (A. G. B. Fairchild collector).

Baccha oriel n. sp.

Characterized by the slender abdomen and pale wings and the proportionate shape of the segments. Fourth segment less than twice as wide as the second. Related to *lepida* Macquart.

Male. Length 9 mm. *Head:* the face, and front except for a crescentic brown spot enclosing a black dot before the antennæ, and cheeks orange yellow. Pile of front thick, long and black, sparse upon the upper part of the face. The antennæ are orange, its pile and arista black, its length short. *Thorax:* light yellow upon all of the pleuræ except for a wide, continuous, oblique, posterior band, light yellow upon the humeri, the broad sides of the mesonotum and the post calli. The disc of the mesonotum is brassy brown with a pair of prominent, yellowish pollinose vittæ that slightly diverge and become evanescent before they reach the scutellum. Between them there is a faint linear pollinose vittæ. Scutellum pale yellow, the disc brownish-yellow, and sub translucent viewed from above, but brown when viewed obliquely. On the disc are eleven long black erect hairs and five upon the margin. I can only see a single central pair of elongate hairs constituting the ventral fringe. *Abdomen:* elongate and slender, brown to brownish-black apically, the sides of the first segment and its narrow base and the narrow basal corners of the second segment light yellow. Just before the apex of the second segment is an orange-brown, transverse fascia medially produced in front and narrowly margined with opaque brown. Third segment with an elongate, obscure, central yellow-brown triangle on either side, its apex bifid and the two triangles apparently contiguous on most of their medial length. Fourth segment similar, the subcoalescent triangle a little more distinct, the medial posterior indentation deeper leaving the figure somewhat V-shaped on each side (inverted) and its lateral arm shorter. Fifth segment with prominent, narrowly divided submedial vittæ that do not quite reach the apex but expand along the base of the margin to the corners and sublaterally emit a narrower stripe which is not quite as long as the submedial ones. *Legs:* wholly light brownish-yellow; there is a faint, preapical brown band on the hind femora. Pile of hind femora short, appressed and quite sparse. *Wings:* uniformly pale brown, the stigmal cell darker.

Holotype: a male. Loma Rucilla and Mts. N., Dominican Republic, June 1938, 5–8,000 feet altitude (P. J. Darlington collector). One paratype, same data.

Baccha cryptica n. sp.

Second abdominal segment longer than third, six or more times as long as its subbasal width. Black flies, the wings smoky-brown almost to apex. Sides of the face broadly yellow. Related to *ida* Curran and *clarapex* Wiedemann.

Male. Length 12 mm. *Head:* the face widely light yellow upon the sides, the cheeks blackish, the middle of face on the tubercle and above widely blue-black, narrow so below the tubercle but above extending on either side of the antennæ to the blue black front. Sides of the front linearly yellowish and with a narrow eye-marginal stripe on the upper part of the front which is silver pubescent. The upper third of the triangle of the front is opaque black and long, erect black pilose, the pile largely confined to areas along the eye margin and extending down to the upper part of the face, lower facial pile white. Antennæ black, the third joint reddish below. Arista blackish except at base. Occipital pile black above, black in the middle excavation and composed of practically a single row of sparse yellow hairs. *Thorax:* dark sepia-brown, moderately shining with a slight violaceous narrow vittæ sublaterally on either side of the mesonotum. Pile short, erect, black and quite sparse. Pleuræ with a yellowish-white pilose and pubescent vertical stripe. Scutellum dark brassy-brown, its pile short, erect and very sparse, its ventral fringe of ten or twelve hairs pale. *Abdomen:* elongate and spatulate and almost wholly brownish-black, the second segment very little narrower than its apex and a little over six times as long as its subbasal width. The apex of the third segment is two and a half times or more wider than its base. Fourth segment almost quadrilateral and barely wider apically. Second segment with a wide, medial, subbasal opaque black vittæ which apically expands to form a subapical fascia some distance from the apex. It is posteriorly indented. All of the third segment black except for prolonged basal and lateral triangles and for an apical margin laterally attenuated. Middle of the opaque black with a pair of small, slender, yellowish vittate spots. Fourth segment opaque black except for narrow basal triangles and a narrow posterior margin widest in the middle. There are similar spots centrally on the fourth segment. There are three, oval, elongate, basal opaque black spots on the fifth segment. The pile of the abdomen is appressed and black but whitish and long on the sides of the first segment, shorter and white on the sides of the second. *Legs:* dark brown, the base of the first four tibiæ diffusely and obscurely paler; the medial surface of the anterior femora is yellowish-brown, the hind tibiæ and basal two-thirds of the hind basi tarsi black and black pilose, their remaining tarsi yellowish-white, the other tarsi dark brown. Pile of hind femora black and short. *Wings:* large, barely longer than abdomen, deep smoky-brown, growing a little lighter narrowly over the posterior margin and apex. The anal crease is long, blackish, well formed and reaching the apex.

Holotype: a male. Villarica, Paraguay, March (F. Schade collector).

Baccha bipunctipennis n. sp.

Second abdominal segment eight to ten times as long as its middle width. The apical and central wing spots are less extensive than in *lanei* Curran. Head femora and tibiæ largely black, black pilose.

Female. Length 10 mm. *Head:* the face, front and cheeks are shining blue-black, the sides of the front narrowly white pubescent, the pile on the sides long and white, black in front of the antennæ and black and white above and confined to a narrow, medial row behind the ocelli. The occipital collar in the middle consists of a single row of pale yellow hairs but with shorter hairs outside, the upper hairs black. Face nearly straight in profile but retreating, white pilose and pubescent on the sides and lower middle. The antennæ are short and dark brown, the third joint about as long as wide and more reddish. *Thorax:* shining black with sparse white pubescence, vertically over the middle of the pleuræ and notopleuræ; pile of mesonotum and whole of scutellum erect and white, suberect anteriorly on the mesonotum and with a band of black pile across the middle; the long marginal hairs of the scutellum and about twenty long ventral fringe hairs are white. *Abdomen:* very slender upon the quite elongate second segment which must be eight or ten times as long as its narrowest width. Third segment a little over four times as wide apically as basally. Fourth segment almost quadrilateral and barely narrowed apically. The remainder of the abdomen is drawn out into a long, flattened, very thin extension which may or may not be natural. The fifth segment is not quite twice as wide as long and scarcely narrowed; the sixth segment is of the same proportion and shape and only a little smaller. Following this is an additional flat extension two and a half times as long as wide and very little narrowed; the abdomen terminates beyond this in an acute, triangular, pointed, flattened, apically reddish ovipositor. Color of abdomen shining black, brownish-black upon the second segment and vaguely upon the corners of the fourth segment. The base of the third segment is somewhat lighter brown. Entire abdomen shining, its pile broadly and triangularly erect and white in the basal corners of the third and fourth segments and over all but the apex of the fifth segment. The entire lateral margins of the second segment white pilose, medial pile black. Pile of first segment long and white and abundant, its apex and middle bare. *Legs:* the front and middle femora are reddish brown, the hind pair dark brown, its apex narrowly lighter, its pile almost wholly black. Front and middle tibiæ and tarsi and all the hind tarsi except the basal three-fifths of its basi tarsi light reddish-yellow. Base of hind basitarsi, which is considerably thickened, black and black pilose. Hind tibiæ blackish-brown except narrowly at the base and with rather long, thick blackish pile. *Wings:* quite hyaline with the costal, subcostal and stigmal cell and an elongate apical, marginal spot occupying the ends of the marginal and end of the submarginal to barely beyond the third longitudinal vein and also a central, somewhat triangular spot, from a short distance before the furcation of second and third vein, to just beyond the small cross vein, and extended posteriorly to fill out the basal part of the third posterior cell and to extend down to the middle of the posterior section of the fifth longitudinal vein.

Holotype: a female. Bella Vista, Paraguay, February (Alto Parana) F. Schade collector.

Baccha potentilla n. sp.

Characterized by the shining black abdomen, widely smoky wings and the shape of the abdominal segment. Second abdominal segment about two and a half times as long as wide. Related to *clarapex* Wiedemann.

Male. Length 10 mm. *Head:* the cheeks, middle of face and front shining steel-blue, the central portion of the front more blackish, the upper middle front opaque with on either side a pair of semicircular, silver pollinose, eye-marginal spots. Pile of front and upper part of face long and black. The frontal pile is largely confined to the eye margins. The lateral silver pubescence of the face continues in moderate width up the sides of the face to a little above the antennæ. The post ocelli pile is black, confined to a single row of hairs. Occipital pile composed of one long posterior row and one shorter lateral row; its upper pile is yellow. The antennæ are somewhat elongate, dark brown, the third joint below and base of arista reddish. Sides of face narrowly yellowish. *Thorax:* mesonotum shining brownish-black with, viewed posteriorly, a pair of broad, submedial, brown pollinose vittæ evanescent in the middle of the mesonotum but expanded anteriorly to form large triangles. Viewed anteriorly or laterally there are, between these vittæ quite slender and almost touching, a pair of brown vittæ. The pile of the mesonotum and scutellum and its ventral fringe black. Pleuræ steel-bluish with a trace of white pubescence in the middle and with white pile. Squamæ light brown with fringe brown. *Abdomen:* spatulate, the second segment about two and a half times as long as wide and subcylindrical. Third segment not quite twice as wide apically as basally. Fourth segment almost quadrilateral, barely wider apically. Abdomen shining black, bluish upon the first segment with a medial, opaque black vittæ upon the second segment expanded some distance from the apex to form an oblique fascia reaching the curved-under lateral margin. Third segment with a pair of practically fused, slender, medial vittæ proceeding from the base to within a short distance from the apex and narrowly separated from large, submedial triangles beginning near the base, ending where the medial vittæ end and extending laterally out to the margin and almost to the apex. Fourth segment with a similar pattern, the submedial vittæ separated, the lateral triangles smaller. Fifth segment with four slender vittate spots on the basal part of the segment. Lateral basal margin of second segment steel-blue. Pile of abdomen appressed and black, white ventrally on the sides of the first segment with long black pile above. *Legs:* first four femora dark brown, lighter at apex, their tibiæ dark brown but pale narrowly at the base and at the extreme apex, their pile almost wholly blackish. The hind femora and tibiæ, and all but the narrow apex of the hind basi tarsi, black and black pilose. Last hind tarsal joint brown; other three joints yellowish-white and white pilose. First four tarsi brown. *Wings:* deep brown except upon the apical fourth which is pale greyish hyaline. Anal crease well formed and brown.

Holotype: a male. Villarica, Paraguay, March, F. Schade collector.

Baccha pandora n. sp.

Characterized by the prominent yellow vittæ of the thorax and the pattern of the abdominal spots. Submedial vittæ of the fourth segment quite large, broadly connected to the anterior triangle. Related to *livida* Schiner.

Male. Length 12 mm. *Head:* the cheeks and face and front are pale yellow; just before the antennæ there is a sharp black oval spot and above this a reddish-brown spot. The rather elongate antennæ are orange, narrowly brownish above on the third joint, the pile black, the arista brown. The pile of the front and upper part of face is black, the former largely confined to the sides of the front. There is a band of white pubescence along the sides of the face extending narrowly on the lower part of the front. There are some white hairs below. *Thorax:* the whole of the pleuræ except the extreme ventral portion above middle and hind coxæ light yellow with a few yellow hairs and some yellowish pubescence. The wide margins of the mesonotum and the whole of the scutellum, except a central transverse brown band over most of its disc, yellow. The mesonotum is broadly golden-brownish centrally with three stripes of brown and two of yellow pollen, all of about equal width. The medial brown stripe is narrowly divided by a linear, yellow pollinose vittæ which expands posteriorly until just before the apex it is as wide as the pointed apical part of the two outer vittæ. The medial vittæ touches the scutellum, the others do not. Mesonotal pile sparse, erect and black, a few pale hairs before the scutellum and upon the lateral margin. Scutellar pile short, erect, quite sparse, appressed laterally, the ventral fringe yellow. *Abdomen:* quite elongate, almost as long as the wings and somewhat spatulate, the second segment four to five times as long as its central width; it is a little wider at base, but the remainder has almost parallel sides. Third segment barely over twice as wide apically as basally; the fourth segment is not quite as long as wide and a little wider apically than basally. The abdomen is dark brown with yellow markings. The whole of the first segment is yellow except at posterior margin, the posterior corners also yellow. The second segment has an hour-glass shaped brown spot beginning a short distance away from the base, almost reaching the posterior margin and actually reaching this margin laterally. The lateral ends of the brown spot turn up and down along the margin to enclose the intervening yellow which is almost isolated into elongate, oval, lateral spots. Third segment brown except for large basal triangles, narrowly extended two-thirds of the lateral length. In the brown there is a pair of central, large, elongate, posteriorly rounded, anteriorly attenuated, vittate yellow spots; these spots are at least twice as wide posteriorly and separated below their middle by a third of their width. Fourth segment with a pair of somewhat similar, longer, medio-posteriorly truncate, vittate spots that are widely confluent with a larger basal triangle. The basal triangles almost meet in the midline. Fifth segment similar, the central spots meet and fuse at the posterior margin, the smaller basal triangles are separated from the lateral margin and are laterally continued as a vittæ to the posterior margin. Pile appressed sparse, bristly and blackish; there are a few bristly hairs on the anterior margin of the brown of the first segment and quite long, sparse, yellow pile upon the sides and corners of this segment. *Legs:* everywhere light yellow and yellow pilose except over the middle third of the hind tibiæ which is black and blackish pilose. Hind femora reddish-brown on the basal half, darker beyond but yellowish at apex, its pile is chiefly black. There are a few black hairs posteriorly on the middle femora. *Wings:* light brown throughout, the apical portion above the third longitudinal vein and the whole of the stigmal cell darker brown. Anal crease long, well formed and brown.

Holotype: a male. El Valle, Cocle Province, Republic of Panama, July 2nd, A. G. B. Fairchild collector.

Mesogramma tubularia n. sp.

Characterized by the elongate, parallel sided abdomen with double fascia and median vitta; related to *flava* Hull.

Male: Length 8 mm. *Head:* face pale yellow, short, white pilose, barely tuberculate; front yellow, black pilose, with an elongate brownish spot in the middle. Eyes touching for a quite short distance. Antennæ, and arista except its reddish base, dark brown. *Thorax:* mesonotum dark bluish-black, brown pollinose, with a prominent, continuous, medial blue grey vittæ, and a narrow, sublateral, yellowish-brown stripe which ends before reaching the pale yellow humeri. Scutellum brownish-black, the edges narrowly diffusely yellowish-brown.

Abdomen: quite elongate and flattened, the sides parallel. The abdomen is black marked with yellow as follows: the extreme anterior margin of the first segment on either side, a narrow medially interrupted, laterally evanescent central fascia on the second segment, a basal, laterally narrow, submedially much expanded fascia upon the third segment, which is medially connected with a long linear vitta, a pair of horn-shaped spots centrally, separated from the medial vittæ, their medial and truncate, their pointed lateral end curved forward a little and not reaching the margins. Fourth segment with a pattern similar in size and shape, its medial vittæ a little expanded at apex; fifth segment with a pair of sublaterally black spots, a pair of lateral, marginal, elongate spots posteriorly, and a long vittate and medial basal spot, all black upon an orange-brown background. The central yellow pattern of the second and fourth segments is outlined in opaque black; elsewhere the black is shining. *Legs:* chiefly black pilose and yellow brown, the hind femora barely darker, the hind tibiæ medially brown centrally but more yellowish at base and apex. *Wings:* pale grey; alula post margin nearly linear.

Holotype: a male. Banos, Ecuador, 2000 M. VII–14–1939. Type in the collection of Dr. C. L. Fluke.

Mesogramma triangulata n. sp.

Characterized by the pairs of yellowish brown triangular spots upon the third and fourth segments. Related to *guttifera* Hull.

Female. Length 6 mm. *Head:* the sides of the face are yellow, the cheeks and middle brownish black, the front flat, shining brownish-black, the sides narrowly sharply yellow to near the ocelli. Vertex convex, violaceous behind and black pilose. Face pile white with antennæ dark brown. *Thorax:* mesonotum greyish or bluish black, grey pollinose. Viewed laterally with a pair of very broad opaque brown vittæ reaching the scutellum. Lateral margins concolorous. The humeri, a somewhat obscure pleural spot and vertical stripe on pleuræ yellow. *Abdomen:* oval, shining brown, the corners of the first segment, its extreme anterior margin the narrow margin of the second segment almost to the apex but not expanded apically yellow. There is a pair of tiny, transverse yellow spots in the middle of second segment. On the third segment there is a pair of subbasal, widely separated, rather large, posteriorlaterally convex, yellowish-brown triangles. They are separated from the narrow, yellow lateral margin of the anterior half of the segment, but are slightly produced in the direction of the margin. Fourth segment with similar pattern. Fifth segment with a pair of subbasal, transverse spots narrowly connected across the middle posteriorly. *Legs:* yellow, the tarsi light brown, the hind tarsi darker basally and apically, the hind femora with a dark brown subapical annulus, their tibiæ with a subbasal annulus. *Wings:* hyaline, the alulæ large.

Holotype: a female. Villarica, Paraguay, March 4, 1938, F. Schade. (In the collection of C. L. Fluke.)

Mesogramma alphabetica n. sp.

Characterized by the pair of large, yellow, crescentic spots on the base of the third and fourth segments which are narrowly fused with the lateral triangles. Related to *confusa* Schiner.

Female. Length 4 mm. *Head:* face, the narrow sides of front and all of the antennæ except the blackish dorsal half and apex of third antennal joint, pale yellow. The cheeks and the middle of the front are shining black, the latter bluish margined; vertex golden. *Thorax:* mesonotum shining blackish with steel-blue median vittæ, the wide lateral margin of the humeri and margin of scutellum yellow, the mesonotum yellow, narrowly black marginate, followed by an obscurely bluish stripe. Disc of scutellum black, all its pile long and black. *Abdomen:* oval, rather broad; first segment black with yellow corners and margins; second segment with narrow, central, laterally arcuate, linearly divided yellow fascia. Third segment with two large, thick, deeply crescentic, basal yellow spots facing one another and narrowly connected basally with the large, yellow, equilateral triangles. Fourth segment with similar pattern, not connected basally. Fifth segment with similar pattern, the more elongate triangles widely separated. *Legs:* yellow, first four femora with blackish dorsal subapical spots. Hind pair black on apical half except its apex, their tarsi and tibiæ except extreme base blackish; other tarsi light brown; last front tarsus yellow.

Holotype: a female. Jalapa, Vera Cruz, Mexico, July 8, 1935, A. E. Pritchard. (Collection of C. L. Fluke.)

Mesogramma nymphalia n. sp.

Related to *rhombicum* Giglio Tos. The second segment is almost wholly yellow, the abdomen is wider.

Male. Length 5 mm. *Head:* cheeks black, the yellowish-red face short. Antennæ reddish. Vertex bright greenish-blue. Mesonotum black with obscure greyish median vittæ, the pleuræ black with yellow vertical stripe; humeri, lateral margins and margin of scutellum bright yellow. *Abdomen:* elongate with nearly parallel sides; vitreous, dark brown to black with pattern as follows: posterior margin of first segment black, base of second segment with a laterally attenuated brown fascia, the corners yellow and the apex with a shining purplish-black fascia narrowly separated by reddish in the middle. The fascia is a little over a third of the segments length. Third segment with medial reddish-brown vittæ and facing it on either side a basal, crescentic, reddish spot widely connected to the large basal lateral reddish triangle. Fourth segment with similar pattern, the crescentic spot more slender and disconnected. Fifth segment with the lateral margins and widely separated submedial vittæ, the latter slightly curved, reddish. *Legs:* yellow, the hind femora with wide black apical annulus, its pile black, the ventral pile long, their tibiæ dark brown except at base and apex, their tarsi brownish. *Wings:* pale brownish hyaline, the alulæ narrow.

Female. Abdomen spatulate, the pattern similar, the crescentic spots of third segment deeper, the medial vittæ connected to a submarginal posterior fascia.

Holotype: a male. Rio Margajitas, Equador, 1250 meters, March 1939 (F. M. and H. Brown). Allotype: female. Sucua, Equador, 950 meters, Rio Bland, 1939. Paratypes: male, Rio Margajitas; male Puyo, Oriente, Equador; female, Rio Mapeto; two females Puyo, Oriente, Equador. (In collection of C. L. Fluke.)

Mesogramma claracunea n. sp.

Characterized by the opposed yellow crescents, median vittæ and yellow corner triangles of the third and fourth segments; related to *confusa* Schiner.

Female. Length 6 mm. *Head:* front black, narrowly yellow along the sides, the face yellow and short. *Thorax:* blackish, the humeri and the lateral margins yellow, the scutellum black with light brown margin. *Abdomen:* flattened and rather broad, the first segment black except upon the anterior lateral corners. Second segment black with yellow pattern as follows: a pair of submedial spots rounded posteriorly, concave medially, angulate anteriorly and diagonally attenuated as they extend towards the lateral margin and somewhat in the direction of the anterior corners. They are narrowly separated from a lateral, obtuse triangle of yellow whose long face lies upon the lateral margin and which is continuous with the yellow of the anterior corners. Third segment with the anterior half of the lateral margin occupied by an acute triangle which is narrowly separated from a pair of crescentic yellow spots on either side of the segment. These crescentic spots lie close to but not touching a narrow, medial, linear, yellow stripe which is evanescent both anteriorly and posteriorly. Fourth segment similar, the lateral basal yellow triangle a little more distant from the crescent. This segment has basal corner triangle and small yellow crescents but no medial vittæ. *Legs:* brownish-yellow, the hind femora and tibiæ with wide subapical and subbasal smoky bands. *Wings:* pale brown hyaline; alulæ narrow and strap-shaped.

Holotype: a female, Rio Margajitas, Rio Pastaza, Equador, 1250 meters, 20–III–29, F. M. and H. Brown collectors. (In collection of C. L. Fluke.)

NOTES ON HIPPOBOSCIDAE. 18. THE GENUS *BRACHYPTEROMYIA* WILLISTON; WITH THE DESCRIPTION OF A NEW SPECIES (DIPTERA)

By J. Bequaert [1]

Brachypteromyia Williston

Brachypteromyia Williston, 1896, Ent. News, VII, p. 184. Monotypic for *Brachypteromyia femorata* Williston, 1896 = *Anapera fimbriata* Waterhouse, 1887.

Brachyptomyia Speiser, 1907, Ent. News, XVIII, p. 104. Misspelling of *Brachypteromyia.*

Brachypteromia Aldrich, 1907, Jl. New York Ent. Soc., XV, p. 6. Misspelling of *Brachypteromyia.*

Head horizontal, oval, as long as or longer than wide, deeply inserted in the very concave humeral margin of the thorax. Dorsal appendage of second antennal segment long, flattened, rounded off at apex. Eyes small, of many small facets, elliptical, placed dorso-laterally and far from fronto-clypeus and postvertex. Fronto-clypeus occupying nearly half the length of the head, separated by a long mediovertex from the large postvertex. Palpi well developed. Ocelli absent. Thorax with large, lobate humeral callosities and prominent preälar angles; dorsal sutures either vestigial, incomplete or absent. Scutellum transverse, short, distinctly divided from the mesoscutum. Mesothoracic spiracle dorsal; metathoracic spiracle between the more or less developed metapleural ("pleurotergal") protuberance and the base of the hind coxa. Legs very long and thick; tarsal claw three-toothed, the basal "heel" being unusually long and slender; two pad-like pulvilli and one slender, feathered empodium. Wing functionless, reduced to a very short pad, about as wide as long, with a few thick rudimentary veins in the anterior half. Halteres well developed. Abdomen

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with only the basal and sometimes a pair of preäpical dorsal sclerites differentiated; otherwise membranous and uniformly hairy above and below; no median striated area dorsally. Pilosity of body and legs very long and dense, the whole insect hirsute.

Brachypteromyia is closely related to *Myophthiria* Rondani, with which genus Ferris (1928, Pan-Pacific Entom., IV, p. 140) proposes to unite it. No serious objection to such a course can be offered. The discovery of a second species, much more like *B. fimbriata* than like the two or three known species of *Myophthiria*, suggests, however, that *Brachypteromyia* might be retained at least with subgeneric rank. Three main differences can be pointed out between the two groups. In *Myophthiria* the thorax is slightly less evolved, with the dorsal sutures more distinct, the scutellum longer and narrower, and the chaetotaxy sparser and more in accordance with the primitive arrangement. The wing is longer and narrower, with the venation more distinct and somewhat less reduced. The abdomen is much less hirsute; in the female it bears dorsally a pair of transverse preäpical sclerotized plates, preceded by one or two small median sclerites; while in the male there are, in addition to the preäpical pair, three transverse median tergal plates, the hindmost of which is very large.

The three females of *B. fimbriata* examined show dorsally no traces of median sclerites nor of sclerotized preäpical plates. In two males of that species there appear to be two minute preäpical sclerites, placed far apart; but I can find no trace of them in the male holotype of *B. neotropica*. More material will have to be studied before a final conclusion can be reached. If, however, the difference in the structure of the abdomen proves reliable, there might be some justification for retaining *Brachypteromyia* as generically distinct from *Myophthiria*.

It should also be noted that *Brachypteromyia* is the most specialized type of the subfamily Ornithomyinæ. It is the final step in a series of changes leading from the fully winged to the subapterous condition. This series, one of the most instructive evolutionary sequences I am acquainted with, is perhaps best understood by following first the gradual reduction of the wings. The more common species of *Ornithomyia*, such as the Palearctic *O. avicularia* (Linné) and the Holarctic *O. fringillina* Curtis (= *O. anchineuria* Speiser), have fully developed wings, with a complete venation, and are as good fliers as any of the Hippoboscidæ. Some species, however, such as the Indian *O. comosa* Austen, show a decided shortening of the wing, though the venation remains normal. The further reduction of the wing to a functionless condition apparently proceeded along two different lines. In one, leading to *Stenepteryx*, the wing retained its length, but reduced its area by losing most of the membrane, while some of the veins disappeared and the remainder were crowded near the costa. In the other, leading through *Crataerina* and *Myophthiria* to *Brachypteromyia*, the whole wing was shortened, with concomitant loss of most of the venation. All known species of these four subapterous genera appear to be incapable of flight. Moreover, the reduction of the wings was accompanied by other changes which affected nearly all parts of the body. The most striking of these are the lengthening of the head, the reduction of the eyes, the loss of the ocelli, the obsolescence of the dorsal thoracic sutures, the gradual disappearance of most of the tergal plates of the abdomen, and the unusual development of the legs and particularly of the claws.

The restricted choice of a host and even more so the type of host selected were no doubt the main factors which determined this orthogenetic evolution. Most species of *Ornithomyia* show very little host specificity, being found mainly on a variety of passerine and some game birds. Some species, however, are restricted to swallows and martins (Hirundinidæ) and *O. comosa* is one of these. It may be significant that typical *Stenepteryx hirundinis* (Linné) occurs on swallows; while a form regarded either as a race of *hirundinis* or as a distinct species (*cypseli* Rondani) lives on swifts (Apodidæ or Micropodidæ). All known species of *Cratœrina*, *Myophthiria* and *Brachypteromyia*, on the other hand, are restricted to the Apodidæ. It seems reasonable to assume that the ancestors of these swift-flies were swallow-flies and that the change of hosts — from swallows to swifts — was in some way responsible for the series of morphological changes eventually culminating in *Brachypteromyia*. As in most such cases, the mechanism of these changes is a matter of speculation; but the end result is readily recognized as an efficient adaptation to the peculiar morphology and habits of the host.

Swallows and swifts are amongst the most aërial of birds, with the swifts by far the speedier of the two groups. Some species of swifts are possibly the fastest birds for their size, capable of reaching 70 to 100 miles per hour.[2] Both swallows and swifts are also capable of long-sustained flight, as they catch their food on the wing; but, again, the swifts spend much longer periods in the air, some species being unable to perch. When not nesting, some swifts must stay aloft for the major part of the day, at one stretch. In swallows and even more so in swifts, the narrow, pointed wings, very long in proportion to the small body, and often the more or less forked tail (the fork capable of opening and closing) are clearly adaptations to a predominantly aërial life. The body, particularly the head, is built so as to offer the least resistance to the air and is perhaps a little more "stream-lined" in the swifts than in the swallows. The plumage is very even and smooth at the surface. That of the swifts is usually coarser, stiffer, with less down on the bases of the body-feathers, than that of the swallows.[3] Several of these features explain well the peculiarities of the parasitic flies of these birds. The wings of the flies have become reduced or atrophied, because on birds travelling at high speed they increase the risk of the fly's being blown off the host. They are, moreover, of little use for reaching a new host, on birds spending so much of their life in mid-air and far away from the nest.[4]

[2] Most published observations on the average and maximum speed of birds are unreliable, as they fail to take in account a number of important outside factors. The following data seem, however, to be fairly trustworthy. R. Meinertzhagen (1921, The Ibis, Ser. 11, III, pp. 232 and 237) gives the observed speed of a Mesopotamian swift (species?) as 68 miles per hour and estimates that of the alpine swift, *Apus melba* (Linné), as 70 to over 100 miles per hour. A. Magnan (1922, Ann. Sci. Nat., Zool., Ser. 10, V, p. 167) includes the European swift, *Apus apus* (Linné), with the European swallows and martins in a group of high-speed birds averaging 45 to 80 miles (80 to 150 kilometers) per hour. E. Stresemann (1931 and 1934, in Kükenthal, Handbuch der Zoologie, VII, pt. 2, pp. 584 and 837) gives the speed of the Asiatic swift, *Hirundapus caudacuta* (Latham), as 80 miles (144 kilometers) per hour. J. P. Chapin (1939, Bull. Amer. Mus. Nat. Hist., LXXV, p. 464) observed the Ruwenzori alpine swift, *Apus melba maximus* (O.-Grant), shooting by at a terrific speed and was tempted to estimate its velocity at about 100 miles per hour.

[3] These and other adaptive peculiarities of swifts and swallows were acquired independently, as the two groups are not related in the opinion of modern ornithologists. The Hirundinidæ are placed in the order Passeres, and the Apodidæ in the order Macrochires. Fossil Apodidæ are known from the Oligocene to date (possibly from the Upper Eocene) (K. Lambrecht, 1933, Handbuch der Palaeornithologie, p. 621).

[4] The larvæ of *Stenepteryx* and *Crataerina* are known to be laid in the nests of the host, where they hatch. In colder climates, some of the puparia remain unchanged through the winter, after the birds have migrated. They hatch upon

The lengthened head and much flattened, nearly wingless body enable the insect to glide swiftly in the dense, coarse plumage, where it can grasp a firm hold with the unusually strong legs and the long, deeply split claws. The many long stiff hairs covering body and legs also help the fly to adhere to the feathers, endowing it with the properties of a burr. The obsolescence of the thoracic sutures is the result of the disuse of the wings and is not directly useful to the insect. The same is true of the reduction of the eyes and the loss of ocelli, which seem to be sequels to the loss of the power of flight.[5]

Brachypteromyia fimbriata (Waterhouse)

Anapera fimbriata Waterhouse, 1887, Proc. Zool. Soc. London, p. 164, fig. (on p. 163) (Fort Wingate, New Mexico, off "*Cypselus melanoleucus*" = *Aëronautes saxatilis* Woodhouse; no sex given, but evidently ♀). Shufeldt, 1887, The Ibis, (5) V, p. 157, footnote; 1894, The Auk, XI, p. 186. Aldrich, 1923, Insec. Insc. Menstr., XI, p. 78.

Brachypteromyia fimbriata Speiser, 1899, Wien. Ent. Zeitg., XVIII, p. 202, footnote; 1900, Ann. Mus. Civ. Genova, XL, p. 555. Bezzi, 1916, Natura, Riv. Sc. Nat., VII, p. 179. Austen, 1926, Parasitology, XVIII, pt. 3, p. 359 (♀ type, at the British Museum).

Brachyptomyia fimbriata Speiser, 1907, Ent. News, XVIII, p. 104.

Brachypteromia fimbriata Aldrich, 1907, Jl. New York Ent. Soc., XV, p. 6.

Myiophthiria fimbriata Ferris, 1928, Pan-Pacific Entom., IV, p. 140, figs. 1–2 (♀ ♂; Tuba, Arizona; off *Aëronautes melanoleucus*" = *Aëronautes saxatilis*).

Brachypteromyia femorata Williston, 1896, Ent. News, VII, p. 185 (♂; Wyoming; off "*Macropis melanoleucus*" = *Aëronautes saxatilis*). Bezzi, 1900, Rendic, Ist. Lombardo Sc. Lett., (2) XXXIII, p. 522. Aldrich, 1905, Cat. North Amer. Dipt., p. 656.

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the return of the host. Both swallows and swifts often seek the same nest several years in succession.

[5] I am indebted to my friend Dr. James P. Chapin for valuable information concerning the habits and adaptive features of swallows and swifts, in so far as they may have influenced the evolution of their parasitic flies.

Specimens Examined. — New Mexico: Fort Wingate, 2 ♀, one the holotype at the British Museum, off *Aëronautes saxatilis* (R. W. Shufeldt Coll.). — Colorado: 1 ♂ off *Aëronautes saxatilis*, without more definite locality (collected in May 1882 by Joel Allen. — M. C. Z.). — Utah: Kanab, Kane Co., 1 ♂ off *Aëronautes saxatilis* (July 1934; W. J. Breckenridge Coll. — Univ. of Minnesota). — The collection of the M. C. Z. also contains two specimens (♀ ♂) received from Osten Sacken, without locality, but with the host record, "off *Nephoecetes niger* (Gmelin)." This is a swift, a race of which (*borealis* Kennerly) occurs in western North America from southeastern Alaska to southern Mexico. Most probably Osten Sacken's specimens came from California. The species is also known from Wyoming.

The following differences have been noted between *B. fimbriata* and the new South American species described in this paper. Head relatively broader, more nearly elliptical, scarcely longer than its greatest width. Inner orbit narrower, about as wide as mediovertex before the postvertex; frontal bristles spread over a wider area, which expands both at the upper and lower ends; 2 to 4 vertical bristles in the upper corner, which is somewhat set off from the remainder of the side of the frons. Postvertex shorter and broader, more semi-elliptical, much shorter than mediovertex. Appendage of second antennal segment longer and narrower, about two and one-half times as long as greatest width, widened about mid-length, bluntly rounded off at tip. No trace of median notal suture. Metapleural ("pleurotergal") protuberance barely indicated. Wing much longer and narrower, more elliptical, about one and one-half times as long as wide; rudimentary venation more distinct. A much smaller fly: total length in dried condition, 6 mm.; from tips of fronto-clypeus to hind margin of scutellum, 3.2 mm.; of wing, 1 mm. In the male the parameres are present and shaped almost exactly as in the Neotropical species.

Brachypteromyia neotropica, new species. Fig. 1

Male. — Head broadly oval, about one and one-fourth times as long (from tips of fronto-clypeus to occipital margin) as greatest width. Frons at its narrowest nearly six times as wide as the eye; inner orbits (parafrontalia) very wide (before the postvertex slightly wider than mediovertex), conspicuously but gradually narrowed anteriorly, the inner margins strongly diverging anteriorly; frontal bristles many, in two or three irregular rows, crowded in a regular narrow strip near the inner margin and extending over the anterior three-fourths of the inner orbit; a fringe of long bristles at the edge of the outer orbit, near and behind the eye; 6 or 7 very long vertical bristles in the upper corner of each inner orbit. Postvertex (vertical triangle) triangular with obtuse and somewhat ogival anterior angle and laterally produced side angles, the hind margin nearly straight; slightly shorter than mediovertex, flat, smooth, without rudimentary ocelli, pits or depressions. Fronto-clypeus long and broad, slightly shorter than its distance from the occipital margin, fused laterally with the base of the antenna; fronto-clypeal suture barely indicated; base of clypeus very broad and short, its antero-lateral arms short, separated by a broad but shallow inward curve; frons proper with a minute and shallow median pit close to the fronto-clypeal suture. Mediovertex well developed, much broader anteriorly, with wide antero-lateral extensions separating the genæ from the fronto-clypeus. Eye of many facets, small, nearly elliptical, occupying a little over one-third of the upper side of the head, seen from above about twice as long as wide, about twice as far from the postvertex as from the fronto-clypeus. Palpi about as long as clypeus, but mostly retracted within the buccal cavity; only the short tips visible from above. Antenna large; first segment with a group of 3 to 6 long bristles in the inner anterior corner; appendage of second segment nearly twice as long as wide, flat, broadly rounded off at apex, densely covered with many long bristles; protruding arista of third segment (beneath the appendage of the second) much flattened, elongate paddle-shaped. Ventrally, the latero-anterior areas of the head (corresponding to the parafacialia and facialia) bear many long bristles (vibrissæ) in several rows, crowded along the inner (buccal) margin; the latero-posterior areas (cheeks) bear two long setæ on each side. Thorax wider before the wings than long from tip of humeral angle to base of abdomen; humeral margin very deeply, but broadly curved inward. Humeral callosity broad, flat, obtusely rounded off, separated by a shallow inward curve from the more prominent preälar angle. Promesonotal suture distinct, but in dorsal view visible only medially behind the occipital margin; scuto-scutellar suture

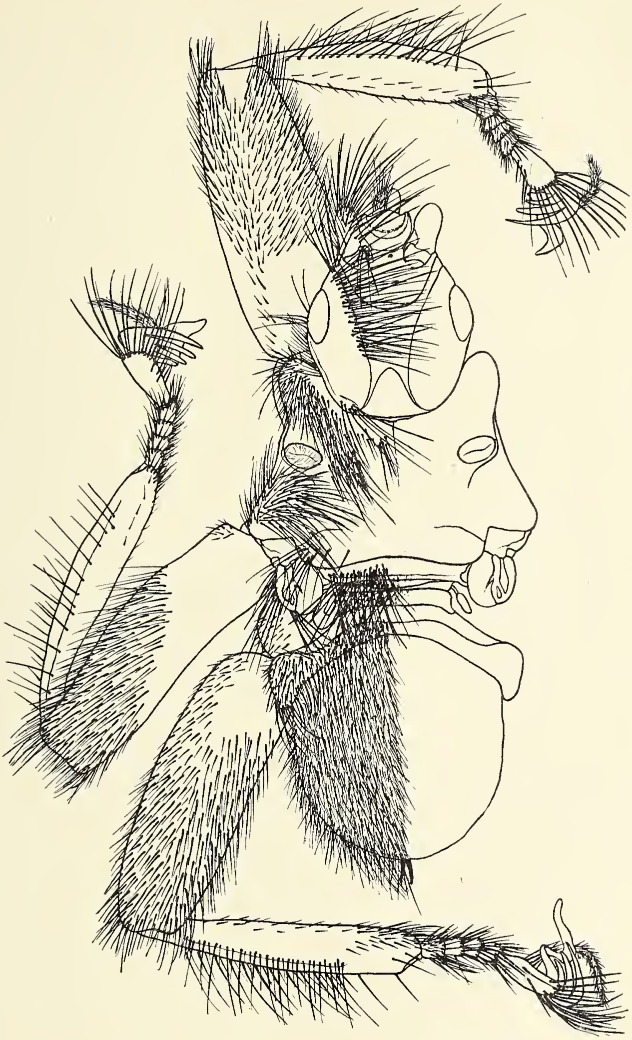

FIG. 1. *Brachypteromyia neotropica* J. Bequaert n. sp. Male holotype in dorsal view. Pilosity omitted over right half.

deep; a distinct suture divides the notopleuron from the epipleurites at the base of the wing; posthumeral suture marked on the sides only, behind and close to the spiracle; transverse mesonotal suture placed far back and weakly marked only over the lateral third; notal suture weakly indicated anteriorly; other dorsal sutures obsolete, the humeral callosities and notopleura fused with the mesoscutum medially. Scutellum very wide and short, with nearly parallel anterior and posterior margins, superficially divided by a transverse depression. Metapleuron with a short, conical, blunt, so-called "pleurotergal" protuberance, hidden in dorsal view by the wing. Mesothoracic spiracle very large, entirely dorsal; metathoracic spiracle large, between the metapleural protuberance and the hind coxa. Dorsal chætotaxy of patches of long bristles, scarcely corresponding to the customary grouping: a dense oblique patch on the humeral callosity to beyond the spiracle, ending far from the middle of the mesoscutum, but with a narrow extension across its anterior part (somewhat behind the humeral margin); a dense patch over most of the notopleuron; 6 or 7 long bristles (postalars) close to the wing, behind the transverse mesonotal suture, and more medially a row of 3 bristles (prescutellars); many long scutellars in several irregular rows on the disk and a row of similar bristles on the hind slope of the scutellum. Prosternum divided by a deep triangular notch into two broad lobes, bluntly rounded at apex, bare. Mesosternum broader than long, with a longitudinal furca, bare except for a narrow patch of setæ on each side before the mid coxa. Metasternum divided into an anterior basisternum (before the hind legs) and a narrower, posterior sternellum (between the hind coxæ); basisternum with a longitudinal furca ending posteriorly in a deep pit, with only a narrow cross-patch of setæ (broadly interrupted medially) near the hind margin; sternellum deeply depressed medially, saddle-like, bare. Legs very long and stout; fore and mid pairs about alike, hind pair slightly longer. Coxæ short, with many short setæ and several long bristles. Trochanters short, with a few short setæ near apex. Femora fairly evenly swollen throughout, bare ventrally, covered dorsally with many stiff hairs and bristles, leaving bare a broad basal area (more extensive on mid and less so on hind pair). Tibiæ flattened, dorsally with a superficial longitudinal groove bearing a row of erect bristles; a similar row of bristles near the outer lower edge; a few short setæ elsewhere; apices ventrally with a patch of strong bristles, but without spurs proper. Tarsi short and broad; basal segments with many short stiff bristles; apical segment much longer and broader than the others, with very long setæ, mostly in a transverse dorsal row at the apex. Claws symmetrical, unusually long, very deeply divided into three slender teeth, the basal "heel" being long and narrow; two broad, pad-like, bare pulvilli; one long, slender, feathered empodium. Wing very short, pad-like, about twice as long as scutellum, scarcely longer than wide; venation crowded over the anterior or outer half, of 2 or 3 thick longitudinal veins (probably formed by fusion of several veins); costa very thick, with many long bristles on basal two-thirds and at apex; other veins bare; membrane bare. The venation is decidedly more reduced than in *B. fimbriata*. Halteres well developed, borne on long stalks. Abdomen (in dried, contracted condition) short, densely hairy both above and below. A short, moderately broad basal tergite (next to the thorax), covered with minute setæ; behind this a much wider sclerotized tergite, with incurved hind margin and broad side lobes, covered with short, stiff setæ, with a row of long bristles at the hind margin and a patch of even stronger ones at the tips of the side lobes. A short, setulose basal sternite. No other sclerotized tergal or sternal plates can be made out on the membranous abdomen. Parameres of terminalia straight, slender, rod-like, very gradually widened toward base, blunt at apex.

Length: total, in dried condition, 9 mm.; from tips of frontoclypeus to hind margin of scutellum, 5.6 mm.; of wing, 0.8 mm.

Venezuela: Galipan, close to Pico del Avila, Estado Miranda, at about 2,000 m. altitude; male *holotype*, off a square-tailed swift, *Aëronautes montivagus* (d'Orbigny and Lafresnaye). Mus. Comp. Zöol., Cambridge, Mass.

The differences between *B. neotropica* and the only other known species have been given under *B. fimbriata*.

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PSYCHE

VOL. L MARCH–JUNE, 1943 NOS. 1–2

THE CORPUS ALLATUM OF THE SHEEP KED, *MELOPHAGUS OVINUS* L.

BY M. F. DAY

Washington University, St. Louis, Mo.

It has recently been shown (Thomsen, 1941; Day, 1943) that the condition of the corpus allatum and corpus cardiacum in muscoid flies is highly specialized when compared with other insects, since these glands have fused to form the so-called Weismann's Ring or ring gland. Burtt (1937) has found that this condition is not found in the Nematocera which he studied, for a typical paired corpus allatum was present in the larva of species of *Chironomus* and *Tipula*. However, Burtt considered the corpus cardiacum to represent the œsophageal ganglion.

In view of the interesting physiological effects of the ring gland on the ovaries reported by Thomsen (1940), the condition of the corpora allata and cardiaca in *Melophagus* presents a particularly interesting problem, for in this insect viviparity is highly developed. No observations on these glands in *Melophagus* are to be found in the literature, except those embryological studies of Pratt (1901) referred to below. Other anatomical studies include those of Hoare (1923) and Hardenburg (1929).

The following notes on the corpora allata and cardiaca of *Melophagus* are presented here as one of a series of investigations of these glands in the Order Diptera. Conclusions regarding the homologies of the structures described are based upon morphological and comparative histological evidence.

The techniques employed have been described previously (Day, 1943).

Observations on Larvæ

Since almost the entire larval life is spent in the uterus of the female ked, the young larva can be obtained only by dissection or in serial sections of the parent fly. All larval tissues retain many embryonic characteristics. According to Pratt (1901, p. 261) the glands (which he refers to throughout as ganglia allata, following Heymons, 1895) arise from the headfold as a pair of spherical bodies, probably from the lateral ectoderm, rather than from the ventral ectoderm as in most other insects. This is not surprising, however, in view of the great modification in the development of other organs of these Diptera when compared with more generalized insects.

The number of larval instars has not been determined. Larvæ are therefore classified according to their size. Three stages are described in detail. The youngest larva studied in the present series was about 0.8 mm. in length. This stage is only slightly more advanced than Pratt's (1901) Figs. 43 and 44, and already the tissue forming the corpora allata can be clearly distinguished from the brain tissue. The unusually large size of the cells is clearly seen in Pratt's illustrations. Cytologically the corpus allatum cells are very characteristic, presenting a considerably larger amount of even, deeply staining, basophilic cytoplasm than is found in any other cells of the embryo.

In a larva approximately 2 mm. in length (Fig. 1) the gland has increased in cell size and in cell number, but not to such an extent that each cell could have divided once. The cytoplasm is even more basophilic than that of the younger larva, and the cells appear to be in a state of secretory activity. In five mature larvæ studied corpora allata are greatly enlarged (Fig. 2). It is to be noted that the gland is a paired structure and thus differs fundamentally from the median corpus allatum of the Brachycera. Moreover, the cells composing it are large and conspicuous and show cytological indications of considerable activity, while the corpus allatum in the larva of Brachycera shows no cytological evidence of secretory changes. The corpus cardiacum, however, is inconspicuous in the larva of *Melophagus*, again in striking contrast to the situation in the Brachycera.

Each corpus allatum of a mature larva measures approximately 150 microns x 125 microns, and extends from the median region laterally between the imaginal discs and the dorsal extension of the developing gut. The cells comprising the gland have distinct cell boundaries and show no indications of forming a syncytium. While there is some variability in nuclear size, there does not appear to be any differentiation into more than one cell type. Measurements of the diameters of 100 nuclei from both glands of a single larva, representing approximately one fifth of the total nuclei, give a unimodal distribution curve with a range of 8.5 to 13.0 microns and a mean of 11.0 microns. Nucleoli are conspicuous and the chromatin evenly distributed following the fixatives employed. The cytoplasm in the cells at this stage exhibits conspicuous vacuoles which are generally peripherally located. There are usually one or two large vacuoles and a number of smaller ones, which give the cytoplasm the appearance of a reticulum, especially after Bodian's technique. As compared with the young larva, the cells representing the corpus cardiacum have been greatly reduced. From cytological evidence it would appear that their principal activity occurs during larval development.

The Pupa. It would be desirable to have a closely spaced series of pupæ, for during this time very active changes occur in the cells of the corpora allata. Unfortunately only a few pupæ (3 "white" pupæ, 1 of about two weeks of age and 2 nearly mature pupæ) were available, but these all agree in showing a marked reduction in the size of the corpora allata. Not only does the cytoplasm become reduced, but nuclear size also decreases. This decrease amounts to about 25 per cent of the former volume. Rhythmic increase in nuclear size is a not uncommon phenomenon in insect tissues (see Geitler, 1940, for review), but a striking decrease as found here is unusual. Moreover, there is a decrease in number of cells, a change reminiscent of that undergone by the mammalian thymus during development, and, as in the thymus, the mechanism of the reduction of the cell number has not been determined.

Pupal development of *Melophagus* occupies approximately three weeks. The puparium is white in color immediately after formation, but it hardens and darkens within about four hours. The corpus allatum of the white pupa is not unlike that of the fully grown larva. Considerable vacuolization of the cytoplasm is evident; the cells are approximately 15 microns in diameter and the nuclei average about 8.7 microns. As development proceeds, the cells lose more and more cytoplasm until, by the end of pupal development, they have assumed the form found in the adult. The glands have moved posteriorly, and come to lie, as they do in all adult Diptera, immediately in front of the proventriculus.

The Adult. No differences have been found in the corpora allata of male (Fig. 3) and female (Fig. 4) *Melophagus*, nor in female *Melophagus* with or without larvæ. The glands are ovoid, measuring approximately 75 microns x 60 microns. Each contains approximately twenty cells in cross section in the region of greatest diameter, the cells having approximate dimensions of 12 microns x 13 microns. The two glands lie one on each side of the dorsal aorta (Figs. 5 and 6). Ventral to them are the convolutions of the salivary glands, and immediately above them there are conspicuous tracheal trunks, which arise from the mesothoracic spiracles. Immediately above the aorta there are numbers of large pericardial cells which are frequently multinucleate, and possess a coarsely reticulated cytoplasm.

The cytoplasm of the cells of the corpora allata is sparse in comparison with that of the previous stages, and contains few or no vacuoles. The diameter of the nuclei is approximately 7.3 microns. Their volume is thus approximately 25 per cent that of the nuclei of the mature larvæ. The single large nucleoli are almost always eccentric. The cells are well innervated by nerve fibers arising from the region of the corpus cardiacum. Almost all traces of the secretory elements of the last mentioned gland have disappeared, but there remain a number of nerve cell bodies representing the hypocerebral ganglion. These are loosely arranged, and do not form a compact gland-like structure as is found in *Lucilia.* A second cell type represented by small cells scattered among the nerve cell bodies is probably connective tissue and supporting cells. The gross arrangement of the incretory organs is most clearly seen in Fig. 6.

The most striking point of the observations reported above is the fact that the changes undergone by the corpora allata of *Melophagus* are so different from those occurring in *Lucilia sericata* as described by Day (1943). Whereas in the latter, the corpus allatum is very inconspicuous in the larva, and its cells reproduce by mitosis during the pupal period, in *Melophagus* the corpora allata reach their maximum size during late larval development, and are considerably reduced in both pupa and adult. Cytologically the cells of the adult *Melophagus* behave similarly to those of *Lucilia.* Neither show visible evidence of secretory activity, though in *Lucilia,* at least, marked physiological effects of the ring gland have been demonstrated by experiments.

The changes undergone by the cells of the corpora allata which have been described above can be tabulated as follows:

TABLE 1

CHANGES IN THE CELLS OF THE CORPORA ALLATA OF *Melophagus* DURING DEVELOPMENT

Stage	Approximate number of cells in each corpus allatum	Average size in microns	
		Nucleus	Cell
2 mm. larva	250	6.9	11 x 15
mature larva	300	11.0	17 x 19
white pupa	..	8.7	14 x 15
adult	100	7.3	12.5 x 13

The reduction in the corpus cardiacum during late larval and pupal development in *Melophagus* is in general similar to the reduction found in *Lucilia,* but this gland is never very conspicuous in *Melophagus* and practically absent in the adult.

It is perhaps not surprising to find such differences in the behavior of the incretory organs of *Melophagus* and *Lucilia* when one considers the great differences in their reproductive processes, but the fact that the corpus allatum is a single median organ in *Lucilia* and paired in *Melophagus,* as in Nematocera and the majority of insects, is evidence that there are some fundamental differences between the Hippoboscoidea and Muscoidea.

Summary and Conclusions

The incretory organs associated with the stomodeal nervous system of *Melophagus* exhibit the following characteristics:

1. There is a pair of corpora allata, as in Nematocera and the majority of other insects, rather than a median unpaired structure as in the higher Diptera. The cells and nuclei are extremely large in the larva, and so differ in this also from those of the corpora allata of the Brachycera.

2. The cells of the corpora allata exhibit cytological evidence of secretory activity in the young larva — thus differing fundamentally from the corpus allatum component of the ring gland of the Brachycera which have been studied.

3. The vacuolization of the cytoplasm of the corpus allatum cells at the time of puparium formation and pupation is comparable to that found in the corpora cardiaca of Brachycera, and suggests that the gland is physiologically active at this time.

4. The reduction in cytoplasm of the cells of the corpus allatum in the adult as compared with the larva is a further unique feature of *Melophagus*.

5. The corpus cardiacum is a single median organ, not well developed in the larva of *Melophagus*, decreasing in the pupa and practically absent in the adult. While the reduction during development is characteristic of Brachycera, the extreme reduction is unique among those insects which have been studied.

The many unusual characters enumerated above correlate with the unusual reproductive habits of *Melophagus*, but it would be of little value to suggest the functional significance of the observations until some experimental procedures have been applied to this most interesting insect. The difficulties of breeding this species under controlled conditions in the laboratory has so far made such work impractical.

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Description of Plate I

The corpora allata of *Melophagus ovinus* L. Figs. 1–4 from transverse serial sections, 10 microns in thickness, Bodian silver impregnation. Drawn with camera lucida with 10x ocular and 44x objective, magnification 200 diameters. Figs. 5–6 drawn from dissections of flies fixed by injection with alcoholic Bouin.

Fig. 1. T. S. 2 mm. larva, showing relationships of corpora allata, corpus cardiacum tissue and other tissues of the larval head. Note the large size of the cells of the corpora allata.

Fig. 2. T. S. portion of a mature larva showing huge increase in size of corpora allata mainly brought about by increase in cell size, which is accompanied by an increase in nuclear size.

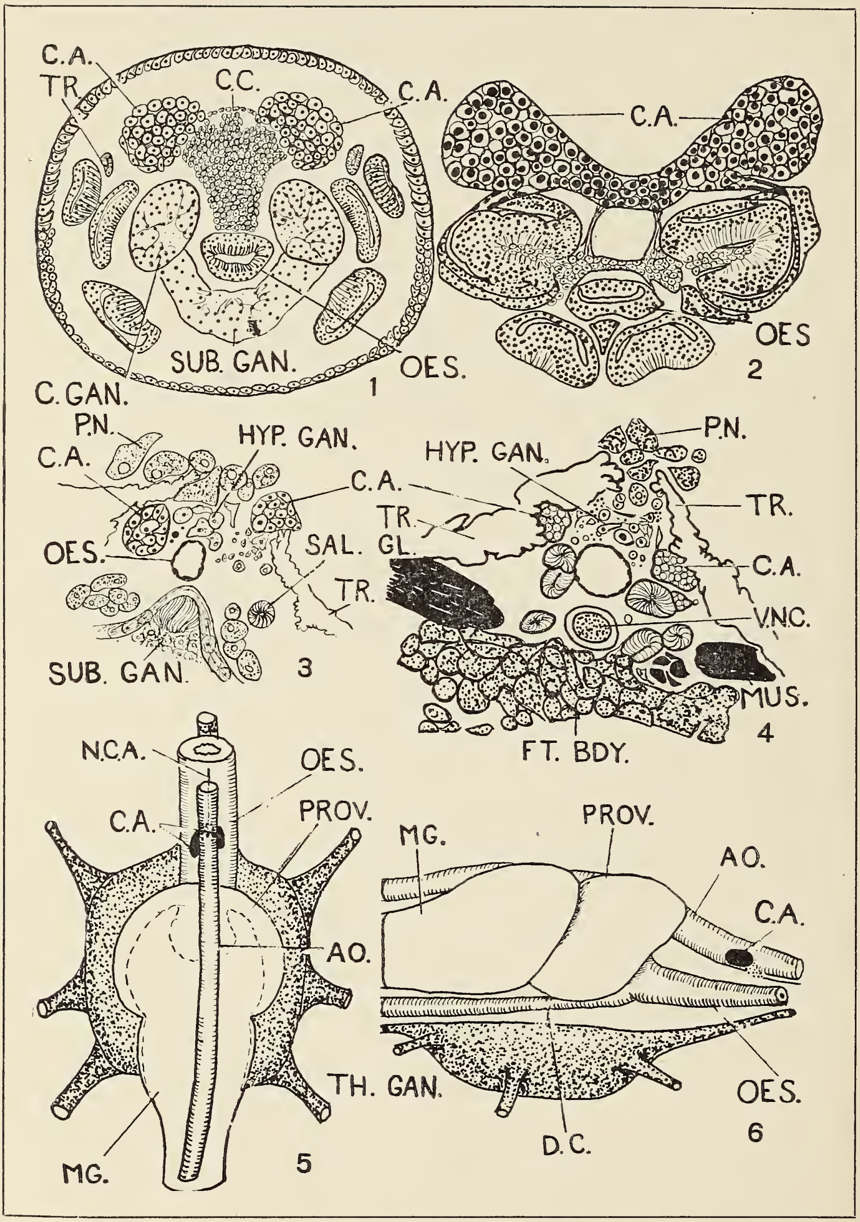
Figs. 3 and 4. T. S. head adult male and female *Melophagus* showing the paired corpora allata and their relation to other organs.

Figs. 5 and 6. Dorsal and lateral aspects of proventriculus, aorta and suboesophageal ganglion, showing the location and anatomical relationships of the corpora allata.

Key to Abbreviations

AO.	Aorta
C.A.	Corpora allata
C. C.	Corpora cardiaca
C. GAN.	Cerebral ganglion
D.C.	Duct to crop
FT. BDY.	Fat body
HYP. GAN.	Hypocerebral ganglion
M.G.	Midgut
MUS.	Muscle fibers
N.C.A.	Nerve to corpora allata
OES.	Œsophagus
P.N.	Pericardial nephrocytes
PROV.	Proventriculus
SAL. GL.	Salivary glands
TH. GAN.	Thoracic ganglion
TR.	Trachea
V.N.C.	Ventral nerve cord

Psyche, 1943 Vol. 50, Plate I



Day — Corpus allatum

NEW SPECIES OF BOTHRIOCERA BURM. (HOMOPTERA: CIXIIDÆ) FROM THE LESSER ANTILLES

By R. G. Fennah

Entomologist, Citrus Pests Investigation, Windward and Leeward Islands

In the present paper seven new species of *Bothriocera* Burm. are described. Five of them, *B. cyanea*, *B. phantasma*, *B. riparia*, *B. daedala* and *B. hastata* (see below), are apparently endemic in the one island from which each has been recorded: another species, *B. longistyla*, has been found only in two adjoining islands, while the seventh, *B. eborea*, has, by contrast, been taken in all islands where the writer has searched.

The relation of these species to Greater Antillean or mainland forms, and even to each other, is obscure, chiefly on account of the difficulty of assessing the value of the available morphological or chroic characters. As regards the pattern of the tegmina it is evident, from a scrutiny of over 700 specimens, that within any one island the pattern of a single species is constant, even in minute details; between islands, however, the differences in tegminal pigmentation of a single species are quite distinct, being revealed, not in changes of pattern, but in boldness of marking. In the genitalia the shape of the male genital styles seems to be a useful character, but forms which are allied in the possession of a common type show very different tegminal markings. On the whole, the writer is inclined to regard the following group of characters as providing the best basis for judging the affinity of Lesser Antillean species: (i) truncate styles of the *B. hastata* type, (ii) a periandrium with a process on the left side, (iii) a triangular median ventral process on the pygofer and (iv) an anal segment with the apical margin rounded. On the basis of possessing at least three of these characters all the species discussed below are allied with the exception of *B. cyanea*, a species which also stands apart by reason of its tegminal markings. For the rest it appears that the various genital and chroic characters are combined at random.

The holotype males and allotype females of all the species described have been deposited in the U. S. National Museum, while paratype series of both sexes have been sent to the British Museum (Natural History), the American Museum of Natural History, and the Museum of Comparative Zoology, Cambridge, Mass., U. S. A.

Bothriocera Burmeister

1835 Burmeister, Handbuch der Entomologie, p. 156. Haplotype *B. tinealis* Burm.

Bothriocera cyanea sp. n.

Male. Length, 3.5 mm.; tegmen, 3.9 mm. Female. Length, 3.8 mm.; tegmen, 4.2 mm. Frons and clypeus piceous, lateral margins pale, almost white; genae piceous, antennal pit white; vertex piceous. Pronotum piceous, but almost white laterad on posterior half. Mesonotum dark, thorax fuscous ventrally. Fore legs piceous, middle and hind legs pale testaceous. Abdomen and genitalia brown. Tegmina pale yellow basally, smoky brown beyond a line from stigma to apex of clavus, clavus dark; stigma dark, often traversed by two parallel crimson lines. Wings smoky, pale at base. Insect in life densely powdered purplish blue and sulphur yellow.

Anal segment of male truncate at apex, lateral angles pointed. Periandrium tubular, penis forming a complete loop round periandrium, outer border minutely serrate distally. Genital styles with apex broadly rounded, a thin lobe lateroventrally at right angles. A small knob at outer angle. Inner border of style concave at base, convex distally. Median ventral process of pygofer semicircular with a minute point at apex.

Described from 17 males and 14 females collected by the writer at 800 ft. in mountain forest near the Imperial Road, Dominica, B. W. I. (June 11–30, 1939; June 15–29, 1940) resting on *Palicourea crocea* and *Inga laurina*. This species is distinguished by the male genitalia and by the dark tegmina with a pale basal spot.

Bothriocera phantasma sp. n.

Male. Length, 2.9 mm.; tegmen, 3.5 mm. Female. Length, 3.0 mm.; tegmen, 3.8 mm. Frons, clypeus, genae, vertex and pronotum white or pale yellow. Mesonotum piceous, pleura pale; coxae smoky, profemora smoky, pro-tibiae and tarsi, middle and hind legs very pale. Abdominal sternites and membrane pale, tergites and genitalia fuscous. Tegmina transparent; a spot at apex of costal cell, a dark line from stigma to apex of clavus sharply interrupted in middle, cross-veins of apical region dark; two spots on R veins near apex of costal margin; a dark spot at base of Cu; clavus smoky posterior to veins. Wings transparent, smoky towards base of anal veins. Insect in life powdered greyish.

Anal segment of male truncate apically, apical angles produced into large rounded lobes. Periandrium tubular, a broad hook-like process directed dorsally and anteriorly on left side near apex. Penis broadest in middle, forming loop of 270 degrees, minutely serrate at apex and at base near junction with apodeme. Genital style with inner margin concave at base, convex in middle, slightly concave at apex, posterior angle only just obtuse; apex truncate; inner angle slightly produced. Median process on pygofer between base of styles forming an isosceles triangle with angles truncate.

Described from 15 males and 12 females collected by the writer at 1,000 ft. in mountain forest near the Imperial Road, Dominica, B. W. I. (June 15–29, 1940) on epiphytic aroids.

Bothriocera riparia sp. n.

Male. Length, 4.6 mm.; tegmen, 5.0 mm. Female. Length, 4.7 mm.; tegmen, 5.1 mm. Head, thorax, legs, abdomen and genitalia (excluding ovipositor) white; abdominal tergites occasionally fuscous, abdomen sometimes tinged with pink; ovipositor fuscous. Tegmina transparent, slightly yellow; stigma black, a dark spot contiguous posteriorly; a dark spot at first fork of M; subapical cross-veins pale smoky; a dark trace at base of second apical cell of R; clavus pale. Wings transparent. Insect in life powdered grey.

Anal segment of male bluntly rounded at apex; periandrium tubular with an elongated vertical process, rounded at apex, on left side; penis wide apically, a large evenly-serrated lobe attached to middle, inner margin serrate, membrane minutely denticulate near apex. Inner border of genital styles with two indentations, obtusely angled at apex; apex truncate. Median ventral process of pygofer forming an isosceles triangle with sides convex in apical half.

Described from 27 males and 33 females collected by the writer at 2,000 ft. on Morne Garu (Aug. 20, 21, 1941), and at Three Rivers (Sept. 3–5, 1941), St. Vincent, B. W. I., mostly resting on *Tabernaemontana* sp. and *Heliconia bihai.* The species is distinguished by the pattern of the tegmina, which, though of a common type, is characteristic in its details, and by the conspicuous processes on the periandrium and penis.

Bothriocera longistyla sp. n.

Male. Length, 3.4 mm.; tegmen, 4.2 mm. Female. Length, 3.5 mm.; tegmen, 4.4 mm. Frons, clypeus, vertex, pronotum and legs pale testaceous, margins of antennal pit narrowly fuscous; mesonotum dark testaceous or fuscous; abdomen and genitalia brown or fuscous. Tegmina transparent, ivory yellow; veins lightly clouded, except R, M, and Cu at base; an interrupted narrow band from stigma to apex of clavus; subapical cross-veins narrowly clouded; clavus pale, smoky behind posterior vein. Wings transparent, clouded over part of anal area. Insect in life powdered grey.

Anal segment of male with posterior border bluntly rounded. Periandrium tubular, a broad process on left side tapering to a point anteriorly. Penis looping in a semicircle, irregularly serrate along margin, tapering to a fine point. Genital styles narrow, elongate, obtusely angled near middle, tapering slightly to a blunt point at tip. Median ventral process of pygofer subconically rounded.

Described from 30 males and 41 females collected by the writer at 1,000 ft. in mountain forest near Quilesse, St. Lucia, B. W. I. (March 20, 21, 1939) and on Morne Fortunée, St. Lucia at 750 ft. (Feb. 2–5, 1940), resting on *Miconia* sp., *Tabernaemontana* sp., and *Inga laurina.* The species is readily distinguished by its pale tegmina and long tapering styles, and by the shape of the periandrium. A long series from Morne Garu, St. Vincent, B. W. I. (coll. R. G. F. Aug. 20, 21, 1941) is assigned to this species, but differs constantly in having the tegmina wholly transparent and unmarked, and a periandrial process with a broader base. The St. Lucian variety is designated as *B. longistyla* var. *vulgaris* and the St. Vincent variety as *B. longistyla* var. *pallida.*

Bothriocera daedala sp. n.

Male. Length, 3.0 mm.; tegmen, 3.4 mm. Female. Length, 3.1 mm.; tegmen, 3.7 mm. Frons and clypeus pale yellow, lateral margins slightly darker, vertex and margin of antennal pit piceous; genae and antennae pale yellow. Pronotum pale or dark, pale laterally; mesonotum fuscous. Ventral surface of thorax pale, legs slightly darker; abdominal tergites and sternites fuscous, genitalia fuscous. Tegmina pale basally, mostly dark distad of a line from stigma to apex of clavus, a pale spot just distad of stigma, a small spot distad of this on margin; a round pale spot posterior to stigma in middle of tegmen; apical cells almost entirely pale to apical margin; a small dark spot between M1a and M1b; apical cells of Cu and clavus wholly dark. Wings smoky, pale basally, a pale spot apically. Insect in life powdered blue-grey.

Anal segment of male truncate apically in a straight line. Periandrium tubular, with a large broad lobe on left side near apex directed dorso-anteriorly to a blunt point. Penis looping for slightly more than a semicircle, a small lobe with about eight teeth on dorsal side in middle; an irregular line of teeth from inner side near base of penis to dorsal margin one third from apex. Genital styles with inner border concave at base, obtusely angled apically; apex truncate. Median process of pygofer between styles in form of an isosceles triangle with convex sides, apex pointed.

Described from 64 males and 71 females collected by the writer at 1,000 ft. in mountain forest near the Imperial Road, Dominica, B. W. I. (June 11–30, 1939; June 15–29, 1940) resting on low bushes. This species is distinguished by the pattern of the tegmina, which is somewhat similar to that of *B. signoreti* Stål, and by the male genitalia.

Bothriocera hastata sp. n.

Male. Length, 3.2 mm.; tegmen, 3.6 mm. Female. Length, 3.6 mm.; tegmen, 4.0 mm. Frons piceous, testaceous laterally; clypeus fuscous, narrowly pale laterally; antennae pale. Vertex, pro- and mesonotum piceous. Femora smoky, protibiae and tarsi smoky, mesotibiae and tarsi testaceous, metatibiae and tarsi very pale. Abdomen and genitalia fuscous. Tegmina pale yellow basally; a fuscous spot at apex of costal cell, a broad dark band from stigma to apex of clavus, tegmina distad of this line mostly fuscous; a transparent spot distad of stigma, a large round transparent spot posterior to this, a small pale spot at margin between Sc and R, a minute spot between M1 and M2, an elongated pale spot subapically crossing four apical cells. Wings smoky, pale basally, a pale round spot in apical half. Insect in life powdered bluish-grey.

Anal segment of male bluntly rounded at apex. Periandrium tubular, a long, somewhat narrow curved process on left side directed upward and anteriorly, beset with numerous minute teeth at tip. Penis somewhat narrow, looping in a semicircle; a bluntly conical projection near base, a few coarse teeth on inner border at basal quarter, a small but prominent coarsely-serrated crest just beyond middle. Genital styles with inner border concave basally, obtusely angled distally; apex truncate. Median ventral process of pygofer forming an isosceles triangle with sides slightly convex.

Described from 22 males and 24 females collected by the writer at 2,000 ft. in mountain forest on Morne Garu, St. Vincent, B. W. I. (Aug. 20 and 21, 1941), resting on *Heliconia bihai* and aroids. This species broadly resembles *B. daedala* but is well distinguished by the tegminal pattern, as well as by characters of the anal segment, the periandrium, and the penis. According to Mr. China this species is identical with specimens from St. Vincent identified by Uhler as *B. signoreti* Stål. It seems to be endemic in St. Vincent.

Bothriocera eborea sp. n.

Male. Length, 3.4 mm.; tegmen, 4.1 mm. Female. Length, 4.1 mm.; tegmen, 4.8 mm. Frons fuscous, testaceous towards and on lateral margins, clypeus pale medially, fuscous on each side of middle line, testaceous at margins, genae and antennal pits testaceous yellow; vertex pale fuscous, testaceous laterally. Pronotum testaceous; mesonotum, abdomen and genitalia piceous; legs dark testaceous. Tegmina with a dark band from stigma to apex of clavus; apical portion of veins, cross-veins, and membrane at apical margin clouded with brown; clavus wholly brown. Wings transparent basally, cross-veins dark, distal portion of wings smoky. Insect in life powdered bluish-grey.

Anal segment of male rounded into a semicircle at apex. Periandrium tubular, dorsal border sinuate, terminating in a broad lobe directed anteriorly, slightly crenulate at rounded tip. Penis with a small curved coarsely-toothed process at base, a curved spine, often somewhat transparent, on inner margin one-third from base; at apex of membrane a very small projection at outer edge, and a long spinose recurved process at inner edge; a long curved transparent process arising two-thirds along penis and projecting anteriorly, terminating in a rounded, spatulate, or cup-like apex. Genital styles with inner border deeply concave at base, obtusely angled distally; outer border concave, apex truncate. Median ventral process of pygofer small, triangular.

Described from 14 males and 21 females collected by the writer at 1,300 ft. in forest near Ottley's Level, St. Kitts, B. W. I. (Jan. 26, 27, 1942) resting on *Tabernaemontana* sp. and on aroids.

The writer has long series of this species from other islands, collected as follows: 1,000 ft. in forest near Quilesse, St. Lucia, B. W. I. (coll. R. G. F. Mar. 20, 21, 1939); 800 ft. in forest near Mahaut, Dominica, B. W. I. (coll. R. G. F. June 14, 1939); 1,300 ft. in forest, Chance's Mountain, Montserrat, B. W. I. (coll. R. G. F. Jan. 18, 1939); 2,000 ft. in forest, Morne Garu, St. Vincent, B. W. I. (coll. R. G. F. Aug. 20, 21, 1941); 1,000 ft. in forest, Nevis, B. W. I. (coll. R. G. F. Jan. 18, 1942). There are differences in intensity of pigmentation between series from different islands, and the genitalia afford the only reliable means of identification.

Explanation of Plate II

1–5 *Bothriocera cyanea*

1. Anal segment of male, dorsal view; 2. Periandrium, lateral view; 3. Penis, lateral view; 4. Genital style, lateral view; 5. Median ventral process of pygofer.

6–10 *B. phantasma*

6. Anal segment of male, dorsal view; 7. periandrium, lateral view; 8. Penis, lateral view; 9. Genital style, lateral view; 10. Median ventral process of pygofer.

11–15 *B. riparia*

11. Anal segment of male, dorsal view; 12. Periandrium, lateral view; 13. Penis, lateral view; 14. Genital style, lateral view; 15. Median ventral process of pygofer.

16–20 *B. longistyla*

16. Anal segment of male, dorsal view; 17. Periandrium, lateral view; 18. Penis, lateral view; 19. Genital style, lateral view; 20. Median ventral process of pygofer.

21–25 *B. daedala*

21. Anal segment of male, dorsal view; 22. Periandrium, lateral view; 23. Penis, lateral view; 24. Genital style, lateral view; 25. Median ventral process of pygofer.

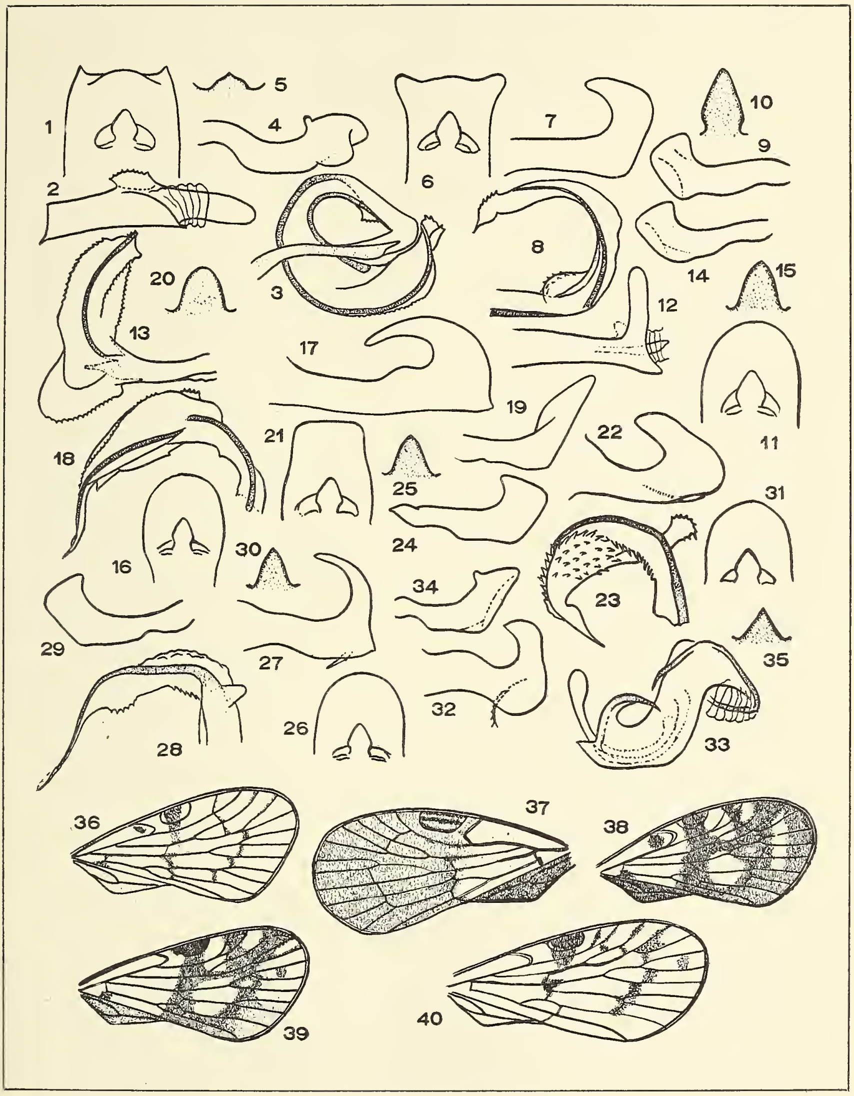
26–30 *B. hastata*

26. Anal segment of male, dorsal view; 27. Periandrium, lateral view; 28. Penis, lateral view; 29. Genital style, lateral view; 30. Median ventral process of pygofer.

31–35 *B. eborea*

31. Anal segment of male, dorsal view; 32. Periandrium, lateral view; 33. Penis, lateral view; 34. Genital style, lateral view; 35. Median ventral process of pygofer. 36. *B. phantasma*, tegmen; 37. *B. cyanea*, tegmen; 38. *B. hastata*, tegmen; 39. *B. daedala*, tegmen; 40. *B. eborea* (St. Kitts), tegmen.

PSYCHE, 1943 VOL. 50, PLATE II



Fennah — New species of Bothriocera

KALOTERMES MILLERI, A NEW SPECIES OF TERMITE FROM THE FLORIDA KEYS AND JAMAICA (ISOPTERA, KALOTERMITIDÆ)[1]

By Alfred E. Emerson

Hull Zoological Laboratory, University of Chicago

The number of undescribed species of termites to be found within the borders of the United States is probably quite small. During trips to Florida (1941) and to the southwestern states (1937, 1941) extensive collections of termites were made enabling me to make new associations of reproductive castes with soldiers in several instances, to gather sufficient population samples to indicate that several named forms are only variants and should not be classified as distinct species, and to extend and clarify the ranges of distribution of many species. After a more thorough study of these collections, I plan to publish a revision of the termites of the United States. As such a study may take several years to complete, it seems best to add the following species to the fauna without delay.

This new species of *Kalotermes* is the smallest member of the genus (*s. str.*) in the United States. The fact that it is found both in the Florida Keys and in Jamaica is not surprising as there are a number of Neotropical species of termites which reach the southern tip of Florida but do not extend north of the tropical area. In time it may be expected that this species will be found in Cuba and possibly other West Indian islands.

Kalotermes milleri, new species

Imago (figs. 1 and 2).

Head, pronotum and abdominal tergites dark shining brown; labrum yellow; sternites a little lighter than the tergites; femora, tibiae and tarsi light yellowish; costal margin of wing and radial veins brown, wing membrane hyaline.

[1] The present investigation was aided by a grant from the Dr. Wallace C. and Clara A. Abbott Memorial Fund of the University of Chicago.

Head and pronotum with scattered bristles and hairs; each tergite and sternite with a few short hairs and long bristles on the posterior portion.

Head oval, the Y-suture not conspicuous. Eye fairly small (fig. 2), somewhat angular, about two-thirds of its long diameter from the lower margin. Ocellus in contact with the eye or close to the eye with only a thin brown line separating it from the ocular suture. Antennae with thirteen articles, the third equal to or slightly shorter than the second and about equal to or a little longer than the fourth.

Pronotum (fig. 1) about the width of the head, about five-eighths as long in the middle as the width, with slightly rounded sides, front margin evenly concave and hind margin slightly emarginate. Forewing scale overlapping the base of the hindwing scale when at rest. In the forewing the subcostal vein joins the costal border close to the suture, R_1 absent, R_{2+3} runs singly to the costal border a little beyond *Sc*, R_{4+5} with about six superior branches, *M* weaker than the radius and running midway between the radius and cubitus, *Cu* running out near the tip of the wing with numerous inferior branches. Anal vein in the hindwing quite thick. Arolium present between the tarsal claws.

Measurements in millimeters: —

Length with wings	7.52–7.76
Width of head	0.84–0.93
Diameter of eye	0.22–0.27
Eye from lower margin	0.15–0.18
Length of ocellus	0.09–0.11
Length of pronotum	0.51–0.59
Width of pronotum	0.80–1.00
Length of hind tibia	0.68–0.76
Length of forewing	5.92–6.10
Length of forewing from suture	5.26–5.37
Width of forewing	1.29–1.30

Paratype alates of *K. bequaerti* Snyder from Banos, Oriente, Cuba have longer wings, are yellow instead of dark brown, and have a distinctly larger eye.

Soldier (figs. 3, 4 and 5).

Head and body yellowish with the front of the head and mandibles a contrasting dark brown to black.

Head, pronotum and tergites with a number of scattered bristles.

Head (fig. 3) elongate with somewhat curved or straight parallel sides; a thick prominent dark ridge above the base of the antenna; a whitish eye spot behind the base of the antenna. Postmentum ("gula") about half or less than half as wide in the middle portion as in the anterior region (fig. 5), sides rather evenly concave from the widest region to the posterior end. Mandibles (figs. 3 and 5) with bases slightly curved on the outside edge and tips curved inward; left mandible with three marginal teeth, the second and third with sinuate edges together making a symmetrical marginal outline; the right mandible with two prominent marginal teeth about equal in size. Antennae with ten to eleven articles, the third about twice the length of the second and darker than the outer articles.

Pronotum (fig. 3) proportionately long, sides fairly straight, front margin angularly emarginate and edges somewhat turned up to fit the back of the head and sometimes flared outward at the junction with the sides, hind margin evenly and convexly curved. Femora swollen and tibiae rather short and thick, less than half as wide as the femora. Tibiae with three terminal thick dark spines.

Measurements in millimeters: —

Length of head with mandibles	2.21–2.71
Width of head	0.94–1.12
Widest width of postmentum	0.41–0.49
Narrowest width of postmentum	0.16–0.23
Length of left mandible	0.91–1.06
Width of pronotum	0.92–1.06
Length of pronotum in middle	0.56–0.79
Length of hind tibia	0.71–0.88

A single paratype soldier of *K. bequaerti* Snyder from Banos, Oriente, Cuba has proportionately wider pronotum and the tips of the mandibles are a little straighter. I am not sure that these characters will always show specific distinction in a large series.

The descriptions are based upon eight reproductives and about thirty-seven soldiers. Samples from eight colonies were collected on the Florida Keys by Dr. E. M. Miller of the University of Miami, Coral Gables, Florida, and by the author. I have recently received samples from three colonies collected in Jamaica by Dr. E. A. Chapin of the U. S. National Museum to whom I am indebted for these and other collections. I take pleasure in naming this species in honor of Dr. E. M. Miller who has collected extensively in Florida and who has recently published interesting studies on caste development in *Prorhinotermes*. Dr. Miller has a paper in press dealing with Florida termites. The collection records of *K. milleri* are as follows: —

Type locality: — Elliott Key, Florida: holotype queen, morphotype soldier, and paratype king and soldiers collected by E. M. Miller, 7.II.1942; paratype dealate and soldiers from four colonies collected by A. E. Emerson, 22.III.1941; paratype soldiers collected by E. M. Miller, 7.V.1938.

Other localities: — Key Largo, Florida: paratype soldiers from two colonies collected by E. M. Miller, 21.III.1931. Bluefields Bay, Jamaica: paratype alates and soldier collected by E. A. Chapin, 20.V.1941, Sta. 588, in old stump. Portland Ridge, Jamaica: paratype dealate and soldiers collected by E. A. Chapin, 3.V.1941, Sta. 539, dead standing tree; paratype soldier collected by E. A. Chapin, 3.V.1941, Sta. 537, dead tree.

The holotype queen, morphotype soldier and a series of paratypes are deposited in the collection of the American Museum of Natural History now in the author's possession. Paratypes will be deposited in the U. S. National Museum, Museum of Comparative Zoölogy and Field Museum of Natural History.

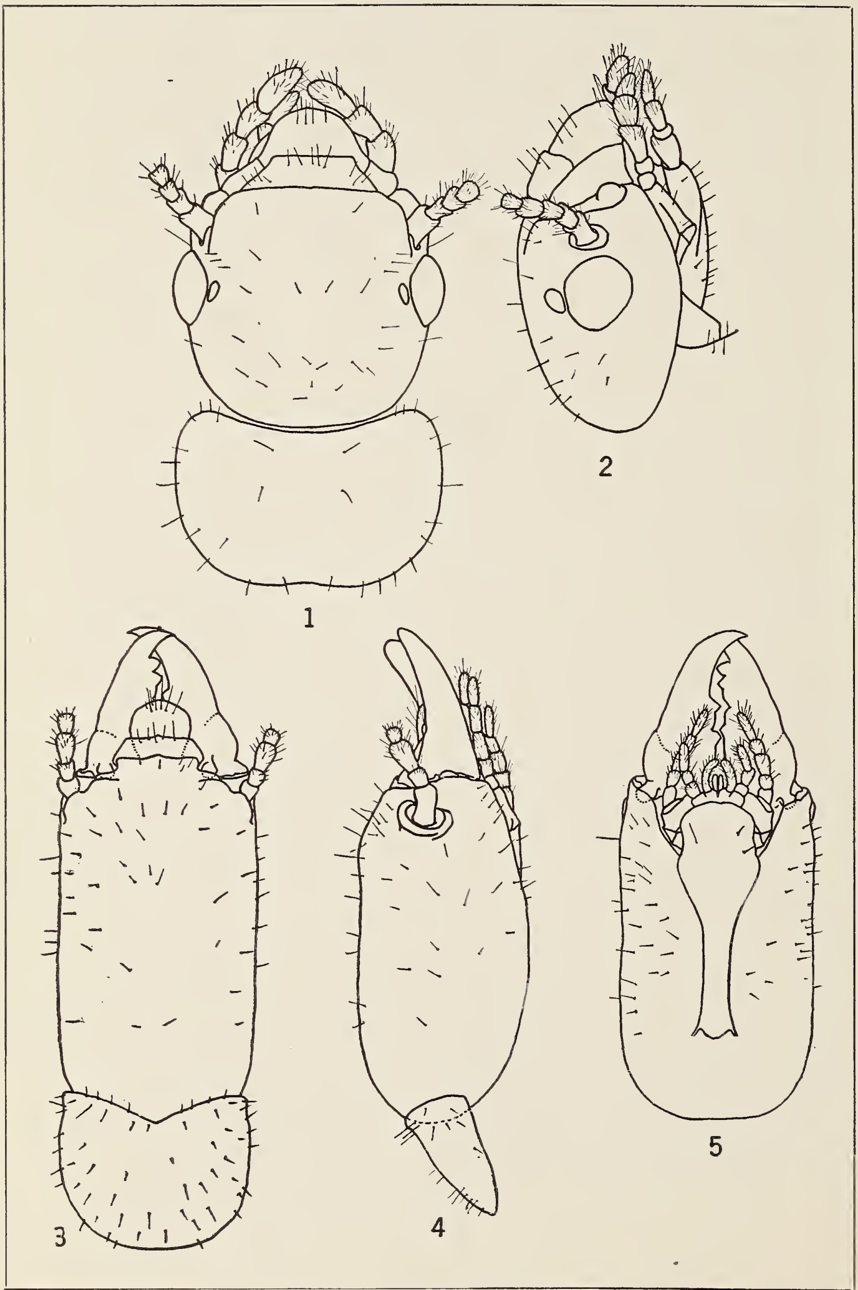
The general biology of the species as far as observed conforms with that of its congeners. It is found in dead hard wood in logs, stumps, standing dead trees and dead branches of living trees. The galleries are often comparatively small in conformity with the small diameter of the soldiers and nymphs. The eggs are laid singly in the galleries inhabited by the queen without any differentiated royal cell. Pellets of excrement are deposited in some of the galleries. It is to be expected that the species will ultimately be found in the hard wood of buildings within the area of its natural range.

Explanation of Plate III

Kalotermes milleri, new species

Fig. 1. Head and pronotum of imago from above.
Fig. 2. Head of imago from side.
Fig. 3. Head and pronotum of soldier from above.
Fig. 4. Head and pronotum of soldier from side.
Fig. 5. Head of soldier from below.

Psyche, 1943 Vol. 50, Plate III



Emerson — *Kalotermes milleri*

SOME NEW CALISTO FROM HISPANIOLA AND CUBA (LEPIDOPTERA: SATYRIDÆ)*

By Harry K. Clench
Cambridge, Mass.

The following new *Calisto* are based upon material collected during the past few years by M. Bates, P. J. Darlington, and C. T. Parsons on various expeditions for the Museum of Comparative Zoölogy.

Calisto batesi, new species

Upperside:

Male. Blackish brown, deeper toward the base of the hind wing. Fore wing with a large area of jet black, covering the basal two-thirds of the wing.

Underside:

Male. Both wings grayish brown, base of the hind wing slightly darker. *Fore wing* with two submarginal lines (the inner one heavier) and a discal line. Near the costa, between the latter and the basal one of the former, there is a black, yellow-ringed ocellus, with two minute white pupils within. Cell with a large red patch, extending from near base almost to cell-end. *Hind wing* with a post-basal, discal and two submarginal lines, the latter both badly dislocated at each intersection with a vein. The discal line approaches these and almost meets them at the anal angle. Between the discal and the submarginal lines, in the Cu_1–Cu_2 interspace, is a tiny ocellus, black, yellow rimmed, as in that of the fore wing, but here with only one central white pupil. Between the same lines, but in the M_2–M_3–Cu_1 interspaces, are two small white spots, placed parallel to the body line, rather than to the outer margin.

Length of fore wing, 14 mm.

Holotype, male, Loma del Toro, foothills of the Cordillera

* Published with the aid of a grant from the Museum of Comparative Zoology, Harvard College.

Central, south of Santiago, Republica Dominicana, Hispaniola, ± 5000 feet, June 1938 (P. J. Darlington). M. C. Z. no. 25915.

Remarks. Calisto batesi differs from the related *grannus*[1] in several points. The cell of the fore wing below is concolorous with the ground, while in *grannus* it is red. The ocellus of the fore wing below is smaller than in *grannus* (even smaller than in the paratypes of *grannus* from Loma Rucilla, Rep. Dom., whose ocelli were noted by Bates to be smaller than those of the remaining (Valle Nuevo, Rep. Dom.) paratypes). On the hind wing below *batesi* may be distinguished from *grannus* by the absence of the apical ocellus and the greatly reduced size of the anal one. The discal line appears to be lighter in *batesi* than in *grannus* (on both wings below), and on the hind wing arises closer to the center of the costa. Possibly this species is intermediate between *grannus* and *tragius*,[2] since to the latter it also bears a resemblance. However, *tragius* has a ruddy patch below the apical ocellus of the fore wing, and on the hind wing has the inner and outer marginal areas shaded with light scales.

This species is named for Dr. Marston Bates, who has contributed so much to our knowledge of this genus.

Calisto hysius montana, new subspecies

Upperside:

Male. Dark black-brown. A small obscure ruddy patch occupies an area near the anal angle of the hind wing.

Underside:

Male. Both wings black-brown. *Fore wing* with the cell completely red, this color extending slightly into the neighboring interspaces. Two very faint submarginal lines and a faint discal line cross the wing. Between the inner submarginal and the discal is a black, bi-pupilled ocellus, ringed with yellowish. *Hind wing* irrorated with light scales, strongly near the inner margin, lightly elsewhere. Two submarginal lines as in the fore wing, but more prominent. A single circular and nearly symmetrical ocellus lies in the Cu_1–Cu_2 area just behind the inner submarginal line. Basal to this inner submarginal line is

[1] Bates, 1939, Psyche 46, p. 49 (Notes on Butterflies from Hispaniola).

[2] Bates, 1935, Occ. Papers Boston Soc. Nat. Hist. 8, p. 236, fig. 3 (The Satyrid Genus *Calisto*).

an obscure purplish band, in which, besides the ocellus, are three white spots, one each in the M_2–M_3–Cu_1 interspaces. Basal to the ocellus is an obscure discal line, and still further basad is another line, the latter composed solely of whitish scales. Anal angle with a small black spot.

Length of fore wing, 15 mm.

Holotype, male, Mt. Basil, Haiti, 4500 feet, September 9, 1934 (P. J. Darlington and M. Bates), M. C. Z. no. 25914.

Remarks. This subspecies differs from typical *hysius*[3] (as represented by the series identified by Bates as typical) in lacking the red patch below the subapical ocellus of the fore wing; in the marginal extension of the red into the outer extremity of the cell below; in the white post-median line on the hind wing below, which in the typical is less prominent and bordered with blackish; and in the slightly larger subapical ocellus on the underside of the fore wing. Also, the subanal ocellus of the hind wing below is more nearly round, and has the pupil almost in the center, while in *hysius* the ocellus is oval, with the pupil towards the base.

Calisto confusa debarriera, new subspecies

Calisto hysius: Lathy, 1899, Trans. Ent. Soc. London **1899**, p. 226, pl. 4, figs. 10, 11 (A Monograph of the Genus *Calisto*, Hübn.).

Calisto confusa: Bates, 1935, Occ. Papers Boston Soc. Nat. Hist. 8, p. 239, 240 (separated as "variety B").

Upperside:

Male. Both wings black-brown. A discal dark patch occupies the lower central part of the fore wing.

Underside:

Male. Both wings brown. *Fore wing* with a subapical, bipupilled ocellus, ringed with yellowish. Cell red, which color extends slightly into neighboring interspaces. There are two submarginal (outward of ocellus) lines, and an indication of a discal (basad of ocellus) line. *Hind wing* lightly overcast with a few scattered whitish scales. A single ocellus near the anal angle, with its small white pupil slightly basad of the center. A very obscure line crosses the basal part of the wing. Inward

[3] Godart, 1823, Encyclopedie Méthodique 9, p. 525.

of the ocellus is a line, bluish near the costa, white thenceforwards. The two submarginal lines slightly converge towards the anal angle, and in the latter part are white in between. Basal to the inner submarginal line are three white spots, one each in the interspaces M_2–M_3–Cu_1.

Length of fore wing, 12–13 mm.

Holotype, male, Debarriere,[4] La Hotte Mt., Haiti, 4000 ft., Oct. 13, 1934 (P. J. Darlington). (M. C. Z. male genitalia slide no. 363.)

Paratype, male, same data.

Holotype, M. C. Z. no. 25916. Paratype in the author's collection.

Remarks. This subspecies differs from typical *confusa*[5] in being darker below and with the light lines obscured. The cellular red is darker also. One male from Targi, near La Hotte, and a male from Ennery (both Haiti), seem referable to this subspecies, but both have slight differences.

Calisto herophile parsonsi, new subspecies

Upperside:

Male. Both wings brownish black, with the disk of the fore wings dull jet black.

Female. Similar to the male, but with the disk of the fore wing not quite so dark a black.

Underside:

Male. Fore wing rather dark brownish gray. Two submarginal lines, parallel, run from costa to inner margin. Basal to these, near the costa, is a rather large, black, and bipupilled ocellus, ringed with yellow. Basad of this ocellus is a discal line bordered outwardly, in the vicinity of the ocellus, with light scales. It is set perpendicular to the costa and approaches the submarginal lines near the anal angle. All of these lines are somewhat obscured towards the inner margin by a grayish shading, more or less distinct, that covers the whole lower half of the wing. A subtriangular reddish patch occupies the cell. *Hind wing* ground color similar to that of the fore wing, but slightly lighter. Two submarginal lines as in the fore wing, but

[4] Sometimes spelled "Desbarriere." I have adopted the name on the labels of the types, both as the type locality and in the formation of the new name.

[5] Lathy, 1899, Trans. Ent. Soc. London 1899, p. 227, pl. 4, figs. 12, 13.

towards the anal angle whitish in between. A discal and a postbasal line cross the wing, the former basally limiting an area of dull bluish in which are four white spots, one to each of the $Rs–M_1–M_2–M_3–Cu_1$ interspaces, and a black, white-pupilled ocellus (reflecting bluish in some lights), ringed with yellow, in the $Cu_1–Cu_2$ interspace. The discal line is outwardly bordered by yellowish scaling, and the inner submarginal line, which outwardly borders this bluish area, is sometimes basally margined with light scaling. This bluish strip, while normally probably always present, appears to be very easily lost, since of the type series of 10 specimens, but three (the holotype, allotype, and one male paratype) have it; the three most perfect specimens. The remainder of the series consists of specimens fairly well flown, and all lack it. It is difficult to say, by examination of the specimens themselves, whether the absence or presence of this bluish is due to wear, but from an inspection of the series as a whole, it would appear that it was lost by prolonged flight.

Female. Similar to the male, with the following exceptions: the cellular red patch is larger; the ground color is slightly lighter; and the marginal area of both wings appears to be somewhat more whitish.

Length of fore wing; male, 14.5–16 mm.; female, 15–16 mm.

Holotype, male, Buenos Aires, western Trinidad Mts., Prov. Santa Clara, Cuba, 3000 ft., June 19–21, 1939 (C. T. Parsons).

Allotype, female, same data.

Paratypes, six males and two females, same data.

Holotype, allotype, and six paratypes, no. 25917 in the M. C. Z. A pair of paratypes in the author's collection.

Remarks. This race, in common with that of the Bahamas, *apollinis*,[6] is rather indistinct from the typical subspecies. The differences are slight, but seem in the specimens examined, to be quite constant. In appearance, at least, *parsonsi* seems to be most nearly allied to *apollinis*. The two may be separated by the darker ground color of *parsonsi*, and the latter's more distinct bluish band (when present). *Parsonsi* may be distinguished from the typical (described from Habana)[7] in its

[6] Bates, 1934, Occ. Papers Boston Soc. Nat. Hist. **8**, p. 136 (New Lepidoptera from the Bahamas).

[7] Hübner, J., 1823, Zuträge zur Sammlung Exotischer Schmetterlinge, 2nd Bund., p. 16, figs. 269, 270.

darker ground color below, duller bluish band, and less distinctly marked lines.

Calisto herophile parsonsi seems to connect *herophile* (s.l.) and *smintheus*,[8] but is quite definitely distinct from the latter. A pair, male and female, from Mina Carlota, in the Trinidad Mts. (1500 ft.), seem to agree with this subspecies.

This subspecies is named for the collector of the specimens, Dr. Carl T. Parsons.

Calisto pulchella darlingtoni, new subspecies

Upperside:

Male. Both wings dark brownish black. *Fore wing* with a large basal area of dull black scales, the scent patch. *Hind wing* with the inner marginal part of the wing lighter.

Underside:

Male. Fore wing dark brownish black, the base overlaid with dull fulvous hairs. Inner margin lighter, almost gray. The subapical ocellus is black, ringed with yellow and bipupilled, the second of which is placed in the margin of the ocellus. Between the ocellus and the outer margin there is an indication of two submarginal lines. Basal to the ocellus is another line, very faintly indicated, that crosses just beyond the cell and extends no further than M_3. *Hind wing* with the ground color as in the fore wing. Base black with scattered fulvous scales. Disk of wing bright golden fulvous, running from costa, where it occupies the basal half of that margin (save for the extreme basal area of black), to the inner margin where it occupies the central two-thirds. Near the costa this fulvous area is crossed by a dark brown, rather sinuate line, parallel to the body axis. Just marginal to the fulvous, near the costa, is another, more obscure line, parallel to the first, but longer, and continuing to M_3 where it enters the now expanded fulvous area, turns slightly and crosses it to the anal angle. Just outward of this line, in the Cu_1–Cu_2 interspace is a much elongated ocellus, ringed thinly with yellowish, and with the small white pupil at the basal end. Outer marginal border twice as thick on the costal half as on the anal half. An obscure post-discal parallels the outer margin, composed of obliquely set dashes. (Basal to this line, in the Rs–M_1–M_2–M_3 interspaces are three white dots, the first two

[8] Bates, 1935, Occ. Papers Boston Soc. Nat. Hist. 8, p. 242, fig. 9.

between the discal and the above-mentioned line; the last on the discal line itself.) This line outwardly limits, near the anal angle, the discal fulvous area, but towards the costa it is set off only by a dull basal fulvous shading. The anal angle is black, basally capped by a curved white bar. A submarginal line is faintly represented, usually only towards the anal angle. The margin, at the anal angle, is irrorated with pale scales.

Length of fore wing, 19–20 mm.

Holotype, male, Constanza, Republica Dominicana, Hispaniola, 3–4000 feet, Aug. 1938 (P. J. Darlington).

Paratypes, two males, same data as holotype; one male, foothills of the Cordillera Central, South of Santiago, Rep. Dom., June 1938 (P. J. Darlington).

Holotype and two paratypes, M. C. Z. no. 25918. One paratype in the author's collection.

Remarks. This subspecies differs quite noticeably from typical *pulchella* in the more extensive and more golden fulvous area beneath (on the secondaries). The discal and median lines that cross this fulvous area are thinner than in the typical race. The subanal ocellus of the hind wing is also much smaller, as is the subapical one on the fore wing. This subspecies has been compared with examples from Camp Perrin, Haiti (± 5000 ft.), and "Hayti, P. R. Uhler," that all agree well with Lathy's figures of *pulchella*.[9] Incidentally, one of the museum's females of typical *pulchella* corresponds to the female form named *tenebrosa* (loc. cit. p. 225) by Lathy, and figured by him (fig. 7). It would appear to be only a minor variant, hardly worthy of a name.

This subspecies is named for Dr. P. J. Darlington, Curator of Coleoptera at the Museum of Comparative Zoölogy.

[9] Lathy, 1899, Trans. Ent. Soc. London, 1899, p. 225, pl. 4, figs. 5, 6, 7.

REVISION OF THE GENUS PLEUROPOMPHA LECONTE (COLEOP., MELOIDÆ)[1]

By F. G. Werner

Biological Laboratories, Harvard University

Genus **Pleuropompha** LeConte

LeConte, J. L., 1862, *Smiths. Misc. Coll.* 3:273. Wellman, C., 1910, *Ent. News* 21: 2, 215, 221,[2] 1910, *Can. Ent.* 42:394. Van Dyke, E. C., 1928, *Univ. Calif. Publ. Ent.* 4:400, 404. Genotype: *Lytta costata* Lec., 1854, monobasic.

The genus *Pleuropompha* belongs to the tribe Lyttini auct. and should be placed near *Epicauta* Dej. because of the patch of silky pubescence on the inner face of the anterior femora. From *Epicauta* it differs in having costæ on the elytra. The other costate genus of the tribe, *Pleuropasta* Wellm., does not have the femoral patch and is glabrous. Elongate third to fifth antennal joints of the male distinguish it from all of the genera of the tribe.

Head subquadrate, densely pubescent except for an impressed median line. Thorax campanuliform, also with an impressed median line. Antennal joints three to five in the male more or less elongate, smooth. All tibiæ with two spurs, in both sexes. First joint of anterior tarsi of male slightly elongated but tarsi not otherwise modified.

Two very distinct species are included, both from North America. These may be found to inhabit also the northern states of Mexico.

Key to Species of Pleuropompha

A. Each elytron with four strong costæ, raised suture and margin set off by denuded margins. Pubescence white. .... *costata* (Lec.)

[1] Published with the aid of a grant from the Museum of Comparative Zoology, Harvard College.

[2] "*Pleuropomph,*" probably a *lapsus calami.*

AA. Each elytron with three strong costæ, raised suture and margin not set off by denuded margins. Pubescence pale olive-cinereous. .... *tricostata* sp. nov.

Pleuropompha costata (LeConte)

Lytta costata LeConte, 1854, *Proc. Acad. Nat. Sci. Phila.* 7:84; 1858, *Journ. Acad. Nat. Sci. Phila.* (2) 4: 23, (♂).

Pleuropompha costata, LeConte, 1862, *Smiths. Misc. Coll.* 3:273.

Black (or dark brown), densely clothed above with flattened white hairs and below with ordinary white pubescence. Elytra with four strong costæ, two arising from the base and two from the humerus, the latter two not reaching the base. All the costæ united posteriorly. These costæ and the raised suture and margin densely pubescent, sharply set off by denuded margins. The elytral intervals with sparser pubescence, so that they appear grey. Narrow; about four times as long as broad. Ten to eighteen mm. long but usually about sixteen.

Head subquadrate; eyes prominent, small, transverse, quite narrow and excavated near the antennæ and mandibles. Median impressed line deep, and conspicuous because of very narrow denuded areas bounding it. The rest of the head, including the antennal calluses, densely pubescent, with flattened hairs. Clypeus also densely pubescent, but with normal hairs. Labrum slightly emarginate, sparsely pubescent. *Antennæ* black. Male: about three times as long as an anterior tibia, reaching to the basal third of the elytra. First joint normal, rather slender, reaching two-thirds across the eye; second and following slender, slightly flattened and loosely articulated. Second joint a little shorter than the first; third to fifth subequal, about two-thirds longer than the second, shiny; sixth to eleventh subequal, short, altogether equal to the fourth and fifth together. Female: first joint reaching to the middle of the eye; second two-thirds the first; third to fifth about equal to the first, normal; sixth to last short, together equal to the second to fifth. *Pronotum* elongate-campanulate, two-thirds longer than broad. Median impressed line as on the head, bounded by a pair of feeble longitudinal ridges. There is often a pair of small denuded spots on the disc just behind the middle. *Legs* dark brown. Pubescence white, black on tips of tibiæ and on tarsi. Outer spur of hind tibia broad, flattened; inner somewhat narrower, also flattened. Rest of spurs slender, spiniform.

Apparently this is not a very common species. The records are from comparatively few specimens. Wickham took it in some numbers at Alpine, Texas, however.

Type: Holotype (♀) in LeConte Collection, MCZ, No. 4992 (examined); type locality: "Frontera, Rio Grande" (New Mexico).

Additional records: in MCZ, USNM, Ohio State, and others. New Mexico: Separ (on *Salsola pestifera*), Deming. Texas: Alpine (4400–6000 ft.), Davis Mts. Arizona: Nogales, Willcox, Chiricahua Mts., Texas Pass-Dragoon Mts., Phoenix, Kayenta, Tucson.

Pleuropompha tricostata sp. nov.

Black, densely clothed with slightly flattened, pale olive-cinereous hairs. Elytra with three strong costæ, only one arising from the humerus. Costæ, raised margin and suture more densely pubescent than the intervals but not set off by denuded margins and the intervals are also densely pubescent. The pubescence is almost uniform over the body, a little more flattened on the head. A little broader than *costata*, and averaging smaller, twelve to fourteen mm. long.

Head subquadrate; eyes as in *costata* but slightly broader. Pubescence dense and covering the entire head except for the median impressed line, which is not further set off by denuded margins. Clypeus and labrum as in *costata*. *Antennæ* black. Male: two and one-half times as long as an anterior tibia, reaching to the basal fifth of the elytra. First joint reaching to the middle of the eye, rather slender. Second slender, two-thirds as long as the first; third half again as long as the second; fourth and fifth a little shorter. Third to fifth shiny, rather slender but increasing in thickness outward. Seventh to last short, equal, each being about three-fourths the sixth and together equal to second to sixth. Female: first and second joints essentially as in the male; third a little longer than the first; rest subequal, three-fourths the third and decreasing slightly in thickness. *Pronotum* campanuliform, one-third longer than broad. Median impressed line as on the head. Raised areas as in *costata* but without denuded spots. *Legs* entirely dark brown, rather densely pubescent. Outer spur of hind tibia broad, but not as broad as in *costata;* inner almost spiniform but both flattened. Rest of spurs spiniform.

Not as common as *costata* and seems to occupy the same range. It has been universally confused with *costata* in collections.

Holotype: ♂, Presidio, Texas, June 1–15, 1941, at light (USNM).

Cat no 56742
10 specimens
returned
11 x 43

Allotype: ♀, eutopotypical (USNM).

Paratypes: 3 ♂ ♂, 4 ♀ ♀, eutopotypical (USNM).

1 ♂, Dog Cañon, Brewster Co., Texas, Sept. 3, 1912 Rehn and Hebard (Phila. Acad.).

1 ♂, 1 ♀, Brewster Co., Texas, D. J. & J. N. Knull (Ohio State).

1 ♂, Cloudcroft, Sacramento Mts., New Mexico, July 1, 1940, D. G. Hall (USNM).

1 ♀, Roswell, New Mexico, Aug., 1902 (Fall Coll'n., MCZ).

1 ♀, Texas Pass, Dragoon Mts., Arizona, July 19, 1917, W. M. Wheeler (MCZ).

The Female of *Neonympha maniola* Nabokov (Lepid.-Satyridæ)

Since describing this species (1943, Psyche, 49:68), I have found three specimens of its female (two labelled "Paradise, Ariz.," one "So. Ariz.") in the collection of the United States National Museum. My reference (l.c. pp. 62, 69, 70) to Wright's figures has proved to be correct.

V. Nabokov, Mus. Comp. Zoölogy
Cambridge, Mass.

THREE NEW SPECIES OF CEBRIO (COLEOP., CEBRIONIDÆ)[1]

By F. G. Werner
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While rearranging the Cebrionidæ in the Museum of Comparative Zoology, recently, I noted three distinct new species. They are described in this paper.

Cebrio abnormis sp. n.

Male. Slender, tapering behind. Head, pronotum, and scutellum dark brown. Elytra pale, almost white (specimen collected in alcohol), with the apices light tan one-third the length of the elytra and with a tannish suffusion extending forward along the suture, becoming broader on the basal third. Antennæ and mouth parts pale tan. Below brown, with tips of abdominal sternites, tibiæ and tarsi paler.

Head moderately densely and deeply punctured. With a pair of protuberances just in front of and inside the bases of the antennæ, connected by a vague, posteriorly directed U-shaped ridge. Front concave, with the median portion irregularly impressed. Labrum with the sides oblique and with a shallow U-shaped excavation at the apex. Mandibles moderate in size, a little more slender than in *bicolor*. Last segment of the maxillary palpi as long as the third, expanded apically and almost squarely truncated. Antennæ strongly serrate, from the third segment. First segment darker than the rest. Third segment almost twice as long as the second and three-fourths as long as the fourth (excluding the process of the fourth). The fourth segment has the largest process of any of the segments. The distance from the tip of the process to the other side of the antennæ is as great as the length of the segment, excluding the process. The processes on all the segments are more slender

[1] Published with the aid of a grant from the Museum of Comparative Zoology, Harvard College.

than usual and the process of the last segment is acute. Pronotum a little more densely but more shallowly punctured than the head. Posterior angles divergent. Striæ of the elytra somewhat indistinct on the basal half, with the punctures obsolete. Intervals with confused punctures. The striæ and punctures are more distinct on the apical half. Prosternal process rather slender, tapering evenly from base to apex, quite abruptly elevated. Apex of last abdominal segment slightly convex.

C. convexifrons Knull has the third segment of the antennæ serrate but the general coloration and the form of the head serve to distinguish it from that species at a glance. Length, 13 mm. 3¾ mm. wide across the base of the elytra.

Holotype: male, Tuba City, Arizona, July 19, 1935. Gift of C. T. Brues (M.C.Z., No. 26074).

Cebrio atokanus sp. n.

Male. Moderately slender, only moderately tapering behind. Castaneous. Antennæ and underside a little paler. Easily distinguished by the small third segment of the antennæ, which is scarcely half as long as the fourth, and by the broad fourth segment.

Head rather densely but finely punctured. A slight V-shaped ridge runs from the bases of the antennæ back to the middle of the head, marking off the anterior portion, which is slightly lower than the rest of the head. Sides of labrum oblique and the apex moderately shallowly excavated. Last segment of the maxillary palpi as long as the third, and more slender than the third. Apex rounded. Third segment of the antennæ only slightly longer than the second and barely half as long as the fourth. The fourth is very broad. The following segments are about as broad as the fourth across the process but become progressively narrower across the base. Process of the last segment distinct, obtuse. Pronotum less densely punctured than the head. Posterior angles small, divergent. Elytra with intervals distinctly punctured, the punctures being separate from each other. Striæ rather feeble, the punctures dying out, toward the base. Process of the prosternum linear, slender. Apex of last abdominal sternite convex. Length, 12 mm. Width, across the base of the elytra, 3¾ mm.

Holotype: male, Atoka, Oklahoma (Indian Territory) June 13, 1915. H. F. Wickham, Hayward Coll. (M.C.Z., No. 26075).

Cebrio bruesi sp. n.

Male. Slender, tapering behind. Dark brown. Antennæ, legs, and abdomen paler. Possibly close to *emarginatus* Schaeffer but it differs from that species in the absence of a "moderately deep" excavation of the apex of the last abdominal segment.

Head quite densely and moderately deeply punctured. Front concave, with a pair of lateral impressions in the concavity. A feeble ridge runs almost straight across between the bases of the antennæ. Sides of labrum almost parallel. Apex deeply, triangularly excavated. Mandibles moderate in size, a little more slender than in *bicolor*. Last segment of the maxillary palpi as long as the third, not greatly broadened apically and obliquely truncated. Third segment of the antennæ almost twice as long as the fourth. The antennæ are moderately slender, the antennal processes short. Process of last segment very faint, obtuse. Pronotum more densely and finely punctured than the head. Posterior angles divergent. Striæ of the elytra distinct for the whole length; the strial punctures not very distinct. Prosternal process broad. Apex of last abdominal sternite just perceptibly excavated. Length, 13–16 mm. Width, across base of elytra, 3½–4 mm.

Holotype and 1 paratype: males; Ganado, Arizona, July 24, 1935. Gift of C. T. Brues (M.C.Z., No. 26076).

DESCRIPTIONS OF SOME NEW EXOTIC SPECIES OF STAG BEETLES (COLEOPTERA: LUCANIDÆ)[1]

By Bernard Benesh
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The present paper, covering seven forms new to science, is primarily based on material conserved in our principal collections at institutions indicated hereafter. The writer's best thanks are due to Drs. Nathan Banks, R. E. Blackwelder, E. A. Chapin, E. T. Cresson, Jr., C. H. Curran, P. J. Darlington, Jr., F. E. Lutz, and J. A. G. Rehn for the opportunity of examining the Lucanidæ under their charge, and the privilege of describing the new forms discovered, as well for the many examples, so generously presented, for incorporation in the writer's collection.

Many valuable data were gained from the vast number of specimens examined and some obvious synonymies noted, which, however, are reserved for a future paper.

The new forms may be diagnosed as follows:

Calcodes (Neolucanus) **maculosus** (Didier) ♂

Didier, Etudes sur les Coléoptères Lucanides du Globe, fasc. 7, p. 143, ♀, fig., 1930.

In habitus allied to *N. laticollis* (Thun.), a species endemic to Java.

♂ Head transverse, black, gradually diffused toward the base into chocolate-brown, opaque; mentum broad, nearly straight in front, anterior angles broadly rounded, sides elevated, base nearly straight, declivous in front, remotely punctured with fairly large, shallow punctures. Mandibles porrect, bent upward from basal half, inner edge dentate with a series of five teeth, which number may vary in larger examples. Prothorax broader than long, dark mahogany-brown, disc shining, mar-

[1] Published with the aid of a grant from the Museum of Comparative Zoology, Harvard College.

ginal areas opaque, with a C-shaped black macula in posterior corners; front margin sinuate, anterior angles obtuse, broadly rounded to posterior angle (broadest part of prothorax), thence obliquely truncate to base, latter nearly straight; a median impressed line extends from the front margin to center of the disc (this line extending the full length of the pronotum in the female). Scutellum heart-shaped, with fairly large, close punctures on the base. Elytra obovate, humeri rounded, broadest in the basal third, posterior gently rounded, with two feebly impressed lines, between the humeri and scutellum; of the same color as prothorax, but more shining, margins and suture black; a lateral, orange-yellow macula extends diagonally from humerus to within one and one-half millimeters of the suture and apex. Surface of the head, prothorax and elytra with remote punctures, those on the head largest.

Beneath slightly darker than on the dorsum, feebly shining; anterior tibiæ bifurcate at tip, and not as broad as in the female, with two strong spines in the distal half; intermediate and posterior tibiæ linearly sculptured, spineless; femora remotely punctured, each puncture bearing a short golden seta; abdominal segments margined in black, finely punctured.

Dimension: Length (excl. mandib.) 22.5 mm; mandibles 3 mm.
Head 7.75 mm. wide; 4.5 mm. long (excl. mandib.)
Prothorax 11.5 mm. wide; 6.0 mm. long (at middle)
Elytra 11.25 mm. wide; 14.25 mm. long

Allotype: ♂, Bangkinang, Sumatra, in the Museum of Comparative Zoölogy, Cambridge, Mass.

The female holotype, described by Dr. Didier, does not differ to any extent from the male; in habitus it is slightly broader, resembling much the common Javanese *laticollis*, to which group it phylogenically belongs. The range of the insect, unknown to Dr. Didier, is now ascertained to be Sumatra.

Prismognathus branczicki Nonf., ♀

Nonfried, Berliner Entomologische Zeitschrift *50*: 11, ♂, 1905.

The female, hitherto undescribed, is characterized in subjoined brief diagnosis:

♀ Golden brown, brassy, shining, elongate (narrower than the female *P. subaëneus* Motsch., used throughout in comparison). Head transverse, broader than long, with a triangular depression, deeper in the frontal angles, extending from the clypeal ridge to occiput; anteocular bosses higher and narrower. Pronotum similar in outline to *subaëneus,* distinctly broader than the base of elytra, with a blackish crescent-shaped macula in posterior angles. Scutellum dark. Elytra one and one-half times as long as wide, diverging to basal third, parallel in median third, thence broadly rounded, base of elytra strongly depressed in ante-humeral area, apical margin distinctly diaphanous. Dorsum uniformly punctured with fairly large, shallow punctures.

Differs from *subaëneus* by its slender and graceful form, finer puncturation, coloration (in *subaëneus* dark castaneus or entirely black), pronotal macula and translucent elytral margins, which, according to Nonfried, is typical of the species.

Allotype: ♀, Szechwan, China, D. C. Graham, 1700 ft. In the United States National Museum, Washington, D. C.

Prosopocoilus duplodentatus n. sp.

Oblong, finely granulate punctate throughout, allied to *P. rubens* Didier.

♂ Head nearly quadrate, broader than long, black, opaque, anterad concave, sloping abruptly toward the clypeus; clypeus subtriangular, with a feeble transverse marginal ridge, top rounded; antero-lateral angles rounded, behind the eyes acuminate, the acumination extending beyond the eyes and overreaching the anterior angles of pronotum; eyes fairly large, round, shining, encompassed halfway by the lateral diagonal canthus; anteocular bosses prominent, gently sloping toward the eyes; anterad to these and slightly inward a roundish fovea. Vertex shallowly and distantly punctured by fairly large transverse-ovate punctures, becoming larger (lunate) behind the eyes. Mandibles asymmetrical, longer than the head, porrect, uniformly arcuate, laterad rounded, interior margin dentate; left mandible with a broad basal cuspidate tooth and four well defined denticles; right mandible with six denticles, the fourth (from the base) largest; below the cuspidate tooth of the left mandible and the two basal denticles of the right, is a column of three teeth on the left and a like number on the right, making the bases of the mandibles appear like the crown of a molar; the right mandible in repose (clinched) is uppermost and slightly shorter than the left. Antennæ: scape club-shaped, slightly bent, longer than the funicle and clava combined, black, glabrous, with a few setæ at the elbow, and when folded backward, extending to the acuminate post-ocular process; funicle one fifth longer than the clava, first segment subglobose (pear-shaped), slightly longer than the second; second, third and fourth of equal length, subcylindrical, anterad dilated, fifth nearly pentagonal in outline and distinctly longer than the fourth, with a single seta on the apex, sixth as long as the fifth, produced into an elongate acute point, on which occurs a clump of setæ; clava compact, three-jointed, rufescent, eighth segment anterad produced in a lobe with a truncate apex, base glabrous, black, lobe spongy, ninth segment spongy throughout, lobe pointed, tenth segment rounded, spongy, embellished with a central circular litura; lobes of clava distinctly flattened. Prothorax broadly convex, nearly twice as broad as long, granulate punctate, opaque, disc with a few scattered punctures, feebly shining; anterior and lateral areas shallowly pitted with roundish, large pits, gradually diminishing in size and intensity toward the posterior angle; anterad bisinuate, antero-lateral angles obtusely pointed, broadly rounded from anterior third to posterior angles, latter produced into an obtuse point, thence diagonally truncate to base, which is broadly rounded; margins reflexed, laterad and basad delineated by an impressed line. Scutellum as long as broad, heart-shaped, with several irregular punctures, shining. Elytra narrower than the prothorax, broader, however, than the prothoracic base, one and one-half times as long as broad, broadest one quarter the length from humeri, parallel to the middle, thence gradually and gently rounding to apex; humeri angulate and rounded on top; each elytron with a single stria, beginning in the ante-humeral region (one-third the elytral width) and attaining to four-fifths the elytral length; margins reflexed from the broadest point to apex; dark chocolate-brown, densely punctured, opaque; suture narrowly impunctate, shining. Legs fairly stout, black, linearly sculptured; anterior tibiæ distad broadly bilobed, armed externally with four large teeth, second largest, serrate between; intermediate tibiæ with a single central spine, posterior with a denticle; tarsi as long as the tibiæ, glabrous, each joint furnished, on the venter, with a tuft of golden setæ at the extremity; onychium present; intermediate and posterior tibiæ sparingly clothed with short golden setæ increasing in length and density toward the extremities. Beneath deep chocolate-brown, glabrous; maxillary and labial palpi reddish; mentum feebly bilobate in front, laterad rounded, nearly as long as broad, roughly sculptured by large confluent pits; genæ similarly sculptured as the top of head behind the eyes; prosternal process prominent, terminating in an obtuse point; abdominal segments emarginate, with a few scattered punctures, shining. Length, without mandibles, 17.5 mm.; mandibles 2.75 mm. Female unknown.

Holotype: 1 ♂, Kuanshien, 14–viii–'34, Szechwan, China, Dr. D. C. Graham, collector, in the United States National Museum, Washington, D. C.

Closely allied to the Sumatran *P. rubens* Didier,[2] from which it can be readily separated by its dark coloration (bright mahogany red in *rubens*), shorter mandibles, broad pronotum (in *rubens* not broader than the head, laterad parallel, overlapped by the postocular spine), ovate elytra (*rubens* distinctly parallel) and the granulose sculpture (*rubens* smooth, shining).

Lissapterus montivagus n. sp. Figs. 2, 2a, 2b

Robust, convex, black, feebly shining; allied to *L. tetrops* Lea, and *L. hopsoni* Carter.

♂ Head transverso-quadrate, convex, front sloping, clypeus small, conical, not exposed; anterad broadly concave, angles rounded to canthus, latter completely dividing the eyes; eyes small, larger, however, than in *tetrops*; behind the eyes with an acuminate process, narrowing to base; above the eyes an oblong, deep cavity, extending to opposite the center of the acuminate process; above and behind the cavity, to base, strongly beset with large pits, which become nearly obsolete on the occiput. Mentum (fig. 2b) transverso-trapezoid, feebly lobed in front, with a central kidney-shaped excavation, finely granulate; strongly and distantly pitted toward margins, anterior and lateral pits bearing a seta, base nude. Mandibles symmetrical, porrect, regularly curved, laterad rounded, in distal half with an acute, upward and slightly inward directed tooth, and, on the inferior margin, in the basal third, another

[2] Bull. Soc. ent. France, p. 270, fig. ♂, 1927.

tooth; inner area between the teeth hollowed, base with an angular downward pointing lamina (larger than in *tetrops*). Antennæ typical to the genus (without a distinct clava), second to ultimate segment anterad progressively dilated, flattened, shining, setose. Prothorax transversal, front margin sinuate, antero-lateral angles acute, sides straight and narrowing to base, feebly dilated in posterior third, basal angles square and slightly produced, base emarginate with reflexed margin; laterad and basad strongly punctured; disc with an obsolete median line, and a distant, small group of punctures, in adjacent fields. Scutellum nearly twice as broad as long, rounded, with a few lateral, fairly large punctures, apex impunctate. Elytra with base produced and rounded, humeri angulate, gradually broadening to middle, thence semicircularly rounded to apex; surface irregular, suture glabrous, impunctate, shining, posterior declivate; punctured from the scutellum to margins, the puncturation much larger and denser in the humeral and lateral areas. Beneath black, strongly tinged with red (more so than in *tetrops*), especially the femora; abdomen black. Legs: anterior femur without the ridge-like tooth present in *tetrops*; all femora, on lower margin, fringed with long, dense, golden setæ; anterior tibiæ strongly bifurcate, with four equiform teeth; intermediate and posterior tibiæ with a spine in the distal half; anterior tibiæ with interior margin setose; intermediate and posterior tibiæ strongly setose on both margins; femora distantly punctured, with some punctures bearing prostrate, golden setæ (in *tetrops* glabrous); tarsi short and slender, each segment with a tuft of golden pile; claws small, simple. Female unknown.

Dimensions: Length (excl. mandib.) 25 mm.; mandibles 7 mm.
Head 13 mm. wide; 6 mm. long
Prothorax 11.5 mm. wide; 5.75 mm. long
Elytra 11.9 mm. wide; 13.0 mm. long

Holotype: ♂, National Park, Queensland, McPherson Range, 3–4000 ft., Mar. 1932, Australia, Harvard Exp., Darlington; type no. 25,911. Paratopotype: ♂, same data as the holotype, in the writer's collection.

Compared throughout with a specimen of *L. tetrops* Lea [3] in

[3] Lea, Arthur M.: Trans. Proc. Royal Soc., South Australia, *40*:272–436; 1916.

the Angell collection, Academy of Natural Sciences, Philadelphia, bearing the late Lea's determination label; readily distinguished from the new species by the characters cited above, and the lack of hirsute adornment on the venter and appendages. As *L. tetrops* Lea has not been, to my knowledge, figured, I append a figure (1, 1a, 1b) of the insect here.

Lissotes darlingtoni n. sp. ♂ ♀

Figs. 3, 3a, ♂ ; 4, 4a, ♀

Robust, ovate, piceous.

♂ Head transverso-quadrate, anterad nearly straight, anterolateral angles rounded, canthus and post-ocular process produced; clypeus broad, feebly trilobate; canthus emarginate and rounded, post-ocular process acuminate; eyes fairly small; mentum twice as broad as long, feebly lobed in front, laterad broadly rounded, sloping toward the center and front, strongly cribrate-punctate, more so on the sides. Front strongly declivate, subcarinate on vertex, beset with circular large pits (pockmarked), which become much larger and closer on the vertex and occiput. Mandibles porrect, arcuate, apices acute, finely remote punctulate, shining above, opaque beneath; outer margins rounded, with a median erect tooth; inner edge, in center, with a broad laminate process, which has on the left mandible two, on the right one, feeble indentation; between the central lamina and the base a circular excision, which, when mandibles are in repose, forms a top-like opening; base with an acute, diagonally forward pointing tooth and, above it, a deep excavation. Prothorax broad, anterior angles produced and nearly square, sides subparallel to posterior angles, latter diagonally truncate, base straight; nearly explanate on top, sides sloping, remotely punctured; disc with a central, ovate, strongly punctured depression and, laterad, right and left, two smaller ones; base, opposite the scutellum, with a triangular fovea. Scutellum small, broader than long, apex subacute, center with a transverse fovea. Elytra ovate, broadest beyond the middle, apex acutely rounded; humeri produced, mucronate; each elytron with two obsolete costæ, densely covered with large, ovate pits, becoming smaller and closer toward margin; margin reflexed with some punctures bearing short, golden setæ. Beneath, strongly punctured (excepting the abdomen), shining;

abdominal segments straight, remotely punctured with shallow punctures. Anterior tibiæ distad broadly furcate, with three to four external teeth; intermediate and posterior tibiæ with a centrally located spine, those of the posteriors nearly obsolete.

♀ Analogous in sculpture to male, rufo-piceous, resembling closely *L. novæ-zealandiæ* (Hp), differing from it, however, by its carinate and declivous head (*novæ-zealandiæ* flattened), robust, narrower body (*novæ-zealandiæ* broad and depressed), sculpture, etc. Dimensions of typical examples:

	♂ length;	♂ width;	♀ length;	♀ width;
Mandibles	4.0 mm.		1.25 mm.	
Head	3.75 mm.	7.5 mm.	2.0 mm.	4.5 mm.
Prothorax	4.8 mm.	8.0 mm.	4.5 mm.	6.75 mm.
Elytra	9.5 mm.	7.5 mm.	9.0 mm.	6.75 mm.

Holotype: ♂, Mt. Donna Buang, Victoria, 1500–4000 ft., Dec. 7, 1931, Australia Harvard Exp., Darlington. In the Museum of Comparative Zoölogy, Cambridge, Mass.; type no. 25,912.

Paratopotypes: 3 ♂ ♂, same data as the holotype, in the collection of Museum of Comparative Zoology, Cambridge, Mass.; 4 ♂ ♂, same data as the preceding, in the writer's collection; one male is destined for the collection of the Australian National Museum. Allotype: ♀, same data as the holotype, in Museum of Comparative Zoölogy, Cambridge, Mass.

Paratopotype: ♀, same data as the allotype, in the writer's collection. Described from a series of eight males and two females, captured by Dr. P. J. Darlington, during the Harvard Expedition to Australia, in 1931–1932. I take great pleasure in naming this fine stag beetle after its discoverer.

Nigidius passaliformis n. sp.

Fig. 5

Cylindrical, black, subopaque, glabrous; in habitus resembling a passalid.

♂ Head transverse, broader than long, anterior angles obtuse, diagonally bisinuate to opposite the eyes, latter large and entirely divided by the canthus, which is as wide as the eyes and laterad rounded; clypeus slightly produced and broadly angular; front strongly declivous, remotely punctured, with a feeble median ridge, and above the eyes an impunctate lateral crest, with adjacent oblong excavations; occipital area slightly elevated, with an adjoining median diamond-shaped depression. Antennæ typical to the genus, with no visible deviation. Mentum transverse-trapezoid, feebly bilobate (part of the left lobe broken off) in front, with two lateral ridges, and overlapping sculpture. Mandibles (apices broken off) minutely and densely punctulate, bent upward, curved, with a central inner tooth, latter distad with a horizontal depression, which thus forms two separate points, of which the superior is simple, and the inferior bicuspid. Prothorax quadrate, with a few obsolete scratches, anterior margin nearly straight, with antero-lateral angles produced and abruptly rounded; laterad nearly parallel to posterior angles, latter diagonal, base feebly sinuate; anterad strongly declivous, with a well-defined, median, truncate boss; disc with a central longitudinal fovea of irregular shape and, adjacent it on the left with two, and right three, smaller impressions. Scutellum: prescutellum cribrate-punctate, broad at base, narrowing toward the scutellum, which is heart-shaped, impunctate, with a basal three-pointed fovea. Elytra parallel, humerus mucronate, posterior regularly rounded; each elytron with 8 striæ, margin rugosely punctate; the striæ, which on first glance appear simple, under higher powers assume an entirely different character, *i.e.*, consist of large circular punctures, interconnected by the sulca; first stria parallel to the suture, terminates on the declivity; second bends outward and forms a complete juncture with the sixth; third and fourth, joined; fifth encroaches on the connection between the second and sixth stria; seventh and eighth terminate near posterior margin; interspaces impunctate, broad and feebly convex, with the triangular area between the first and second stria strongly cibrate-punctate. Beneath, prosternum and prosternal episternum strongly rugose-punctate; prosternal process rounded, not prominent; metasternal episternum punctate, with an impunctate, lateral ridge; metasternum with a median longitudinal impressed line, glabrous, anterad strongly confluently punctate; abdominal segments emarginate, base of each with a line of large punctures (apparently a stridulating apparatus); terminal segment remotely punctured. Anterior tibiæ strongly furcate, with five external teeth; intermediate and posterior tibiæ with distal spurs prominent, the outer spur longer than the inner one; intermediate tibiæ with two, posterior with three external spines. Female unknown, but as characteristic to the genus, may resemble the male very closely in habitus, with slightly modified mandibles. Dimensions; Length (excl. mandib.) 18.5 mm.; mandibles (minus apices) 1.75 mm.

Head	6.5 mm. wide;	3.25 mm. long
Prothorax	7.0 mm. wide;	5.25 mm. long
Elytra	7.25 mm. wide;	10.0 mm. long

Holotype: ♂, West Africa, Coll. Harvard, in the Museum of Comparative Zoölogy, Cambridge, Mass.; type No. 25,913.

Superficially resembling the Australian *Figulus trilobus* Westw.,[4] assigned, subsequently, by Parry[5] to *Nigidius*; it differs, however, from *F. trilobus* by the broader head (in *trilobus* more triangular in outline), mandibles, cylindrical body (*trilobus* depressed), scutellum (*trilobus* wedge-shaped), etc.; it can be mentioned here that *F. trilobus* Westw. is a true *Figulus*, and not a *Nigidius*, as Parry suggested.

Ceratognathus tasmanus n. sp. ♂ ♀

Figs. 6, 6a ♂, 7 ♀

Oblong, convex, rufous, cribrate-punctate, pubescent; pubescence on the dorsum intermixed (in both sexes) with lanceolate yellowish-gray squamæ.

♂ Head transversal, three times as broad as long (3 : 1), strongly sloping toward the front, anterior angles rounded, behind the eyes broader; vertex with two tubercles on line with the center of the prominent eyes. Antennæ slender; scape one-third the length of the entire antenna, second segment globular, third to seventh uniformly dilated to apex, eighth, ninth and the tenth lobate; clava one-fifth longer than the funicle, pale rufous, with grayish pubescence. Mandibles regularly curved from base to tip, bent upward from the basal third, apices of both mandibles bicuspid, strongly punctate; at the middle of

[4] Westwood, J. C.: Ent. Mag. *5*: 263, 1838.
[5] Parry, F. J. S.: Trans. Ent. Soc. London, p. 343, 1873.

the exterior margin a lateral, laminate, obtuse tooth and, anterad, near the apical third, a superior, subacute tooth. Prothorax one and one half times broader than long, front margin gently bisinuate, anterior angles rounded, diverging diagonally to the middle, thence nearly parallel to posterior angles, latter broadly rounded, base nearly straight; disc with an oblong median depression and, postero-laterad, circular impression. Scutellum broad, apex rounded, base impunctate, with an irregular impressed line, which circumscribes, in the apical area, five unequal punctures. Elytra with humeral angles broadly rounded, sides parallel, apex regularly rounded, suture with an ill-defined costa and each elytron with two irregular costæ, terminating on the posterior declivity. Beneath, densely clothed with long grayish pubescence; abdominal segments nearly explanate, feebly emarginate, confluently punctate; posterior segment slightly convex. Intermediate and posterior tibiæ serrate, with a prominent spine near the apical third; spurs well developed; tarsi short and fairly stout, ultimate segment nearly as long as the others combined.

♀ Of the same general appearance as the male, but with head smaller (2 : 1), with frontal margin slightly transverso-carinate, mandibles shorter than the head, with a central bicuspid tooth on the inferior edge, thorax narrower in front and longer than wide, stouter legs, less prominent spines, etc.

Dimensions: ♂ 12.5 mm. long, mand. incl.; width, 4.5 mm.
♀ 13.75 mm. long, mand. incl.; width, 5.6 mm.

Holotype: ♂, Tasmania, Edwards Collections, in the American Museum of Natural History, New York, N. Y.

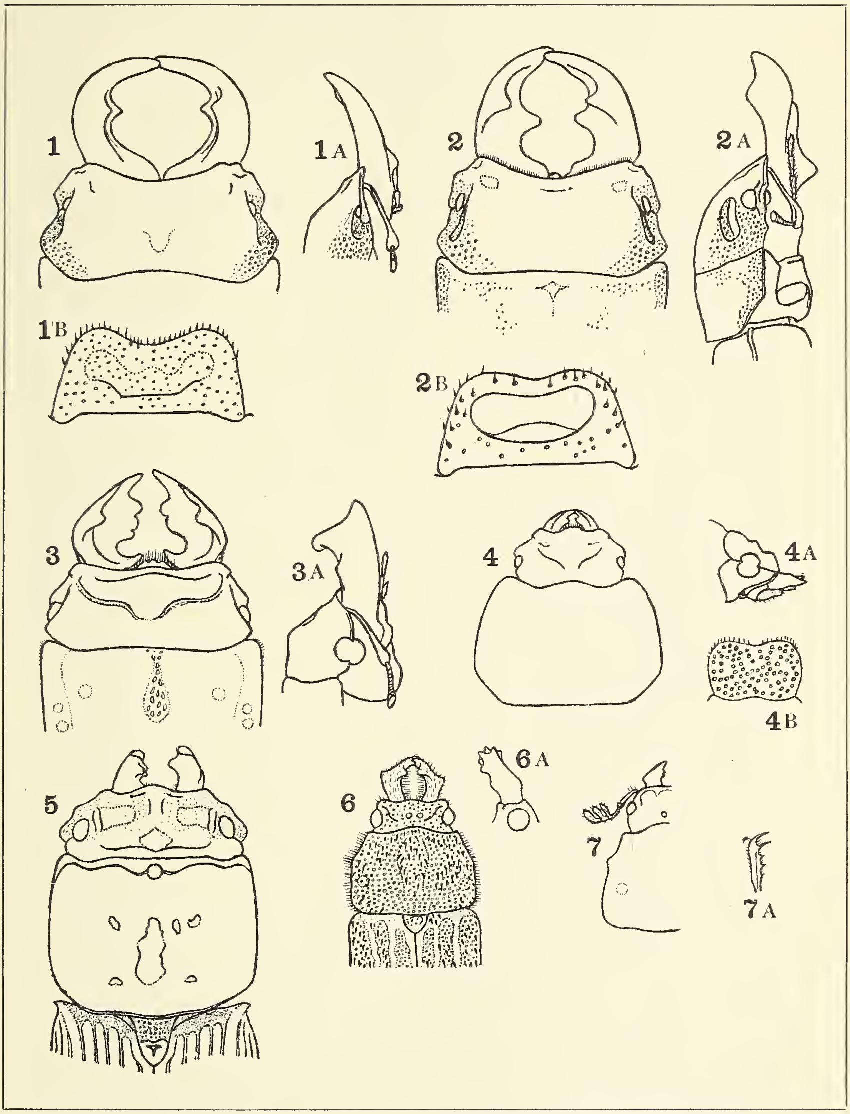
Allotype: ♀, same data as the holotype, in the American Museum of Natural History, New York, N. Y.

Allied to *Ceratognathus bitumulatus* Carter, from which it can be readily distinguished by the shape of the mandibles, squamæ, non-tumulate elytra, etc. The female here figured has asymmetrical margins on the pronotum; left margin has a slight protuberance, which is missing on the opposite side, as indicated by the broken line in the drawing. Described from a pair of (rather dilapidated) examples; the male is minus left antenna, anterior tibiæ, right intermediate leg and all tarsi; the female lacks the right antenna, left intermediate leg and posterior tarsus and the tarsi of right anterior and intermediate legs.

Explanation of Plate IV

Fig. 1. *Lissapterus tetrops* Lea, ♂. 1A. Lateral aspect of head. 1B. Mentum.
Fig. 2. *Lissapterus montivagus* n. sp., ♂. 2A. Lateral aspect of head. 2B. Mentum.
Fig. 3. *Lissotes darlingtoni* n. sp., ♂. 3A. Lateral aspect of head.
Fig. 4. *Lissotes darlingtoni* n. sp., ♀. 4A. Lateral aspect of head. 4B. Mentum.
Fig. 5. *Nigidius passaliformis* n. sp., ♂.
Fig. 6. *Ceratognathus tasmanus* n. sp., ♂. 6A. Lateral aspect of the mandibles.
Fig. 7. *Ceratognathus tasmanus* n. sp., ♀. 7A. Right anterior tibia.

PSYCHE, 1943 VOL. 50, PLATE IV



Benesh — Exotic Stag Beetles

SOME NORTH AMERICAN SPECIES OF CHÆTOPLEUROPHORA (DIPTERA, PHORIDÆ)

By Charles T. Brues
Biological Laboratories, Harvard University

A collection of Phoridæ recently sent to me from Cornell University for identification contains an interesting new species of Chætopleurophora. To the description of this which is given below, I have added generic references for several other American species.

Chœtopleurophora Schmitz.

Chætopleurophora rufithorax sp. nov.

♀. Length, 2.0 mm. Black; the thorax above reddish brown, lighter at the extreme sides and indistinctly so as a streak on each side of the median line; pleuræ also brownish; scutellum paler, except at the base; front and middle legs entirely pale yellowish; hind legs pale at the base, blackened beyond the basal third of the femora and again brown on the tarsi; palpi fuscous. Halteres whitish. Wings weakly, but distinctly infuscated; heavy veins brown. Front minutely roughened, not shining; quadrate, or slightly longer than wide. Frontal bristles long and stout; postantennals inserted very near together; lower frontal row equidistant, the lateral ones very close to the eye-margin and slightly higher than the median ones; preocellar row of four forming a straight transverse line, equidistant from the lower row and the ocellar row. Median frontal line faintly indicated, ocellar tubercle distinct. Eyes pubescent. Antennæ unusually small, rounded; with a long, sparsely pubescent arista. Palpi very small, with moderately long bristles at tip, but those along the lower margin are weakly developed. Mesonotum subshining, with conspicuous minute hairs; one pair of dorsocentral bristles set very near to the base of the scutellum; sides of the mesonotum bristly behind, but only a couple of these bristles are long and stout. Propleura with two small, but conspicuous bristles at the posterior margin next to the spiracle and a few scattered small bristly hairs near them. Mesopleura with a large area of bristly hairs above, extending anteriorly almost to the spiracle and one unusually long, stout bristle near the posterior edge. Front tibiæ without any bristles before apex. Middle tibiæ with a pair of long bristles near the base, one at the basal fourth just anterior to the dorsal line and one at the basal third just inside the dorsal line; these bristles very stout and half as long as the tibia; at the apical fourth with a small anterodorsal bristle that does not extend to the tip of the tibia. Hind femur broad; hind tibiæ each with two long stout bristles, both just anterior to the dorsal line, one at the basal third and one just before the tip; also with three terminal spurs; the tibia with transverse rows comb-like bristles on the apical half of its inner surface although these are not so clearly comb-like as in some species and do not form rows on the basal half. Abdomen subopaque above, without noticeable bristly hairs, except at the sides of the second tergite; third tergite longer and narrower than the second; fourth very short, about four times as wide as long; fifth twice as long as the fourth, about twice as wide as long; sixth narrower and longer, about quadrate; seventh minute, not emarginate behind; genitalia with sparse bristly hairs, wings narrow, the costa less than half as long as the wing (35:75); first section of costa nearly twice as long as the second and third combined, third two-thirds as long as the second (20:6:4) costal fringe short and delicate; fourth vein weakly, evenly curved; fifth very faintly sinuate; seventh distinct.

Type from Ithaca, New York, Sept. 6, 1922.

This species is similar to the European *C. erythronota* Strobl. but differs at once by the narrower, opaque front which is wider than long and distinctly shining in the European species. Also the spine near the apex of the middle tibia is reduced to a very weak bristle whereas in *C. erythronota* it is exceedingly large, extending beyond the tip of the tibia. These comparisons are based on a female from Admont, Austria sent me many years ago by Strobl.

Chætopleurophora scutellata Brues.

Trans. American Entom. Soc., vol. 29, p. 344 (1904) (*Phora*). Malloch, Proc. U. S. Nat. Mus., vol. 43, p. 426 (1912) (*Paraspiniphora*).

Brues, Bull. Mus. Comp. Zool., vol. 62, p. 499 (1919) (*Paraspiniphora*).
Schmitz, Monogr. Phoriden, p. 93 (1929) (*Chœtocnemistoptera*).

This species should be placed in the genus Chætopleurophora as it has a single large, backwardly directed bristle on the mesopleura in addition to the small hairs that clothe the upper portion of the mesopleura.

Chætopleurophora jamaicensis Brues.

Bull. American Mus. Nat. Hist., vol. 41, p. 431 (1919) (*Paraspiniphora*).
Schmitz, Monogr. Phoriden, p. 93 (1929) (*Chœtocnemistoptera*).

This is likewise a Chætopleurophora, but as Schmitz has suggested should rank as a distinct species rather than as a subspecies. The bristling of the hind tibiæ is distinctive; in *jamaicensis* the anterodorsal bristle is paired with the first of the three dorsal bristles and in *scutellata* it is paired, or nearly so, with the second of the four dorsal bristles.

Chætopleurophora multiseriata Aldrich.

Trans. American Entom. Soc., vol. 29, p. 345 (1904) (*Phora*).
Malloch, Proc., U. S. Nat. Mus., vol. 43, p. 438 (1912) (*Paraspiniphora*).
Schmitz, Monogr. Phoriden, p. 93 (1929) (*Chœtocnemistoptera*).

This rather common and conspicuous North American species is also a Chætopleurophora, with the mesopleural bristle large and stout.

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BIONOMICS OF *ECTOPSOCUS PUMILIS* (BANKS) (CORRODENTIA, CÆCILIIDÆ) [1]

BY KATHRYN M. SOMMERMAN [2]

University of Illinois, Urbana, Ill.

Two species of *Ectopsocus* have been recorded from the United States: *E. pumilis* (Banks) and *E. californicus* (Banks). The former has been found commonly on corn (maize). Although *E. californicus* has been taken from the palm *Areca lutescens* in the greenhouses of the University of Illinois, and has been reared for several generations in the laboratory on corn sheaths, it has not been found in the cornfields.

E. pumilis has been recorded previously from New York, Virginia, North Carolina, Georgia, Florida, Louisiana, Tennessee, Kentucky, and Missouri, where it occurs almost throughout the year, but most commonly in September and October. During this work it has been taken in Missouri, Tennessee, Illinois, North Carolina, Florida and Connecticut. It is interesting to note that these records are limited to the eastern states.

Complete descriptions of the adults may be found in the works of Banks (2), Chapman (3) and further notes are given by Ball (1). The males (Figs. 12, 15) can be readily distinguished from the females (Fig. 7) by the elaborate, darkly-pigmented genitalia that are apparent on the dorsal side of the abdomen.

[1] Contribution No. 230 from the Entomological Laboratories of the University of Illinois. This paper was included as a part of a thesis submitted in partial fulfillment of the requirements for the Degree of Master of Science in Entomology in the Graduate School of the University of Illinois, 1941.

[2] I wish to express my appreciation of the suggestions made by Professors C. L. Metcalf and W. V. Balduf during this work. Thanks are also due Dr. A. B. Gurney of the U. S. Bureau of Entomology and Plant Quarantine for determination of the species concerned.

Only two variations in wing venation were found on the many specimens examined. Figure 10 shows a malformed short wing, that appeared on two individuals, the opposite wing being normal. Figure 11 illustrates the one case where peculiar venation was found in an otherwise normal wing. The extremity of R_{4+5} is bent and M_1 does not reach the margin of the wing. Figure 14 is a normal wing. A greater degree of stability in wing venation is apparent in this genus because anomalies have rarely appeared among the individuals of *E. californicus* that have been raised on corn sheaths in the laboratory. Perhaps this lack of variability accounts for the fact that the genus is limited to two species in the United States.

E. pumilis first attracted my attention in October, 1938 when it was found in great numbers infesting the ears of corn in fields at Lawrenceville, Ill. During this work it has been taken from dry alfalfa stubble, dry grass, dead *Viburnum*, bamboo furniture, dried leaves of oak, maple, elm and palm. Habitats previously reported were dead oak leaves, straw and debris indoors, and windows of a cattle barn.

Of the thirty-five species in the family Cæciliidæ recorded from the United States this is one of twenty-two for which both males and females are known. The two species of *Ectopsocus* have both sexes known, but it is interesting to note that both males and females of the related species *E. californicus* have been taken only in California, while the females alone have been collected from Connecticut, New York, Virginia, Kentucky, North Carolina, Tennessee, Georgia and Florida. From work done by McClure (4) on the life history of *E. californicus* on palms in the University of Illinois greenhouses, and from my observations of this species in corn sheath cultures it is evident that *E. californicus* reproduces parthenogenetically and males do not occur. This information, along with collection records, suggests that *E. californicus* might be parthenogenetic in the East. It is interesting to note that the known distribution of the eastern parthenogentic (?) strain of *E. californicus* coincides almost state for state with that of *E. pumilis*. The sex ratio of *E. pumilis* was 0.5 and reproduction by parthenogenesis was not observed at any time.

Mating. — Copulation was observed several times, but the procedure varied to some extent each time. Sometimes the male just approached the female from the side, and backed into the mating position. On other occasions they approached each other and bumped head-on several times and furiously rubbed their heads together; then the male tried to approach the female from the side. The female raised the anterior part of her body and the male backed under with his wings erect. The female was directly above the male, but when the genitalia were united she side-stepped and the male's wings dropped back and rested across hers. They remained perfectly motionless, except for an occasional twitch of the palpi or antennæ, for twenty-two minutes. Usually the male started to walk first and when he stopped the female started. This brought them almost to a 180° angle, facing in opposite directions. Each tried to go its way, with the result that the male usually dragged the female a short distance. Then they separated. A few minutes later the male approached as before, then stood still and appeared to rapidly raise his abdomen and head and rock forward and backward. It was not possible to determine if the tip of the abdomen or labium touched the substratum during these rapid motions. The male again approached the female and, failing to regain the mating position, went through these movements again. The genitalia of the male remained exposed for some time after mating (Fig. 13).

Copulation apparently did not occur within twenty-four hours after both sexes had moulted to the adult. Eggs deposited by females exposed to males for that period only did not hatch. In several instances adult males were observed trying to copulate with nymphs in the sixth instar.

Oviposition. — Eggs were found in the field in the fall and late spring on the inside of the corn sheaths (Fig. 8). They were most commonly found on the sheaths about four or five feet up on the stalk. The lower sheaths apparently fitted too tightly around the stalk, making it almost impossible for the cæciliids to crawl under the sheath. Near the top of the stalk the inner surface of the sheaths is exposed, offering little protection from the weather; so eggs were seldom found there. In late fall the eggs were sometimes found on exposed ears especially around kernels injured by the corn earworm. In late summer eggs were found on the drying leaves (Fig. 9) in the tunnel formed by the midrib and especially around caked pollen.

Eggs were laid in groups of one to sixteen, most commonly four to eight with an average of about six. The females seemed to prefer the smooth surface of the glass, because the eggs were deposited on the glass and cork more often than on the corn in the rearing cages, which are described by the writer, Sommerman (5).

When males were continually present, egg-laying started from two to four days after moulting to the adult, and continued two to four weeks, but eggs were not always deposited each day. The number of eggs in the first group deposited ranged from three to nine, and as the end of the oviposition period approached the number did not always dwindle. The number of egg masses per individual ranged from one to fourteen. There seemed to be a tendency to add eggs to previously deposited masses, resulting in fewer masses with a larger number of eggs per mass. Some females also scattered individual eggs. Material collected in the field indicated that the eggs were usually deposited in masses. There did not appear to be any particular production peak, the number varying from day to day without any gradual increase or decline. The maximum number of eggs deposited by any female was 92. Death usually occurred five or six days after oviposition ceased.

Non-fertilized females usually deposited their first eggs from three to eight days after the last moult. Fifty was the maximum number laid by any virgin. None of these ever hatched. After oviposition ceased these females continued to live up to twenty-four days, making the adult stage for virgins usually about forty-three days, whereas the adult stage for fertilized females lasted about twenty-one days. Adult males usually lived about thirty-nine days but one male was collected in the field April 9, 1940 and died June 15, having lived sixty-seven days in a rearing tube. It is probable that this male had also passed the winter as an adult.

The process of oviposition is similar to that described for *Cœcilius manteri* Sommerman (6). Eggs are deposited in masses and silk threads are spread over them but not in a dense sheet as in *C. manteri* or *E. californicus*. The silk threads are numerous. They criss-cross at various heights forming a loose network. The females wander about after depositing each egg. Within thirty minutes one female had deposited a mass of six eggs, and had started to cover them with silk. She rapidly turned and turned, fastening the threads here and there, and within four minutes had completely covered the mass and wandered away.

Egg Stage. — Eggs (Fig. 1) are oval and flattened only on the surface contacting another object. The shells are smooth and shiny. Measurements of fifteen eggs chosen at random averaged 0.388 mm. in length and 0.208 mm. in width. The eggs were white when first laid, but turned a creamy yellow as development progressed. This change in color made the eggs still more difficult to find because they blended with the dried sheaths. They are easily overlooked because the silk is not dense enough to shine as it does in *E. californicus* or *C. manteri.*

Embryonic development was easy to observe in this species. The chorion and vitelline membrane remained practically transparent so the eyes of the embryo could be seen clearly on the fifth day of development, which was the day before hatching. Fifteen egg masses kept under laboratory conditions hatched on the sixth day. As the time for hatching approaches, the eggs become a little darker and the chorion wrinkles to the form of the body and appendages (Fig. 2). The embryo is ventral side up and the head, eyes, antennæ, legs and tip of the abdomen are easily visible. The arms of the egg burster (Fig. 4) stretch across the front of the head with the center puncturing shaft projecting posteriorly toward the clypeus. The heads of several individuals were observed pulsating before the chorions were broken, and in one case as much as eight hours before. This activity, spasmodic at first, occurs at more regular intervals until at the time the chorion splits the top of the head is pulsating regularly. Air bubbles appeared to be passing into the embryo through the mouth before the split in the chorion could be seen on the anterior end of the egg.

Hatching. — The pronymph, within its membrane, slipped from the chorion and vitelline membrane with no apparent effort at first, then as it rose it swayed back and forth. Fifteen minutes after the chorion was noticeably broken the egg burster punctured the pronymphal membrane. This differs from the report of Wachter (8) who states that the egg burster ruptures the chorion and that the vitelline membrane is broken by internal pressure. This puncture lengthened to a slit that continued to progress toward the eyes. It required another fifteen minutes before the head was completely free of the pronymphal membrane. At this time bubbles of air were passing into the head, which was becoming transparent. Thirty-five minutes from the time hatching started the head, thorax and most of the abdomen were out of the shell, and two minutes later the antennæ and legs were free. Forty-two minutes from the start the nymph dropped down and stood beside the chorion. At this time the pulsations on the vertex could still occasionally be seen, and the bubble of air in the head extended anteriorly as far as the eyes. The segments of the abdomen were telescoping into their normal position. One hour after hatching started, the bubble in the head had almost completely disappeared. Several other individuals completed hatching in twenty-five and thirty minutes. The pronymphal exuviæ bearing the egg burster always remained partly extruded from the chorion.

Postembryonic Development. — The nymphs (Figs. 3, 5, 6) are buff with slightly darker appendages during the early instars and gradually become light brown. There are bristle-like setæ on the head and thorax. The dull color of the abdomen gives this species a characteristic velvety appearance. The antennæ are eight-segmented in the first instar (Fig. 3) and thirteen-segmented thereafter. The wing pads appear in the third instar (Fig. 5) and the forewings approximately double their length with each successive moult. The sexes of the sixth instar nymphs can easily be distinguished because the asymmetrical genitalia of the male show through on the dorsal surface of the abdomen (Fig. 6). The duration of the six instar periods was as follows: first, 2.3 days; second, 2.4 days; third, 2.4 days; fourth, 2.7 days; fifth, 2.8 days and the sixth, 4.4 days. Apparently the last instar period is longer than any of the others, which is also true in *C. manteri* (6). The measurements in the following table were taken from ten preserved specimens in each instar:

Instar	First mm.	Second mm.	Third mm.	Fourth mm.	Fifth mm.	Sixth mm.	Adult mm.
Head width	0.190	0.250	0.293	0.375	0.450	0.507	0.552
Antennal length	0.338	0.440	0.512	0.627	0.763	0.900	1.097
Forewing length	....	....	0.094	0.175	0.333	0.616	1.607

The complete nymphal period averaged 17.3 days with a minimum of twelve and a maximum of twenty-seven. The nymphal period could probably be lengthened still more if feeding conditions were poor, because this species, like *Lachesilla nubilis* (Aaron), eats the epidermis and mesophyll of the sheaths when fungus is scarce. The total length of all the life stages was usually about 53 days.

Moulting. — Often the nymphs ate their exuviæ, thus making it difficult to determine moults in cases where measuring was impossible. The majority of the exuviæ were in a vertical position with the head down, but some were horizontal. Moulting seemed to be the same as that described for *C. manteri* (6). The epidermis split along the top of the thorax and head. The nymph arched up, with the antennæ held down along the sides of the body. The head was finally freed and gradually the nymph rose until it was actually resting on the end of its abdomen, although the tarsi of the exuviæ were in contact with the substratum. When almost vertical the antennæ were released, then the legs. All this time air bubbles were being swallowed and the abdomen stretched out. After moving the legs it bent over, freeing the tip of the abdomen, and stood beside the exuviæ. After a short time the abdomen contracted to its normal length. One adult was observed from the time it first freed its legs from the exuviæ until its wings were completely unfolded. Five minutes after freeing the legs it walked from the exuviæ. The wings were beginning to unfold; so it turned around to a vertical position with the head up. In twelve minutes the wings were completely straightened and were the same light color throughout. After the third instar one can determine when moulting will occur because the thick wing pads stick out from the body as in Figure 6.

Habits. — Under laboratory conditions the nymphs and adults eat fungi, epidermis and mesophyll of the corn sheaths, pollen, embryo and starch of broken corn kernels, exuviæ, and dead of their own kind. This species seemed to get along very well on the embryo and starch of the corn kernels. In some cases when they finished there was nothing left but the hard yellow seed coat of the kernel. Silk is deposited by the nymphs and adults. Although the quantity produced by *E. pumilis* is considered rather conspicuous it is a small amount in comparison to that deposited by *E. californicus*. *E. pumilis*, like *C. manteri*, gave a sudden start when the cotton plugs in the rearing cages were moistened, and they usually pushed their mandibles into the cotton and took water from the plugs. There seemed to be a tendency for both the nymphs and adults to walk upward, if confronted with a vertical surface. This negative geotropism made this species easy to handle. If a glass tube were placed over an escaped nymph or adult it immediately walked up the side of the glass to the cotton plug. Other species sometimes had to be coaxed for a long time before they would walk upon a piece of corn sheath. This habit made it easy to transfer cultures from an old cylinder to a freshly prepared one. This species was successfully reared both in colony and individual cultures as described by Sommerman (5).

The adults exhibited somewhat regular periods of extreme activity. This was especially noticeable in cultures decidedly overcrowded (i.e., in comparison to any conditions normally found in the field). Late at night they became active but the cause is not known. They may have been stimulated by hunger, temperature, light from the desk lamp, or perhaps it was just a daily rhythm.

Overwintering. — This species was numerous on corn plants only in the fall. The heaviest infestation encountered occurred at Lawrenceville, Ill., in October 1938. In December 1939 it was numerous in a cornfield at Urbana, and was the common species found on corn at Mt. Carmel, Conn., during the same month. Eggs were not easy to find. Those taken in the field from December to April did not hatch when brought into the laboratory or when left out of doors. Usually eggs found during the winter were straw-colored and withered. Adults taken from the field December 30, 1939 at Mt. Carmel, Conn., deposited fertile eggs within two days after being brought in from out of doors. Living nymphs or adults were not taken in the field between January first and April first. An active male that had probably overwintered was found in the sheath on an uprooted corn stalk April 9, 1940.

On December 12, 1939 some nymphs and adults of *E. pumilis* were put in a tube and left out of doors. February 6 they were transferred out of doors to a clean tube. On April 1 an adult male, female and three nymphs were still alive. The cotton plug in the tube was moistened and they all drank readily. By April 9 these individuals had become active and their bodies were plump. By April 16 the overwintering female had deposited a mass of ten eggs. These eggs were taken into the laboratory for rearing, to see if the change from variable out-of-doors temperatures to the abnormal indoor temperature would interfere with hatching. Seven of the ten hatched and all the nymphs matured. On April 21 one of the overwintering nymphs moulted to an adult and the overwintering female had also laid a group of eleven more eggs. These eggs were left out of doors and they hatched May 4. By May 12 these nymphs had reached the third instar. By May 25 they were in the sixth instar. The overwintering nymphs matured and deposited eggs that hatched, their nymphs likewise maturing. The overwintering nymphs and adults, and the unsuccessful attempts to hatch overwintering eggs suggest that a few nymphs or adults manage to survive the winter and continue their normal activities in the spring. They were not found during late June and July, but on August 1 adults and eggs were taken on the dried leaves of new corn.

Parasitism. — Groups of *E. pumilis* eggs were exposed to adults of *Alaptus cæcilii* Girault (Hym., Mymaridæ) that had emerged from the eggs of *Cæcilius aurantiacus* Hagen. Various groups of eggs were exposed on April 1, 5 and 11, but the eggs did not hatch and parasites did not emerge. The parasites were not definitely observed ovipositing in these eggs but they did walk over them. Other groups of eggs laid by the same female, not exposed to the parasites, hatched and matured normally. This scanty information suggests that *A. cæcilii* oviposited in the eggs, that the embryo was destroyed and that conditions were not favorable for the complete development of the parasites; so neither emerged. It is interesting to note that Spruyt (7) records *Alaptus cæcilii* from the eggs of *Ectopsocus californicus* (Banks), the other species of this genus in the United States, and which is also parasitized by *Alaptus psocidivorus* Gahan.

Summary. — Adults of *Ectopsocus pumilis* have been taken in many of the eastern states as far west as Missouri. Both sexes are known and the sex ratio is 0.5. The eggs are smooth-shelled and are laid in masses covered with a loose network of threads. The nymphs and adults feed on fungus, pollen, starch and embryos of the corn kernels and on the corn sheaths. The egg stage requires six days. The egg burster, apparently on the inside of the pronymphal membrane punctures the latter, while the chorion and vitelline membrane are probably broken by internal pressure. The nymphs swallow air bubbles at hatching and at moulting. The pronymphal membrane, with the egg burster attached, is always found protruding from the chorion after hatching. The antennæ are eight-segmented in the first instar and thirteen-segmented thereafter. Wing pads appear on

the third instar and about double their length with each moult. During moulting the nymphs are in a vertical position with the head down. The nymphal stage requires about seventeen days and the adult stage lasts about thirty days. The usual life span including the period within the egg is fifty-three days. Silk is deposited by all nymphs and adults. Winter is probably spent in the adult or nymphal stage.

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EXPLANATION OF PLATES

Plate V.

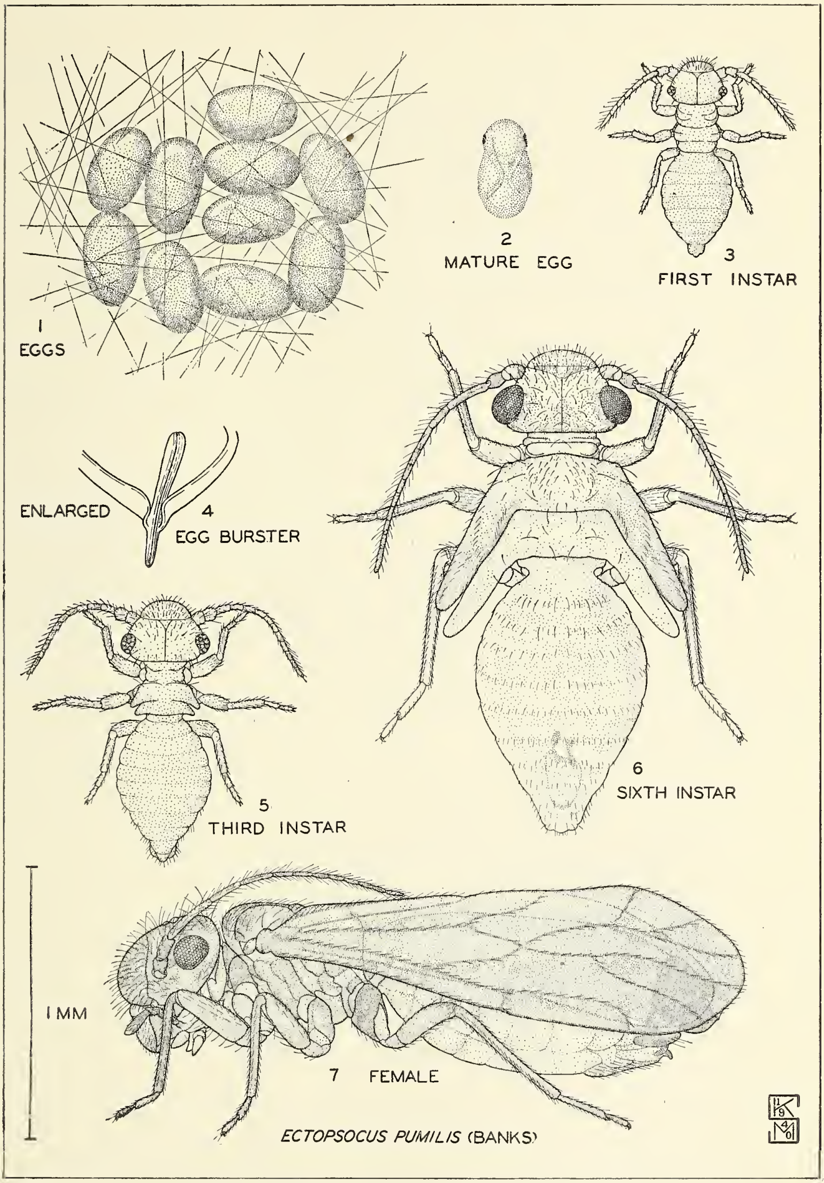
Figure 1. Egg mass covered with silk threads.
Figure 2. Mature egg.
Figure 3. First instar (dorsal view).
Figure 4. Egg burster (enlarged).
Figure 5. Third instar (dorsal view).
Figure 6. Sixth instar (dorsal view).
Figure 7. Female (lateral view).

Plate VI.

(Scale of enlargement applies only to Figures 12 and 15.)

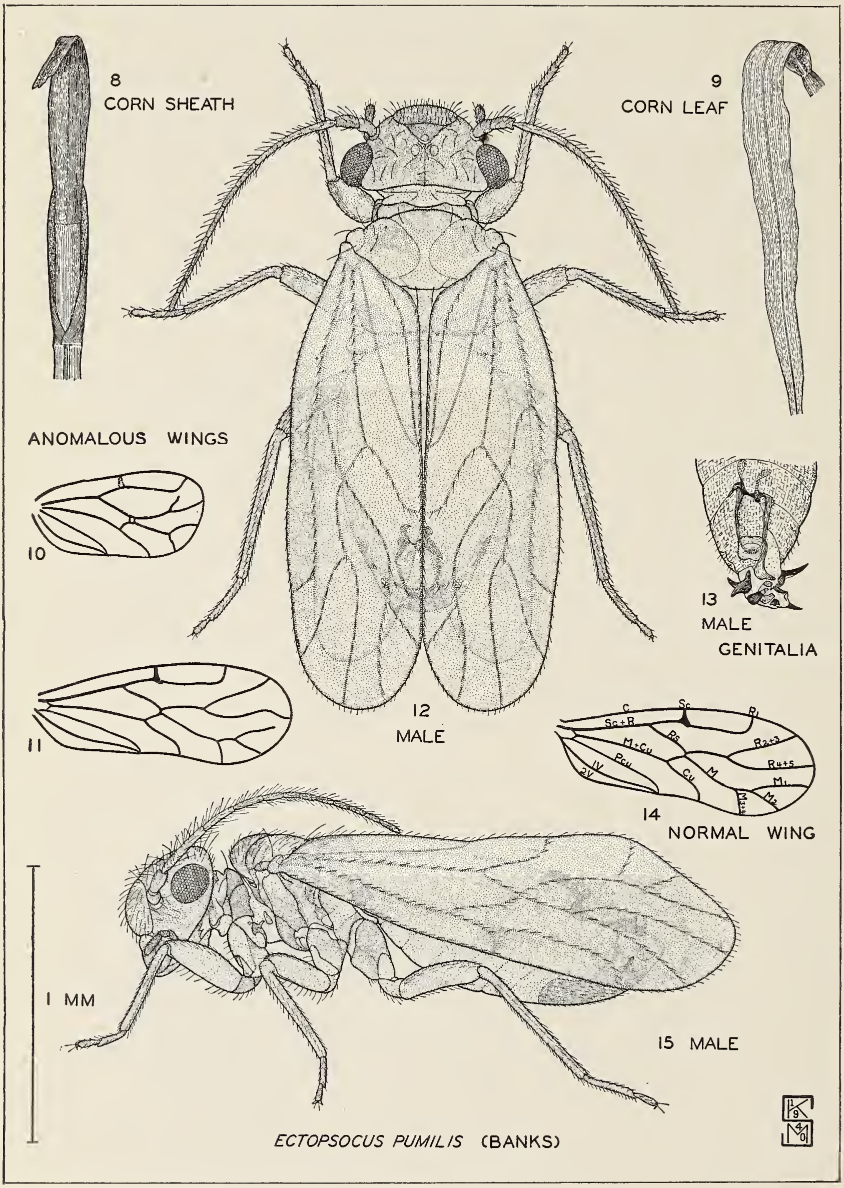
Figure 8. Corn sheath.
Figure 9. Corn leaf.
Figure 10. Malformed short wing.
Figure 11. Anomalous wing.
Figure 12. Male (dorsal view).
Figure 13. Protruding male genitalia (dorsal view).
Figure 14. Normal wing.
Figure 15. Male (lateral view).

PSYCHE, 1943 VOL. 50, PLATE V



Sommerman — *Ectopsocus pumilis*

PSYCHE, 1943 VOL. 50, PLATE VI



Sommerman — *Ectopsocus pumilis*

SOME NEW NORTH AMERICAN SPECIES OF *EPICAUTA* (COLEOP., MELOIDÆ)[1]

By Floyd G. Werner

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The completion of my revision of the genus Epicauta having been delayed by my entrance into the U.S. Army, I have decided to publish separately the new species in it so that they will be available to workers in this group. They will be described more fully in my revision.

Epicauta maculata (Say)

Black, clothed with olive-cinereous to cinereous pubescence, with numerous denuded spots. Maxillary palpi of male enlarged, flattened, labial palpi small. Male anterior tarsi not modified. East of the Rocky Mountains, from North Dakota to Wickenburg, Arizona and eastward to western Iowa and Missouri.

Marginal notes by Anderson 24-III-'44

Epicauta nogales sp. n.

Male labial palpi not nearly as greatly expanded as in *maculata*. Male anterior tarsi not modified. Elytra shorter and broader, leaving the tip of the abdomen broadly exposed. Denuded spots small.

Holotype: ♂, Nogales, Arizona, Aug. 10–13 Wickham (MCZ No. 26085).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: 4 eutopotypical (MCZ), 1 eutopotypical (USNM), 1 topotypical — Sept. 9, 1906 — Nunenmacher (USNM), 2 Tucson, Arizona (USNM).

4 paratypes U.S.N.M. No. 56881

Epicauta normalis sp. n.

Replaces *maculata* from the Rockies to the Pacific, except in Arizona. Maxillary palpi as small in the male as in the female.

[1] Published with the aid of a grant from the Museum of Comparative Zoölogy at Harvard College.

First segment of male anterior tarsi narrow, slightly outcurved, with the pad absent from at least the basal three-fourths.

Holotype: ♂, Bridgeport, California, July 12–15 Wickham (MCZ No. 26086).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: California: 6 eutopotypical (MCZ), 3 Cal. (MCZ), 6 Shasta Valley (AMNH), 2 Eagleville (AMNH). Oregon: 1 Echo (MCZ), 1 Burns (MCZ), 1 Or. (MCZ). Washington: 2 Yakima Valley (MCZ), Nevada: 2 Paymaster Cañon — Lone Mt. (ANSP), 5 Reno (Werner), 3 Nev. (MCZ). Idaho: 1 Ruhl (MCZ). Wyoming: 2 Green River City (MCZ), 1 Laramie (Ohio), 3 Wy (MCZ). Montana: 2 Helena (MCZ). Utah: 1 Fillmore (BYU), 1 American Fork (BYU), 1 Sheep Creek-Duchesne Co. (BYU), 1 Jordan River (BYU), 1 Provo (BYU), 1 Indianola (BYU), 1 Ogden (AMNH), 1 Ut. (MCZ). Colorado: 8 Manitou (MCZ), 2 La Veta (MCZ), 2 Colo. Spgs. (1 MCZ, 1 Ohio), 5 Windsor (3 Colo., 2 Werner), 2 Ft. Collins (Colo.), 2 Colo. (1 MCZ, 1 Ohio). Arizona: 4 Chiricahua Mts. (Ohio), 1 Huachuca Mts. (Ohio).

1 specimen rec'd from Werner and marked "Paratype" by him. The locality not listed here so the specimen not considered a paratype

Epicauta phoenix sp. n.

Elytra more convex than in the others in this group. Antennæ shorter and more slender. Spots on the elytra moderately large, elsewhere small and indistinct. Male with the palpi small, the anterior tarsi normal.

Holotype: ♂, Phoenix, Arizona, Liebeck Coll. (MCZ No. 26070).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: Phoenix, Arizona: 11 (MCZ), 6 July 16–18 Wickham (5 MCZ, 1 USNM), 2 Wenzel Coll. (Ohio). 3 Ariz. (2MCZ, 1 AMNH).

One paratype U.S.N.M. No. 56882

Epicauta andersoni sp. n.

Close to *pardalis* Lec. but has both pairs of palpi enlarged and flattened in the male and with the antennæ more slender.

Holotype: ♂, Gallo Springs, New Mexico VI–21 Green (USNM).

Allotype: ♀, eutopotypical (USNM).

Paratypes: New Mexico: 4 eutopotypical (USNM). Arizona: 1 Flagstaff VI–20–35 Wildermuth, on potatoes

Type, allotype and 6 paratypes U.S.N.M. No. 56883

(USNM), 1 Flagstaff, VIII–2–37 Maehler (Colo.). TEXAS: 1 Childress VI–8–06 Mitchell (USNM). KANSAS: 1 Ks. (MCZ NO. 26084).

Epicauta uniforma sp. n.

This is one of the species from the Southwest misidentified as "*cinerea*." Uniformly clothed with dull ferrugineous to golden pubescence, and without markings at the base of the elytra. First segment of male antennæ slender, reaching to the hind margin of the eye, not covered with golden pubescence. Head subquadrate. Antennal calluses not denuded. Eyes moderately narrow.

2 specimens rec'd from Horned and indicated by him to be paratypes. They are not listed here so not considered & be paratypes

Holotype: ♀, Ramah, Arizona — Aug. — Vestal (MCZ No. 26581).

Paratypes: COLORADO: 1 LaJunta (AMNH), 1 Hoehne (Parker). TEXAS: 7 Davis Mts. (6 Ohio, 1 Parker), 1 Odell (ANSP), 1 Chisos Mts. (Parker), 1 Texas (Parker). ARIZONA: 1 Baboquivari Mts. (Ohio), 1 Nogales (Ohio), 1 Patagonia Mts. (Ohio), 4 Tombstone (2 ANSP, 2 Frost), 2 Douglas (Parker), 2 Tucson (Parker), 1 Picacho (Parker), 1 Tucson-Liebeck Coll. (MCZ).

Epicauta alpina sp. n.

Similar to *uniforma* but always clothed with golden pubescence and narrower. First segment of antennæ with golden pubescence and in the male extending one-fourth its length beyond the eye, slightly excavated externally near the tip. Head rather narrowly triangular, especially in the male.

3 paratypes U.S.N.M. No. 56884

Holotype: ♂, Alpine, Texas Jul. 20–22, 4400–6000 ft., Wickham (MCZ No. 26061).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: TEXAS: 2 eutopotypical (1 MCZ, 1 USNM), 2 Alpine (USNM), 3 Texas (Parker). NEW MEXICO: 1 Deming (Parker).

Epicauta brunnea sp. n.

Another Western species commonly misidentified as "*cinerea*." Large, black, the elytra brown; entirely clothed with appressed ferrugineous pubescence. Elytra darker across the base. First segment of the anterior tarsi of the male with the pad broadened, about twice as broad as on the second segment.

Holotype: ♂, Alpine, Texas, 6000 ft. 8–15–26 (MCZ No. 26064).

Allotype: ♀, topotypical 8–20–26 (MCZ).

Paratypes: Texas: 1 topotypical (MCZ), 2 Brewster Co. (MCZ), 1 Fort Davis (Frost), 1 Sabinal (USNM). Arizona: 2 Sta. Cruz Village-Cobabi Mts. (1 ANSP, 1 AMNH), 2 Superior (1 ANSP, 1 AMNH), 1 Douglass (USNM), 4 Capitan Mt. (3 Parker, 1 Werner), 1 Globe (Parker), 2 San Carlos (1 Parker, 1 Werner), 1 Canon Lake (Parker), 1 Gila Valley (Parker), 1 Whiteriver (AMNH). Colorado: 1 Denver (Ohio).

2 paratypes U.S.N.M. No. 56885

Epicauta floridensis sp. n.

Similar to the cinereous form of both species known as *cinerea* in the East. The antennæ are slightly more slender than in the species which feeds on *Clematis* and have the first segment more slender. Posterior tibial spurs slender. Smaller and more slender than either species.

13 paratypes U.S.N.M. No. 56886

Holotype: ♂, Sebring, Florida VI–1–10–42 Parsons (MCZ No. 26067).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: Florida: 15 eutopotypical (MCZ), 1 Croom (MCZ), 2 Cleveland (MCZ), 4 Capron (USNM), 1 Biscayne (USNM), 2 Tampa (USNM), 3 Cutler (USNM), 2 Jacksonville (USNM), 1 St. Nicholas (USNM), 2 Lake Istopoga (MCZ), 8 Fla. (MCZ). New Jersey: 4 DaCosta (MCZ). Mississippi: 1 Lucedale (MCZ).

Epicauta punctipennis sp. n.

Black or dark brown, elytra ferrugineous. Rather densely clothed with tannish-cinereous pubescence. Elytra with small, sparsely scattered, denuded spots. There are no spots on the rest of the body. Male anterior tibiæ with two spurs.

Holotype: ♀, Columbus, Texas, May 24, 1879 LeConte Coll. (MCZ No. 26159).

Allotype: ♂, "Tex.," Liebeck Coll. (MCZ).

Epicauta ensiformis sp. n.

Black, sparsely clothed with erect black pubescence. Resembles *oblita* in general form but has the antennæ strongly ensiform, with the third segment the broadest and flattened.

Anterior tibiæ of male with two spurs and male anterior tarsi not modified.

Holotype: ♂, "Cal." with an ink spot on the lower part of the "a," Liebeck Coll. (MCZ No. 26079).

Paratype: 1 ♂, "Cal." Fall Coll. (MCZ).

Epicauta occidentalis sp. n.

Identical with *lemniscata* but has the intermediate segments of the antennæ broadened and somewhat flattened and has the outer edge of the anterior tibiæ and tarsi denuded, smooth and shiny. No intergrades have been seen.

Holotype: ♂, Cambridge, Nebraska VII–VIII–21 Morse (MCZ No. 26069).

1 paratype
U.S.N.M. No 56887

Allotype: ♀, eutopotypical (MCZ).

Paratypes: Nebraska: 6 eutopotypical (MCZ). Kansas: 1 Abilene (MCZ), 2 Ks.-Liebeck Coll. (MCZ). Colorado: 5 Rocky Ford (Colo.), 3 Joes (Colo.), 1 Ft. Collins (Colo.). Texas: 3 Dallas-Boll (MCZ), 2 Tex. (MCZ). Louisiana: 1 Baton Rouge (USNM), 3 La. (MCZ).

Epicauta fortis sp. n.

Resembles *sericans* greatly in general shape and habitus but is consistently smaller than that species, has the antennæ shorter and has the outer spur of the hind tibiæ broad and flattened. Some specimens of *ferruginea* resemble it but they are narrower and have the pubescence coarser.

2 paratypes
U.S.N.M. No. 56888

Holotype: ♂, Phoenix, Arizona, Liebeck Coll. (MCZ No. 26066).

Allotype: ♀, eutopotypical (MCZ).

Paratypes: Arizona: 17 topotypical (MCZ), 5 Tucson (MCZ), 1 Picacho (Colo.), 52 Florence (ANSP). New Mexico: 1 Las Cruces (USNM).

Five additional spec. rec'd from Sterner and indicated by h[im] to be "paratypes." They are not listed here and are not consider[ed] to be paratypes.

Epicauta barberi sp. n.

Black, fairly densely clothed with semi-erect black pubescence. Head and pronotum shiny. The head is much more densely and finely punctured than in *puncticollis* or *oblita*. The outer division of the tarsal claws is curved from the base and the inner division is not more than three-fourths as long as the outer. In *puncticollis* and *oblita*, the outer division is curved near the tip and the inner division is almost as long as the outer.

Type and paratype S.N.M. No. 56889

Holotype: ♂, La Panza, California May 17–18 CCWilson (USNM).

Paratype: 1 ♂ San Luis Obispo, California — May 16–35 CC Wilson (USNM).

Named for Mr. H. S. Barber of the U. S. National Museum.

Epicauta kansana sp. n.

Type and four paratypes S.N.M. No. 56890

Black, with scattered semi-erect but rather short pubescence, resembling *puncticollis* and *oblita.* Head and pronotum shiny, the head more densely punctured than the pronotum. Tarsi unusually slender. Inner division of tarsal claws as long as the outer but very slender. The outer curves near the tip. Fourth segment of the antennæ longer than the fifth.

Holotype: ♂, Sedgwick, Kansas, June 4, 1910 J. C. Warren (USNM).

Paratypes: 2 eutopotypical (USNM), 2 topotypical, April 7, 1910 Warren (USNM).

Epicauta calcarata sp. n.

Similar to *sericans* in general shape but has longer pubescence, especially on the pronotum. The labrum is deeply excised. The pronotum is noticeably globose. Tibial spurs very stout, especially on the anterior legs, curved. Mandibles long, the tips crossed.

Holotype: ♀, Roswell, New Mexico, Aug., 1902 (MCZ No. 26065).

Allotype: ♂, between Wild Horse and Plateau, Culbertson Co., Texas 2852 ft. Aug. 31, 1937, Rehn, Pate, Rehn (ANSP).

Paratypes: 1 Carlsbad, New Mexico — R&H — Aug. 25, 1921 (ANSP), 1 Dim Lake — Pecos Val. — New Mexico Aug. 21, 1902 (MCZ), 1 Ft. Stockton, Texas 2500 ft. Sept. 1, 1937 RPR (ANSP).

Epicauta aspèra sp. n.

Misidentified as "*cinerea*" in most collections. Second to fourth abdominal sternites, sometimes fifth, with a black median spot and with a spot anteriorly on each side near the edge. Male middle and posterior femora denuded behind and with marginal long hair. Actually belongs to the *caviceps* group but does not have the head modified. Uniform above but for a humeral and

scutellar spot on the elytra, sometimes joined across the base.
Holotype: ♂, Salida, Colorado Aug. 13 (MCZ No. 26063).
Allotype: ♀, Jemez Springs, New Mexico (MCZ).
Paratypes: COLORADO: 4 Masonsville (3 Colo., 1 Werner), 5 Ft. Collins (4 Colo., 1 Werner), 3 Boulder (1 Colo., 1 AMNH, 1 Parker), 1 B. Rotger C. R. (Parker), 1 Morison (Colo.), 1 Colo. (Colo.). TEXAS: 4 Davis Mts. (2 Ohio, 1 Parker, 1 Werner). NEW MEXICO: 3 Jemez Spgs. (Frost), 1 Barton — 6700 ft. (ANSP). ARIZONA: 4 Copper Basin — near Prescott (USNM), 1 White Mts. (Parker), 1 Wilmsn. Val. — Ball (Parker). Four paratypes U.S.N.M. No. 56891

Epicauta parkeri sp. n.

This and the species that follow fall into the old genus *Macrobasis*, which I have decided to suppress under *Epicauta*.

Resembles *E. gissleri* (Horn) in general appearance. Black, sparsely clothed with cinereous pubescence, which forms denser margins on the elytra. The antennæ are more slender than in *gissleri*, with the segments less distinctly separated. The head is elongate-triangular and the mandibles are as long as in *mimetica*. They go one-third beyond the labrum, cross at the tip and have a distinct tooth.
Holotype: ♀, White Mts., Arizona July 8, 1933 (Parker).
Paratypes: 3 eutopotypical (1 Parker, 2 Werner), 1 topotypical (Parker), 1 San Rita Mts. — Ball (Parker), 1 San Rita Mts. — 5–8000 ft. — July (Snow) (MCZ No. 26080), 1 Globe (Parker), 1 Baboquivari Mts. (MCZ), 1 Flagstaff (Ohio).

Epicauta polingi sp. n.

Three distinct species have been known under the name of *linearis*. None of these is the true *linearis*, which has the first segment of the male antennæ excavated externally at the tip and has the second segment shorter than the third in both sexes. It is a rare species.

Slender. Head and pronotum black or dark brown, the elytra pale ferrugineous, the whole rather loosely clothed with cinereous to luteous pubescence. First segment of male antennæ exceeding the head by one-third its own length, not over one-sixth as broad as long, straight, flattened behind and with cinereous pubescence along this surface. Second segment narrower, elongate oval, about one-third as long as first. The first and second segment together are about equal to the rest in length. Anterior tarsi of male with the first segment short, contorted.

Holotype: ♂, Davis Mts., Texas VI–VII–1928 OCPoling (MCZ No. 26071).

Allotype: ♀, eutopotypical (MCZ).

14 paratypes U.S.N.M. No. 56892

Paratypes: 6 eutopotypical (MCZ), 18 topotypical VI–VIII– DJ&JN Knull (14 Ohio, 4 Parker), 1 Phantom L. — Davis Mts. (MCZ), 7 Alpine (1 AMNH, 6 MCZ), 4 Sabinal (USNM), 3 Devil's River (USNM), 2 Rio Frio (USNM), 2 Cotulla (USNM), 24 Tex. (MCZ), 1 Texas-Ulke Coll. (Carnegie). New Mexico: 2 Cloudcroft (MCZ), 1 Alamagordo (MCZ). Arizona: 1 Sta. Catalina Mts. (USNM), 2 Douglass (USNM).

Epicauta liebecki sp. n.

Head and pronotum black or dark brown, elytra brown, much darker than in *polingi*, margined with denser pubescence. First segment of male antennæ one-fifth as broad as long and the first two segments distinctly longer than the following. Averages smaller than *polingi*. The posterior tibial spurs are more slender than in the other two.

Holotype: ♂, Tucson, Arizona V–25 Liebeck Coll. (MCZ No. 26068).

Allotype: ♀, eutopotypical (MCZ).

14 paratypes U.S.N.M. No 56893

Paratypes: Arizona: 2 eutopotypical (MCZ), 1 Bowie (MCZ), 1 Ajo (MCZ), 1 Pima Co. (MCZ), 6 Globe (Parker), 6 Congress Jc. (Ohio), 2 Wickenburg (Ohio), 1 Nogales (AMNH), 9 Columbia-on *Prosopis pubescens* (USNM), 1 Tempe (USNM), 1 Lowell (USNM), 3 Sabino Cn.-Sta. Catalina Mts. (2 MCZ, 1 USNM), 1 Sta. Catalina Mts. (USNM), 9 Baboquivari Mts. (MCZ). Sonora: 1 Imuris VI–25–40, on pigweed (USNM).

Epicauta arizonica sp. n.

Uniformly luteous to dull brown, with sparse cinereous pubescence. Eyes larger than in the other two. First segment of male antennæ exceeding head by only one-sixth its own length, a little less than one-fifth as broad as long. First two segments of male antennæ about one-fifth shorter than the rest. Averages smaller than the other two.

Holotype: ♂, Baboquivari Mts., Arizona IX–5–30–23 Fall Coll. (MCZ No. 26062).

Allotype: ♀, topotypical IX–23 (MCZ).

Paratypes: ARIZONA: 4 topotypical (MCZ), 4 Kits Peak Rincon-Bab. Mts. (AMNH), 15 Tucson (Ohio), 1 Wickenburg (Ohio), 9 Nogales (8 USNM, 1 MCZ), 1 Capitan Mt. (Colo.), 5 Canon Lake (Parker), 7 Globe (Parker), 3 San Bernardino Rch.-Cochise Co. (2 MCZ, 1 USNM), 1 Phoenix (MCZ), 1 Rice (MCZ), 1 Sta. Rita Mts. (MCZ). SONORA: 4 Arizpe (USNM).

13 paratypes U.S.N.M. No. 56894

also 2 additional spec. rec'd from Werner and indicated to be paratype. Some doubt as to whether or not they are listed so not considered to be paratypes

Epicauta texana sp. n.

Close to *albida* (Say). The first segment of the male antennæ is longer and less curved, narrower, reaching to middle of thorax. Shorter and stouter than *albida*. The black pronotal markings are absent or extremely faint. The abdominal markings of *albida* are always lacking. Eyes narrower than in that species.

2 paratypes U.S.N.M. No. 56895

Holotype: ♂, Davis Mts., Texas VIII–2–37 DJ&JN Knull (Ohio).

Allotype: ♀, eutopotypical (Ohio).

Paratypes: TEXAS: 9 eutopotypical (Ohio), 3 Alpine VII–20–22 4400–6000 ft. Wickham (2 USNM, 1 MCZ No. 26072), 3 Marfa (Ohio), 1 Texas-Wenzel Coll. (Ohio).

NEW NEUROPTERA AND TRICHOPTERA FROM THE UNITED STATES[1]

By Nathan Banks

In the course of identification of Neuropteroid insects in the Museum of Comparative Zoölogy several species were found that are new. Descriptions of these are given, and further studies with additional material enable one to prepare a synopsis of our small species of Myrmeleon.

Order NEUROPTERA

Chrysopidæ

Chrysopa sperryæ sp. nov.

Pale greenish; head, antennæ, and legs more yellowish; pronotum with a median yellowish stripe, extending back on mesonotum; both pairs of palpi marked with black, otherwise without dark marks, no dark nor reddish on cheeks. Wings with green venation, the only black is on the first (and sometimes second) branch from cubitus to the cubital fork. Stigma long, plainly green.

The fore wings have eleven radial cross-veins, six cubitals beyond the divisory cell, latter ending before cross-vein above; about six inner gradates and seven outer, the rows nearly parallel, each gradate separated from the next by more than its length, except the two or three at upper end of outer row; hairs on veins about as in *C. plorabunda*. The costal area (at broadest) almost as broad as the radial area, and each about equal to the post-cubital area, latter fully one-third broader than cubital area; subcostal area of stigma with but one or two cross-veins.

In hind wings eight or nine radials; three inner gradates, and four or five outer ones, in nearly parallel series, and well separated.

[1] Published with the aid of a grant from the Museum of Comparative Zoölogy at Harvard College.

Length of fore wing 10 to 12 mm.

From Riverside, Calif. 22 August to 19 September, from Grace H. and John L. Sperry; also two from Lake Arrowhead, Calif., 29 August (Buckwalter coll.). Type M.C.Z., No. 25753.

Readily separated from all others in the *plorabunda* section by the absence of dark or reddish marks below the eyes.

Myrmeleonidæ

Vella texana minor var. nov.

Acanthaclisis fallax Rambur was described from "Guyane"; Hagen identified specimens from Mexico as this, and in my Revision of the Myrmeleonidæ (1927) I kept the Mexican and Arizonian specimens under that name. Now I have seen specimens from Guiana, and ours is a different form.

It is in many particulars like *V. texana* Hagen, so I describe it as a variety of that species.

It is uniformly a little smaller, fore wing from 48 to 51 mm. long (*texana* 54 to 56 mm.) but the wing scarcely more narrow; the tip is very plainly less pointed, the hind margin before tip not or scarcely concave (in *texana* plainly so). As noted in my Revision, the venation is more dense, but not as heavily marked. The costal area has a number of cells before middle that are crossed, while in *texana* there are few or none. The markings on body are similar; on pronotum the pale areas are paler than in *texana*, and the dark on mesoscutellum is divided by a fine pale line.

The male appendages of minor are plainly a little shorter than in *texana*.

The type is from Phoenix, Arizona, paratypes from Tucson, 6 to 9 August and 6 September. M.C.Z., No. 25758.

Myrmeleon carolinus sp. nov.

In general much like *M. crudelis* Walker from Florida. It is readily separated by the last joint of labial palpi being much less swollen, and in the male the abdomen is plainly a little longer and more slender. In the female of *crudelis* there is a large triangular pale spot on each side of the last segment of the abdomen, in *carolinus* none or a faint line. The hair on abdomen is fully as long as in *crudelis*. The wings of *carolinus* are not as broad, and the dark marks on veins are not as distinct as in *crudelis*.

The specimens average a little smaller in size than *crudelis*.

Many specimens taken at Southern Pines, North Carolina, by Mr. Manee from the latter part of May until August, also

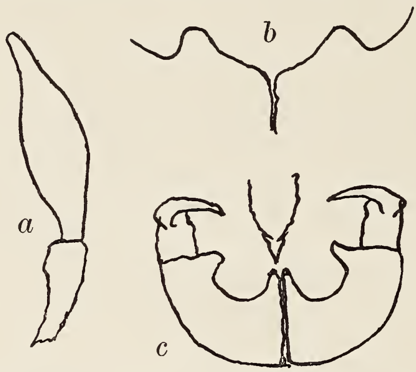

FIG. 1. (a) Labial palpus of *Myrmeleon carolinus*, n.sp.; (b) Base of ♂ claspers from behind of *Banksiola* "*concatenata*" Walker; (c) ♂ claspers from behind of *Banksiola crotchi*, n.sp.

several from Millin, Scriven Co., Georgia, July (Morrison). Type M.C.Z., No. 25752.

Myrmeleon arizonicus sp. nov.

Head black, except lower clypeus and orbits, antennæ black except part of basal joint, last joint of labial palpi much swollen, black. Pronotum black; in front of groove is a median pale line and each side is a rounded pale spot, and outer margin pale; behind the groove is an elongate pale spot each side, behind the spot in the front part; hair white. Thorax black, hind margin of mesonotum narrowly pale; abdomen black, last five segments narrowly pale at tip above, hair short and white, except that last segment of female has short erect black hair as usual. Legs pale; mid and hind femora largely black, and front femora black below; all tibiæ black within, the front also dark on sides; tarsi, except basal joint black.

Fore wings with longitudinal veins plainly streaked with black; cross-veins pale with dark dots, but in apical fourth of wing they are mostly black; hair short and black; hind wings with similar venation. Wing slender, acute at tips; fore wings with seven cross-veins before radial sector, nine to eleven radials before stigma, five or six branches of anal; one series of gradates in apical costal area. In hind wings four cross-veins before radial sector, about eight radials before stigma, and five branches to anal; no gradates in apical costal area.

Length of fore wing 21 to 25 mm., width 4.9 to 5.5 mm. Length of hind wing 19 to 23 mm., width 4 to 4.2 mm.

From Tucson, Arizona, 6, 20 June; 6 August; Nogales, Arizona 25 July; El Paso, Texas, 4 July, and Brownsville, Texas, April. Type M.C.Z., No. 25849.

In general similar to *M. rusticus*, but smaller on average, with plainly more slender wings, and cross-veins dotted, vertex usually wholly black, and the last joint of labial palpi rather more swollen.

Myrmeleon californicus sp. nov.

Face mostly reddish brown, lower part of clypeus and the orbits yellowish, front and vertex deep black, also the antennæ except part of basal joint. Pronotum pale, markings very faint, behind groove is a large broad dark area, and in front a smaller median spot, hair white; thorax black, pruinose; abdomen black, with short white hair, none of segments pale at tips except the last; legs pale, mid and hind femora somewhat embrowned, mid and hind tibiæ with black line within, all tarsi mostly black except basal joint, spines black, spurs almost equal first joint.

Wings hyaline, veins mostly pale, subcosta, radius, and cubitus marked with dark streaks as usual, stigma white; most of venation beyond stigma dark, and some cross-veins behind are dark; hair on veins in costal area mostly black, elsewhere it is largely snow-white, or only the tips of hairs black. Last joint of labial palpi black, except tip, about as much swollen as in *M. rusticus*.

Wings broad, especially toward tip; in fore wing the apical costal area is expanded in front and just behind the tip of wing is a distinct concavity, so the tip appears slightly falcate. In fore wing seven cross-veins before radial sector, about ten radials before stigma, one series of gradates in apical costal area, six or seven branches of anal vein; posterior part of cubital area almost twice as broad as anterior part; the cubitus beyond the forking curves forward more than in most species; in hind wings four cross-veins before radial sector, seven radials before stigma, no gradates in apical costal area, three branches of anal vein.

Length of fore wing 23 mm.; width 5.8 mm. Length of hind wing 21 mm., width 4.8 mm.

One female from Gavilan, California, 11 July (G. H. &. J. L. Sperry). Type M.C.Z., No. 25850.

Synopsis of the Small Myrmeleons of United States

1. Two series of cross-veins in apical field of fore wings; vertex usually entirely dark; veins with dark dots (or none), no dark streaks on cross-veins . . . . 2.
   But one series of cross-veins in apical field of fore wings; vertex often spotted with pale; cross-veins often partly or wholly dark . . . . 4.
2. Pronotum with a median dark streak, narrowed in front; veins scarcely dotted with dark; legs not marked with black; at most reddish brown . . . . *texanus*.
   Pronotum with a broad dark mark, containing more or less plainly about five pale spots; veins plainly dotted with dark . . . . 3.
3. Last joint of labial palpi much swollen . . . . *crudelis*.
   Last joint of labial palpi slender . . . . *carolinus*.
4. Hair on veins, especially toward tip of wing, largely white; apical costal area expanded in front; cross-veins little marked with dark; vertex wholly dark . . *californicus*.
   Hair on veins black; apical costal area not expanded in front . . . . 5.
5. Radials and many cross-veins dotted with dark, not dark in streaks nor wholly so . . . . 6.
   Radials and most other cross-veins not dotted, but of an even color, usually dark, or dark in streaks . . . . 7.
6. In the hind wings the radius and cubitus at least on basal part are plainly darker than other veins; radial sector also partly dark; mid and hind femora broadly banded with black; scutellum dark; vertex mostly dark; fore wings not 25 millimeters long . . . . *arizonicus*
   In hind wings the radius and cubitus not darker than other veins; mid and hind femora largely yellowish brown; scutellum pale; fore wings fully 25 millimeters long . . . . *rusticus*.

7. In hind wings radius and cubitus darker than other veins; dark spots on clypeus; fore wings over 25 millimeters long . . . . *distans.*
   In hand wings radius and cubitus pale as other veins, most of cross-veins wholly pale; no spots on clypeus; pronotum largely pale; fore wings not over 25 millimeters long . . . . *diversus.*

Ascalaphidæ

Ululodes nigripes sp. nov.

Of the general appearance of *U. senex* Burm. The hair on face much darker, that near base of antennæ dark gray; on pleura just below base of fore wings there is also gray hair (instead of the white); the hair on pronotum almost black, that on mesonotum dark gray; most of the hair on pleura is white, but more gray hair than in *senex*; hair at base of abdomen nearly black. Antennæ nearly evenly black, sometimes a faint dot or narrow line at base of some joints, but not like the broad pale bands of *arizonensis* and *albifrons*, the knob of antenna short and black.

Mid and hind tibiæ and tarsi black (sometimes also front pair), densely clothed with black hair and bristles; femora with mostly long white hair as in other species. In the female the antennæ do not reach to the stigma, about five costal cells before it.

Wings hyaline; in female sometimes a dark stigmal band in hind pair; venation black; stigma black, covering four or five cross-veins. The fore wings are a little broader at middle, and a little more acute at tip than in *senex*.

Fore wing 25 to 26 mm. long.

From Davis Mts., Texas (D. J. & J. N. Knull) in June, July, and August. Type in Ohio State Univ. Collection; paratypes there and at the M.C.Z., No. 25744.

Mantispidæ

Manispa uhleri sp. nov.

Face pale, with a narrow median dark stripe, enlarged on clypeus and on labrum, and also at antennæ where it extends up on front in two dark stripes leaving a pale stripe between them, and extending laterally on vertex to eyes, and also just above antennæ extending laterally to eyes; palpi marked with dark; antennæ brown, basal joint pale yellowish; pronotum pale, with a median black line distinct in front and behind, the side margins of anterior lobe also brown; mesonotum with a broad brown area through the middle, and a brown stripe each side above wing-base, a yellowish stripe each side between the brown; abdomen dark brown to black, the tips of some segments narrowly pale; legs yellowish, front femora and tibiæ dark brown, inner side of femora partly pale, the long spine yellowish, others brown.

Wings hyaline, stigma brown, a pale yellowish-brown streak between the subcosta and radius; venation mostly dark brown to black, toward base of wings some veins are pale.

Structure similar to *sayi* and *cincticornis*; each radial cell with two or three branches.

Length 14 mm.

Holotype from Pennsylvania, 1858 (P. R. Uhler).

Type M.C.Z. 22132. Paratype, Starved Rock, Ill. 4 Aug. (F. G. Werner).

Differs from *sayi* and *cincticornis* in the almost entirely black abdomen, and in that the dark face mark extends upward on front to the vertex.

Specimens from the Field Museum taken at Palos Park, Edgebrook, Lombard, and Dowers Creek in Illinois in July, August, September, and November are paratypes, also from Delaware, Wisconsin. In the females several joints of the antennæ near the apical third are yellowish.

Order TRICHOPTERA

Phryganeidæ

Banksiola crotchi sp. nov.

In general appearance very similar to the common Eastern species which has been considered (but wrongly) "*concatenata*"; the fore wings banded and spotted in the same manner, also the apical part of hind wing is marked as in that species; the venation is also on the same plan.

But the claspers of the male show a striking difference; seen from behind each shows two widely separated processes or teeth, one very slender at the extreme inner end, the other much further out is broader and larger. (In "*concatenata*" so-called there is a broad somewhat triangular lobe or plate near the extreme inner end.) The lateral curved median process is about as in the Eastern species, and the penis is about the same. The superior plate (tenth segment) has the apical indentation much as in the Eastern form, but the lateral lobe or process near its base is much larger.

Length of fore wing 12 mm.

Two males from Victoria, Vancouver Island, July (G. R. Crotch). Type M.C.Z. 25956.

TWO NEW GENERA IN PSAMMOCHARIDÆ (HYM.)

By Nathan Banks

Museum of Comparative Zoology, Cambridge, Mass.

Pompilus nobilis Fab. exhibits an interesting assembly of characters which tend to lessen the differences between the subfamilies of these wasps. The general structure and venation is much as in the Pseudageninæ but there is no true petiole.

Priochilus gen. nov.

The attachment of abdomen to propodeum simply tapers to the base, no petiole. The claws are cleft, there is a median row of spines on under side of last joint of hind tarsus, the hind femora have a few minute spine-pits on upper side near tip; there is no distinct pocket in the third discoidal cell, and no groove on second ventral segment; spines above on hind tibiæ are rather long and not in rows. Genotype, *Pompilus nobilis* Fabricius. There are various other species in South America.

Priophanes gen. nov.

This is based on species formerly placed in Priocnemis which have a petiole, or hour-glass shaped attachment, of abdomen to propodeum, and thus goes into the Pseudageninæ. The hind tibiæ have rows of spines above, and distinct teeth at least on basal part. The venation is much like Pseudagenia; claws toothed; no beard under head; venter of female with a groove across second segment; mesosternum not prominent laterally. Genotype, *Priocnemis facetus* Cresson. Various other species in North and South America.

NOTES ON *DICTYOLATHYS MACULATA* BANKS (ARANEÆ: DICTYNIDÆ)

By Elizabeth B. Bryant

Museum of Comparative Zoölogy, Cambridge, Mass.

Recently in examining some material from Raleigh, North Carolina, collected in January 1941, two females were found described as *Dictyolathys maculata* Banks. This genus, erected by Banks in 1900, was based on females from Mobile, Alabama, and Meridian, Mississippi, and was separated from *Lathys* by the strongly procurved anterior eye row.

In 1903, Simon, who had never seen a specimen, placed the genus as a synonym of *Lathys* and was followed by Emerton, in 1913. He described and figured the male from specimens collected May 1, 1912 at Lakehurst, New Jersey. At the end of the description, Emerton says, "In the original description of *Dictyolathys maculata*, Banks says that the front middle eyes can be indistinctly seen but I have not been able to find them in the Lakehurst specimens nor in the (Banks) type specimen from Alabama. They appear to have only six eyes in two groups as in *Scotolathys pallida*."

Today with the sharp light from a condenser, the small anterior median eyes seen by Banks can be distinctly placed both in the type and the specimens used by Emerton, as well as in the recent material from Raleigh, so that the Banks genus *Dictyolathys* can no longer be considered a synonym either of *Lathys* or *Scotolathys*.

For the benefit of those who do not have ready access to the original description of *Dictyolathys* Banks, I quote verbatim as follows:

"Much like *Dictyna*, but apparently six-eyed, three in a group each side but the A.M.E. are present, although very small, and situated close to and a little higher than the A.S.E. Head not much elevated; legs of moderate length, no spines, but very hairy; accessory spinning organs like *Dictyna*."

A more detailed description of the genus can now be written to include other characters not used by Banks in the original description.

Genus **Dictyolathys** Banks

Proc. Philadelphia Acad., 1900, p. 534.

Cephalothorax moderately high, no thoracic groove; eight *eyes*, lateral eyes on a low tubercle, a.m.e. very small on the posterior slope of the tubercle, widely separated, so that the anterior row of eyes is strongly procurved, posterior row slightly procurved, p.l.e. largest of the eight; *clypeus* equals a radius of a.l.e.; *labium* triangular, as long as wide; *sternum* convex, almost as wide as long, ending in a lobe between fourth coxæ; legs varying little in length, fourth pair longest, no spines, dorsal row of trichobothria on fourth tibia; calamistrum confined to basal half of fourth metatarsus.

Dictyolathys is separated from *Lathys* by the strongly procurved anterior eye row, and the p.l.e. larger than the p.m.e., and from *Scotolathys* by the presence of small a.m.e. and the large p.l.e.

The genus *Lathys* Simon, 1884, was based on the species *humilis* Blackwall, common to northern Europe. This has eight eyes, with the anterior row straight, eyes contiguous, a.m.e. very small, posterior row slightly procurved, eyes equal and usually equidistant.

The genus *Scotolathys* Simon, 1884, was erected for a species, (*simplex*) from Algiers, with but six eyes, the a.l.e. the largest of the eight. In both Les Histoire Naturelle des Araignées, 1903, 2, p. 977 and Les Arachnides de France, 1914, 6, p. 62, Simon has placed *Lathys heterophthalma* Kulczynski, 1891, in the genus *Scotolathys* but states that the a.m.e. almost obliterated. No specimens of this species are in the museum collection; but in the original description, "♀ Oculorum; series posterior paullo procurva, oculi magni, inter se subæquales et spatiis parum inæqualibus, circiter radium æquantibus remoti; series anterior subrecta, oculi valde inæquales, mediorum diameter radio lateralium minor, oculi laterales posticis subæquales, medii inter se late (plus quam diametro sua) distantes, lateralibus valde approximate." Having regard to this and the figures, it would seem that Kulczynski was correct in placing the species in the genus *Lathys*.

Dictyolathys maculata Banks

Figure 1

Proc. Philadelphia Acad., 1900, p. 534.

Female. Length, 1.5 mm.

Cephalothorax moderately convex, cephalic portion level, with a median row of very long bristles from near the posterior margin to eyes, thoracic portion falls rapidly to posterior margin; *eyes* in two groups that do not cover the anterior margin, anterior row strongly procurved, lateral eyes on a tubercle, a.l.e. separated by a diameter, a.m.e. very small, on posterior slope of tubercle, posterior row procurved, p.l.e. largest of the eight,

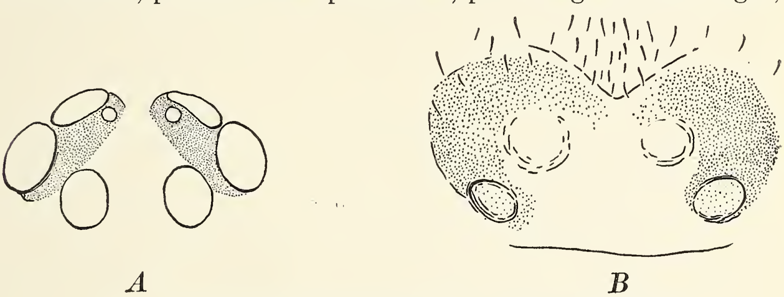

Fig. 1. *Dictyolathys maculata* Banks. A, eyes; B, epigynum.

separated from a.l.e. by a line and from p.m.e. by less than a radius, p.m.e. separated by about a diameter; *quadrangle* of median eyes much narrower in front and as high as wide behind; *clypeus* as high as radius of a.l.e.; *mandibles* small, verticle; *labium* triangular, with tip black, not fused to sternum; *maxillæ* inclined over labium with tips almost touching; *sternum* pale, strongly convex, only slightly longer than wide, ending in a lobe between IV coxæ, IV coxæ widely separated; *abdomen* oval, pale, with a small median basal black spot, followed by five pairs of diagonal black spots, sides with black streaks, venter pale; *legs*, pale, relatively short, varying little in length, but the IV pair longest, no spines, a dorsal row of trichobothria on IV tibia; calamistrum of curved bristles, less than the diameter of the joint in length, on basal half of IV metatarsus; *epigynum* large for the size of the spider, chitinized area wider than long, with openings widely separated, and a pale depressed area just anterior to openings.

Dictyolathys maculata Banks has been reported by Bishop and Crosby in 1926, from Madison and Raleigh, North Carolina and by Gertsch and Mulaik in 1940, from Houston, Harris Co., Texas.

Material in the Museum of Compartive Zoölogy Collection:
Holotype Ala.; Mobile, Banks Coll.
2 ♂ N. J.; Lakehurst, 1 May 1912, Emerton Coll.
2 ♀ N. C.; Raleigh, oak woods, 23 January 1941, (Wray).

In 1904, Banks described *Dictyolathys californica* from Palo Alto, California, also from a female. Unfortunately, this specimen cannot be found in the museum collection, but from the description and the figures, it probably does not belong to the genus *Dictyolathys* since the small a.m.e. are only a diameter apart; the anterior row is almost straight as in *Lathys* and the other eyes are subequal.

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THE NEARCTIC FORMS OF LYCÆIDES HÜB. (LYCÆNIDÆ, LEPIDOPTERA) [1]

By V. Nabokov

Museum of Comparative Zoölogy

What follows is a brief summary of some conclusions mainly relative to the classification of the American forms of *Lycæides* Hübner, 1823 (Plebejinæ). This genus comprises at least half-a-dozen structural (genitalic) unities which may be termed species, and a full account of its morphology will be published in due time. Except in one inevitable case, no new names are introduced, as it is felt that further study might result in some equilibrium of the variational scheme in *Lycæides*, so as to avoid a chaotic accumulation of poorly balanced "subspecies."

Owing to the abundant Holarctic material in the Museum of Comparative Zoölogy, and thanks to generous loans from the American Museum of Natural History and from private collections (I have especially to thank Mr. H. K. Clench and Mr. Don B. Stallings), a considerable number of specimens could be examined; of these, some 350 were dissected and measured.

Three specific categories may be distinguished as affecting the classification of the Nearctic forms:

argyrognomon Bergsträsser, 1779, Nomencl. 2:76 (Tutt, 1909, Brit. Butt. 3 pl. 50, fig. 2, male genit.; *argus* [L.] Hübner, [1800], Samml. europ. Schmett. fig. 316, male; Scudder, 1872, 4th Ann. Rep. Peabody Acad. Sci. 1871:54; Reverdin, 1917, *in* Oberthur, Et. Lép. Comp. 14 pl. 1, 2, fig. 1, 1a, male genit.; *idas* L [*nom. præocc*], *auct.*, *pro part.; non argyrognomon* Beuret, 1935, Forster, 1936).

scudderi Edwards, 1861, Proc. Acad. Nat. Sci. Philadelphia, 1861:164 male; Scudder, 1889, Butt. N. Engl. 2:967, line 22; Stempffer, 1933, Bull. Soc. Ent. France 102:110, 111, fig. 1, male genit.; *non scudderi auct.* [nec female *scudderi* Edw., 1861, l.c. = (*Agriades*) *aquilo* Boisduval, 1832]

melissa Edwards, 1873, Trans. Amer. Ent. Soc. 4:346 (Mead, 1875, Rep. Lep. Colorado etc.:783, pl. 36, fig. 5, 6, male, 7, 8, female; Chapman, 1917, *in* Oberthur, Et. Lép. Comp. 14, pl. 9, fig. 25, male genit.).

[1] Published with the aid of a grant from the Museum of Comparative Zoology at Harvard College.

Besides being dissimilar both in specific expression of generic external variation and in the basic shape of the male armature (e.g., the "retroussé" spur [processus superior of the valve] in *argyrognomon*, the spare tapering weakly hooked falx in *melissa*) these three unities are separated throughout the numerous forms that cluster around the three peaks of speciation by constant relations between certain parts of that organ when its dorsum is viewed from below. If F ("forearm") denotes the length of the falx from its distal point to its elbow; H ("humerulus") the length of the falx from elbow to shoulder point; and U the length of the uncus lobe from its tip to the shoulder of the falx, then the following three categories can be formulated:

(1) argyrognomon:	H greater than U, F/H smaller than in (2)
(2) scudderi:	H equal to U, F/H smaller than in (3)
(3) melissa:	H smaller than U.

The Palearctic and Nearctic forms of *argyrognomon* are not only absolutely conspecific, but in one or two cases are strikingly alike exteriorly. *Argyrognomon* was presumably derived from a form of which the Central Asiatic *agnata* Staudinger, 1889, is the closest image to-day. *Scudderi* and the Asiatic *cleobis* Bremer, 1861 (?*subsolanus* Eversmann, 1851 [2]) are, except for a more robust build in the *cleobis* organ, practically identical in genitalic structure (and share at least two peculiar underside characters), but either have not been in touch for a longer time or are coincident species *i.e.*, separately evolved from initial *argyrognomon*-like structures (*scudderi* decreasing in the *argyrognomon* H while *cleobis* arrived at the same proportional result by an increase in the *argyrognomon* U). We find these two on parallel lines which after passing through two coincident stages have widely diverged to produce *melissa* on one hand and *ismenias* Meigen, 1830 (Heydemann, 1931; *insularis* Leech, Verity, 1921, *nec* Leech) on the other. This scheme of course is not a phylogenetic tree but merely its shadow on a plane surface, since a sequence in time is not really deducible from a synchronous series. What seems certain, however, is that *scudderi* in its actual structure stands about

[2] Eversmann's type of *subsolanus*, if it still exists, should be examined: his lucid description (grotesquely mistranslated by Rühl and thus copied by Seitz) seems to me to fit quite exactly the species known as *cleobis* Bremer.

midway between *argyrognomon* and *melissa* — somewhat closer perhaps to the former than to the latter.

The *Lycœides* variation in color and pattern as expressed in more or less constant races of each species can only be briefly alluded to here. Its scope in regard to the male upperside does not seem so wide in the American *argyrognomon* and *scudderi* as it is in the palearctic *argyrognomon* and *cleobis*, in both of which the upperside may be, racially, almost or totally devoid of optical scales, thus leaving the richly pigmented fuscous surface intact. In the nearctic groups, both in *argyrognomon* and in *scudderi*, the optical spread transcends at least the subterminal limit so that the insulæ of the secondaries (the silhouetted in fuscous pigment counterparts of the underside præterminal spots), if not circumviated more or less completely by the violet blue, are left sometimes encased in a slightly less compact fuscous which the eye sees as a thick, sometimes crenulated, "black border." The effect of crenulation may be enhanced by the strong development of terminal triangles and cilian markings in both these species as well as in *ismenias*. In *melissa* the blue extends at least to the circumviating stage but more often swamps the insulæ to reach a terminal limit (that last bulwark of tenuous fuscous which is not crossed in any Blue) so that on the upperside the male *melissa* may be said to be (as far as is known) the least variable of the polymorphic Lycæides species.

On the underside, however, all three pass through a gamut of coloration just as wide as in the palearctic forms. Each of them goes racially from the nearest approach to the basic pigmentation of the upper surface, namely from brown or brownish fawn, through fawn, pale fawn and greyish fawn, to greyish and almost pure white. If a combination of characters does not produce in both sexes some striking and constant aspect in a more or less extensive population, and insofar as tangible objects, and not ecological or other causalities, should receive systematic names, it seems to me quite useless to separate a series of, say, pale underside Yakima *melissa* from equally pale Nevada series, or a darkish underside Texas series from a similar one collected in Saskatchewan.

The rhythms in the pigmentation of the spots, in the spread of the underside optical scaling and in the structure of the marginal ornamentation [3] cannot be treated here; but a few words in regard to the disposition of the extradiscal series as I understand it may be of use. What we see as a transverse, more or less sinuous "line" or "row" of spots seems to me to be the outcome of two unrelated phylogenetic phenomena. The "upper" part of the "row" (from the last radial interspace to the last median one) is formed by spots having radiated fanwise from the discoidal owing to an apicoid extension of the wing texture; the "lower" part (spot in Cu_1 and the two Cu_2 spots, separated by the memory of an A_1 nervule) have been pulled out from a subcellular position (in the proximal corners of their respective interspaces) presumably by a cubitoid extension which did not necessarily occur at the same time as the other. Had not a third phenomenon taken place — namely the appearance and expansion of subterminal ornamental markings ("caudæ pavonis") which held the advancing spots at bay — the latter might have gained the practically præterminal position which they reach in some *Glaucopsychinæ*. This is why the classical conception of a row of ocelli as the result of a statically placed line or band having broken up into spots, seems to me absolutely irrelevant to the understanding of the Lycænidæ pattern. Insofar as spots have been evolved in this family, they occupy different positions in different species or genera, and what we see is not the remnants of a definite band in a definite place, but this or that stage of a more or less coordinated longitudinal movement of spots distad along the interspaces (certain comet-tail traces of this progress are sometimes caught and fixed aberrationally). In a word it is not a row of squares on a chessboard, but a shifting line of attacking pawns.

Lycæides argyrognomon Bergsträsser

As represented by my material, the nearctic *argyrognomon* forms, contrary to those of *melissa*, may be for convenience's sake divided into groups A and B ("white underside" and "fawn underside") and each may be subdivided again into 1 and 2 ("weakly marked" and "strongly marked"). A1 to A2 is expressed by *argyrognomon anna* Edwards, 1861 (Proc. Ac.

[3] The latter shows a tendency towards obliteration throughout the Nearctic *Lycæides* — a feature unknown racially (except perhaps in the case of the Corsican *argyrognomon bellieri* Obthr) among western Palæarctic forms and paralleled only by certain Central Asiatic ones.

Nat. Sci. Phil. 1861: 163; Strecker, 1874, Lep.: 88, pl. 10, fig. 4, male, fig. 5., female; Stempffer, 1933, Bull. Soc. Ent. France 102: 111, fig. 2, male genit.).[4]

"Typical" fairly weak *anna* is represented by series from California (seven stations), Nevada and Oregon. A stronger *anna* comes from "Glacier Pt." (it is figured by Wright, 1906, Butt. W. Cst, fig. 384, *anna*), and a form of *anna* with all markings as well developed as in any *Lycæides* is provided by a pair from "Pt. Arena," Mendocino Co. What I suppose is *ricei* Cross (1937, Pan-Pacific Ent. 13:88) is represented by a small, very weak underside *anna* form with a uniformly brown female from Oregon ("Kirk") and by a series without locality data mislabeled "*annetta*." A form from "Yakima R." and another from "Vancouver Isl." may be also placed under *anna*.

The other, B group with fawn or whitish fawn underside, represented by long series, has apparently never been detected before and may eventually require a subspecific name to counterbalance the *anna* group. Of B1 I have a series from Washington ("Brewster"): these specimens, if I am American-minded, look like unusually dingy or dusty underside "*anna*" and if I am European-minded, curiously resemble certain weak Swiss forms. Of B2 I have series from Brit. Col. ("B.C.," "Fernie," "Cranbrook," "Michel," "Landsdowne") and from Alberta ("Calgary," "Didsbury," "Carbon," "Laggan"), darkish "black-border" specimens (see above, discussion of *Lycæides* pattern), with an underside resembling series of *argyrognomon singularis* Heydemann, 1932, and other strong W. European races.

Lycæides argyrognomon, trans. ad **scudderi** Edwards

I have not yet examined Edwards' specimens of *kodiak* Edwards (1870, Trans. Am. Ent. Soc. 3:20). Judging by its O.D. and the colored photographs professing to illustrate it (Wright, 1906, *op. cit.*, fig. 365; Holland, 1930, Butt. Bk. pl. 66, fig. 14, 15), it seems somewhat similar to what I have as "*kodiak*" from Alaska ("McKinley").

In this series a twofold individual variation (on the general basis of a dingy underside tone with faint dull fulvous lunules)

[4] In the case of this form, as in that of the *nom. sp. argyrognomon* and *melissa*, I give only the most pertinent bibliographic data. A fuller synonymy, as well as complete data and acknowledgments in regard to the series of specimens mentioned here, will be given in the main work.

easily allows the eye to sort out the "*argyrognomon*" and the "*scudderi*" specimens. Genitalically they do represent these two species but the twofold variation mentioned is shared by examples of structural *argyrognomon* and structural *scudderi* in such a way as not to correspond to the definite specific differences in the valve and the falx; so that not only are they inseparable by the shuttling external characters, but all the examples look as if they belonged on the whole to one "arctic" race of one and the same species. Here we put our finger on something very like the actual evolution of *scudderi* from *argyrognomon*, and I have discovered an analogical case in the Palearctic, where *cleobis kenteana* Staudinger, 1892, (?*ida* Grum Grshmaïlo, 1891)[5] is linked up with a most interesting (undescribed) "black" form of *argyrognomon* from North-Eastern Asia. Otherwise, throughout their nearctic distribution wherever a *scudderi* form comes from the same locality as an *argyrognomon* one, both series are correctly separable at a glance. On the other hand in the case of forms from widely separate regions, such as the distinctly marked Glacier Pt. form of *argyrognomon anna* and the ridiculously similar talcum white underside *scudderi* from Riding Mts., Manitoba (kindly loaned me by Dr. Gertsch of the Am. Mus. Nat. Hist. and by Don B. Stallings), the two can be distinguished externally only by the wider terminal space in the former.

Lycæides scudderi Edwards

scudderi Edwards.

The types are lost. The name is precariously poised on the brink of synonymity into which it is drawn by the alien *aquilo* female. The type locality is not the vague "Lake Winnipeg" as given by Edwards, but the more Western "mouth of the Saskatchewan" mentioned by Scudder who took the type specimen there in 1860. I find it just possible however to save the name by applying it to the *Lycæides* species the organ of which was figured by Stempffer in 1933 (from a Brit. Col. specimen). Up to now it has been confused by all authors with the Eastern subspecies of *melissa*, Ontario specimens of which Edwards misidentified as his *scudderi* in 1862 (Proc. Acad. Nat. Sci. Philadelphia 1862:225).

[5] I question the accepted identity of *kenteana* Staudinger with Grum Grshmaïlo's *ida* from Amdo.

Most of the Northern specimens are greyish, whitish-grey or white on the underside, but in some cases, when sympathetically examined, or when the whitish bloom has worn off, may be said to fit in with the "dark grey" of Edwards' very poor description.

scudderi scudderi Edw.

Male. Upperside: rather strong terminal line; discernable insulæ in secondaries. Underside: greyish; fuscous spotting delicate but fairly distinct; white arches ray-like in secondaries, i.e. separated throughout by the greyish ground along the vein (a character not represented in my *melissa* material) and fused with the extradiscal halos; fuscous arches on both wings fairly strong, though not distinctly pointed; fulvous arches weak, thin, disconnected from præterminal spots (a character found also in "weak" specimens of *argyrognomon anna* and in some *melissa annetta*) by the ground which is quite whitish towards the termen; præterminal spots in secondaries touched up with ("aquamarine") optical scales conspicuous only in Cu_1 and anally; quite strong terminal line with well-developed triangles and cilian points. [Extradiscal spot in Cu_1 aberrationally distended as it was in Edwards' type specimen.]

Male, neotype, "Saskatchewan. Kennicott." Slide No. 168. Mus. Comp. Zool.

This description holds good for most Northern individuals of *scudderi scudderi* (except that the iridescence may develop in a greater number of spots and that the ground may be quite white throughout with a pale blue dusting of basal optical scaling). Northern females are generally "blue" with, if at all, weakly developed fulvous arches, upperside. My material comes from: Saskatchewan ("Narlan"); Manitoba ("McCreary," "Beulah," "Riding Mts."); Minnesota ("Pequot," "Arrowhead Trail"); Brit. Col. ("B.C.," "Atlin," "Heffley Ck."); Alberta ("Foothills," "Banff," "Jasper"); and Yukon ("White Horse," "Mayo"). If, as I believe, the Yukon insect figured by Gibson (1920, Rep. Can. Arct. Exp. 3, pl. 3, fig. 15, male) is a specimen of *scudderi scudderi*, then it is its first and only representation.

From "Mt. Rainier," Washington, I have a series of remarkable *scudderi* specimens expressing the same variation as *annetta* does for *melissa* and as *ricei* (if correctly identified) does for *argyrognomon anna*. Underside: shiny pale greyish white with conspicuous pale blue basal scaling in secondaries and quite distinct extradiscal spotting in primaries, but with an almost total lack of all other markings so that except for a gleam of aquamarine and a hint of fulvous in the cubital interspaces the secondaries seem quite spotless to the naked eye.

Eastward from Manitoba, presumably through Northern Ontario and Quebec, *scudderi scudderi* intergrades into a Labrador form which differs from the typical mainly in a reduction of size. This is probably the *scudderi* of Möschler (1874, Ent. Zeit. Stettin 35:155–156) which judging by that author's naive but clear description is not the "*scudderi*" of Scudder although of course the latter form may reach much further North than is so far authentically known. Of this small *scudderi* (generally labelled "*aster*" in collections) I have Labrador specimens from "Hopedale" and "Sawbill." Whatever may be the "*aster*" from "Labrador" the armature of which is figured by Chapman (1917, *op. cit.* pl. 15, fig. 45–46), it belongs to *melissa*. The Newfoundland *aster* Edwards, 1882, Can. Ent. 14:194–195 (1898 Holland, *op. cit.*: 266, pl. 30, fig. 40, 46, 47) is presumably the same Little Blue Argus that had been discovered on Carbonear Isl. by Gosse in 1834. Of this I have only two (white, sparsely but distinctly spotted underside) females ("Salmonier") which until I see the types I cannot assign to *scudderi*. Of the Nova Scotian *empetri* Freeman (1938, Can. Ent. 70:62; et 1943, *ibid.*, 75:37), which shows in the underside a striking development of the fuscous spotting upon a greyish-fawn ground, I have as yet only dissected one paratype (Clench Coll.) and in this specimen one important genitalic character seems about to slip out of the *scudderi* specific series.[6]

scudderi lotis Lintner.

(1878, 30th Rep. N. Y. St. Mus. Nat. Hist. 1876:169; *non lotis* Lintn. *auct.*)

Under this name I propose to group various integrading forms of the Southern *scudderi* section. They all disclose on the underside a neater development of the *caudæ pavonis* and, in some cases, an inclination to fawn in the ground color. In

[6] Dr. T. N. Freeman has very kindly provided me now with a number of specimens of *empetri*. Although connected specifically with *scudderi*, it exhibits certain curious (reversional?) characters echoed by the most primitive of the Central Asiatic forms.

other words they approach nearer to the conventional type of the Lycæides, although generally the exiguity of the ornamental band and the *scudderi* character of the white arches give them away. *Lotis* Lintner, which has nothing to do with the "*lotis*" figured by Wright, Barnes-McDunnough, Comstock and Holland (in the case of Wright, 1906, *op. cit.*, fig. 387, it is a male *anna* coupled with the female of a not even congeneric species, and in the case of Holland, 1930, *op. cit.*, pl. 66, fig. 18–20, a fairly typical *melissa*), seems to be known only in two specimens: a female labelled "L. Lota Lintn. 5668 Type" in the Lintner coll., which is an unquestionable *scudderi* female of the more Southern "brown" sort, and a male labelled "4878 Mendocino, California" and "No. 6139 coll. Hy. Edwards Lyc. Lotis Lintn." in the Amer. Mus. Nat. Hist. This unique male, except for showing a trace of fulvous subterminally, in the primaries underside, fits in exactly with Lintner's really admirable description. The data he gives is: "Mendocino, California. Two examples. Coll. of W. H. Edwards." The male type is apparently lost. The Hy. Edwards specimen is the one mentioned (but not figured) by Barnes and McDunnough (1916, *op. cit.*: 169, lin. 12, 13), and having dissected it I found as expected from its appearance, that it was conspecific with *scudderi*.

I have various forms of *scudderi lotis*, from Idaho ("Heyburn Pk"), Montana ("Martina," "Uranus Peak"), Wyoming ("Yellowstone," "Jackson Lake," "Jackson Hole"), Colorado ("Telluride," "San Isabel Forest") and "?N.M." The Jackson and Telluride series have a curious increase in the F suggestive of a slight approach to *melissa* though otherwise typical *scudderi*.

"Black border" (see p. 89) specimens (i.e. similar in this to the Alberta and B. C. *argyrognomon*) are referable to *atrapræ-textus* Field (1939, Journ. Kansas Ent. Soc. 12(4):135). I have such dark specimens from Idaho ("Priest R.") and Montana ("King's Hill"), with intergrades. In the case of *scudderi* the interest of this variation lies in its producing the nearest approach known to a lightish form of the normally very dark *cleobis* Bremer (from Sayan Mts.).[7]

[7] Other Palearctic forms (all from Turkestan) which reveal a *scudderi* armature (but have been assigned to *ismenias*) are: *dschagatai* (? Grum Grsh., 1890) Stempffer, 1931; *ægina* (? Grum Grsh., 1891; *nec* Leech, 1894, *nec* Seitz, 1909, *nec* Oberthur, 1910) Forster, 1936, and *buchara* Forster, 1936 (? *dschagatai* Grum Grsh.).

Lycæides melissa Edwards

Melissa is the commonest and most widely distributed nearctic Lycæides, or more exactly its structure seems to be the most popular achievement in the genus. There is some indication that in some form or other it reaches Labrador in the North-East. For the Palearctic, it has been reported from the Lower Volga (as *sareptensis* Chapman, 1917, *in* Oberthur, *op. cit.*, 14, pl. 12, male genit., *et* 1918, Ent. Rec. 30:2–5) on the basis of specimens collected by Sheldon and Jones (Sheldon, 1914, Ent. 47:273); the authenticity of the locality data has been criticised by Stempffer, 1931, who however was only aware of the brief mention of *sareptensis* in the 1917 paper. A pair of specimens has also been reported from Kamchatka by Forster (1936, Mitt. München. Ent. Ges. 26:81, slide 418, male genit.) and this might seem fairly plausible had not Forster's work been full of the most preposterous blunders.[8]

melissa melissa Edw.

Although different shades of underside coloration can be racially perceived, the intergradation is so complete and geographically so intricate that I do not hesitate to group all such specimens which only differ in the shade of fawn, from brownish fawn through greyish to almost white, under *melissa melissa.* I have series of this from nineteen stations in Colorado, eleven in California, six in Utah, five each in Idaho, Montana and Manitoba, four each in Washington and British Columbia, two each in Nevada and Wyoming, and from single localities in Saskatchewan, Alberta, Oregon, Arizona, Texas and Kansas.

My material shows that at four points of its extensive Western range *melissa* produces four striking local races embossed as it were on its rather monotonous morphological texture. These are:

1. A curious Colorado form from Pitkin Co. and Lake Co. which, owing to the narrowness of the underside ornamental band, bears a false resemblance to *scudderi.* Possibly referred to by Barnes and McDunnough *op. cit.*: 110.

2. A darkish form with discernible insulæ and a peculiar underside: hoary greyish fawn with a generous spread of pale

[8] Such as assigning an alien *Lycæides* organ (Mitt. Münchner Ent. Ges. 26, slide 493) to *Plebejus argus* ssp. *tancrei* Græser (l.c. fig. 27) or confusing *Lycæna anna* Edwards with *Thecla anna* Druce (l.c.:141), etc.

greenish-blue dusting from base in secondaries and very large golden-green præterminal blotches. From Gold Lake and Mammoth Lake, California. Figured by Comstock, 1927 (Butt. Calif., Pl. 53, Fig. 21, *melissa* female).

3. A showy, rather light lilac blue form with a white underside, well developed and sometimes quite separate orange lunules, and a florid female. From several districts in California ("Bouquet Cn," "Owens Lake," "Tehachapi"; also apparently "Arrowhead," "Olancha," "Lebec"). This race is the "*lotis*" of authors (Barnes and McDunnough, 1916, *op. cit.*, pl. 11, fig. 12, male; Comstock, 1927, *op. cit.*, pl. 53, fig. 23, 24, male, 25, female; Stempffer, 1933, Bull. Soc. Ent. France 102:110).

4. *melissa annetta* [Mead in litt.] Edwards, 1882 (Papilio 2:48–49; Holland, 1898, *op. cit.*: 266–267, pl. 32, fig. 13, male, 14, female; et 1930, *ibid.* pl. 66, fig. 16, male). Sparse, weak or obsolescent markings on white ground of underside; pale greyish blue female. In 1943 I travelled to Utah with the express object of obtaining this little known form and found it in fair numbers, though very local, on lupine among firs at 9,000 ft. near Alta in the Wasatch Mts. A full account of its habits will be given later. The male armature is quite similar to that of the typical *melissa* which occurred at about 6,500 ft., some ten miles nearer to Salt Lake City (with intergrades especially in females cropping up among the *annetta* population). In some of the *annetta*, however, there is a slight increase above the *melissa* average in the H of the otherwise typical *melissa* organ, and this, together with a *scudderi lotis* aspect of some of the specimens, tends to diminish the hiatus between *melissa* and the Wyoming form of *scudderi*.

The production of such local forms with more or less fluid edges is characteristic of the other species too, but in one respect *melissa* seems to be unique among its American congeners, and, namely, in that it is completely replaced East of the Mississippi (from at least Southern N. Carolina to at least Ontario) by a remarkably constant form which might serve as an example of how a really good subspecies ought to behave. It is the best known *Lycæides* in America, but lacks a name.

Lycæides melissa subsp. **samuelis** nom. nov.

(*scudderi* Edwards, Scudder, 1889, Butt. N. Engl. 3, pl. 6, fig. 6, male, pl. 34, fig. 29, male genit., *non scudderi* Edw.;

Holland, 1898, Butt. Book, pl. 30, fig. 48, male, fig. 49, female, *et* 1930, *op. cit.* pl. 66, fig. 12, male,[9] *non scudderi* Edwards, *nec* "type"; *melissa* Edwards, Chapman, 1917 *in* Oberthur, *Et. Lep. Comp.* 14, pl. 9, fig. 26, male, genit.; *et* 1918, Ent. Rec. 30:4).

Distinguished from all *melissa* forms by the following combination of characters: ampler (cubitoid) termen, especially noticeable in female. Upperside: optical scaling producing a duller violet effect in both sexes. Fulvous arches in female generally restricted to the secondaries and to the strong interspaces. Underside: colder tone of greyish fawn coloration which produces, in spite of the pronounced halos around the well-pigmented extradiscal spots, a uniform effect (recalling certain palearctic *Plebejus* species), this effect being due both to the broader wing space and to a peculiar reduction of the white arches which form mere rims to the thin fuscous arches (this distinguishes it also from *scudderi*); narrowness of subterminal ornamentation in contrast to spacious disc; spot in Cu_1 generally placed in a more distad advanced position due presumably to cubitoid wing shape, and thus not forming with the discoidal and the $Cu_2+(A_1)$ spots a regularly slanting line as it does in most individuals of other *melissa* forms. Genitalically shows the highest differentiation of the *melissa* male organ from that of *scudderi*, in all specimens measured the fraction H/U being even smaller than is usual for most *melissa* forms (see p. 88).

Male, holotype, labelled "Orig. Pl. 6, fig. 6, Butt. N. Engl. Cab. S. H. Scudder, 306," Mus. Comp. Zool. Slide No. 338. Genitalia measurements: F=0, 57mm., H=0, 35mm., U=0, 44mm. Female, allotype, labelled "Albany N.Y." ex coll. Scudder, Mus. Comp. Zool. Paratypes: 5 males, 1 female, "Albany N.Y."; 1 male, 1 female "Centre N.Y."; and 1 female "Canada, Saunders." [London, Ont.], all these ex coll. Scudder, Mus. Comp. Zool.; 2 males, 1 female "Centre N.Y.," 1 female "Detroit, Mich."; 1 male, 1 female "Pa." and 2 males, 1 female "N.Y. State," all these in Mus. Comp. Zool.; 22 males, 12 females "Albany N.Y." coll. H. K. Clench; 1 male "Albany, N.Y.," 6 males "Sylvania, Ohio" and two pairs "Toronto, Ont."

[9] Dr. W. R. Sweadner of the Carnegie Museum, where this specimen (coll. Edwards) is preserved, obligingly sent me a replica of the locality wiggle. It reads: "N. York."

coll. Don B. Stallings; four pairs "Albany, N.Y.," two pairs "Karner, N.Y., 1 male "Massach ex coll. Angus," and 2 females "Mass. ex coll Hy. Edwards ["from W. H. Edwards" — W. P. Comstock *in litt.*], Am. Mus. Nat. Hist.; one pair each "Sylvania, Ohio," "Ness Lake, Mich." and "Toronto, Ont." coll. T. N. Freeman and one male, two females "Nashua, N. H." coll. W. P. Comstock.

TWO NEW INDIAN EMBIOPTERA AND THE LECTOTYPE OF *OLIGOTOMA BORNEËNSIS* HAGEN[1]

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Embiidæ

Metembia flava Ross, new species

(Figures 1 to 5)

Holotype male (on slide): *Color* — pale yellow throughout, head and thorax somewhat darker, wings light brown, abdominal terminalia with tenth tergite and basal segment of left cercus tan. *Dimensions* — length 7.5 mm.; fore-wing length 3.57 mm., breadth 1.0 mm.

Head (fig. 1) with form as illustrated, very weakly pigmented throughout except the mandibles which have golden-brown apices.

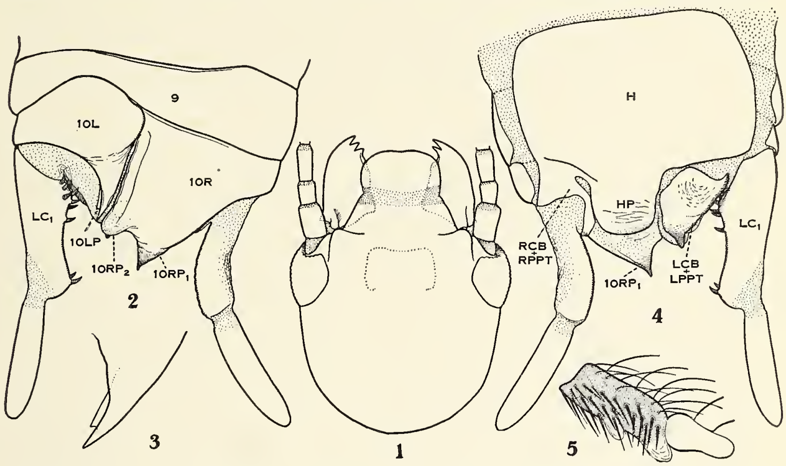
Wings with hyaline stripes very broad, margins ragged. R_1 nearly attaining wing apex, slightly curved toward R_{2+3} and R_4.

Hind basitarsi (fig. 5) with two conspicuous sole-bladders.

Terminalia (figs. 2 to 4) with left tergal process (10 LP) small, short; form as illustrated (fig. 3). Right hemitergite (10 R) with a cone-like caudal projection (10 RP_1) which terminates as a minute sclerotic point; secondary process (10 RP_2) represented as a long, longitudinally folded, submembranous area closely paralleling inner side of 10 L and terminating as a small rounded lobe. Hypandrium (H) scarcely pigmented, outline inconspicuous, quadrate; caudally produced medially as a short, broadly rounded lobe (HP). Composite left cercus-basipodite and left paraproct (LCB + LPPT) with caudal margin somewhat sclerotized, posterior angle with a roughened, pigmented lobe. Composite right paraproct

[1] Published with the aid of a grant from the Museum of Comparative Zoölogy at Harvard College. The material upon which this paper is based is from the Museum. The writer is grateful to Professor Nathan Banks for permission to study these specimens.

(RCB + RPPT) inconspicuous, apparently partially fused to H at base and curving around inner base of right cercus. Basal segment of left cercus (LC_1) sclerotized, especially along inner margin, cylindrical with a broadly expanded basal foramen and a slightly swollen apex; a weakly inflated, inner basal lobe bears seven very stout, curved "teeth"; the terminal lobe bears



Figures 1 to 5, *Metembia flava* n. sp., holotype male: fig. 1, head; fig. 2, terminalia (dorsal); fig. 3, detail of 10 LP; fig. 4, terminalia (ventral); fig. 5, left hind basitarsus.

Explanation of symbols: 9 = 9th tergite; 10 L and 10 R = Left and right hemitergites of tenth segment; 10 LP = left tergal process; 10 RP_1 = major right tergal process; 10 RP_2 = secondary right tergal process; H = hypandrium (9th sternite); HP = hypandrium process; LCB and RCB = left and right cercus-basipodites; RPPT and LPPT = left and right paraprocts; LC_1 = basal segment of left cercus. All drawings are based on Camera Lucida outlines; setæ are omitted; stippling represents membrane; the outline of submentum is dotted.

only two such "teeth." Basal segment of right cercus almost entirely membranous; terminal segments of both cerci normal in shape, but submembranous.

Female: Unknown.

Holotype: Male, on slide, from Nedungadu, Tanjore, South India, May 2 (P. S. Nathan). Deposited in Museum of Comparative Zoölogy.

Paratype: Male, on slide, with type data but collected February 14. Deposited in the writer's collection.

Flava cannot be confused with the other species of *Metembia*

Davis, i.e., *ferox* Davis (1939a, p. 474) and *immsi* Davis (1939a, p. 475). It may be separated from both by its small size, pale color, short left tergal process (10 LP), and the slight lobes of LC_1 with the few stout "teeth" (echinulations). Both *ferox* and *immsi* have very pronounced basal and apical inner lobes on LC_1 bearing numerous echinulations.

The paratype differs from the holotype only in its more swollen caudal lobe of the composite left paraproct and its possession of three "teeth" on the apical lobe of LC_1 instead of two.

Family Oligotomidæ

Oligotoma borneensis Hagen

(Figures 6 to 8)

Oligotoma borneensis Hagen, 1885, Can. Ent., **17**:146 (as "*O. saundersii* Westw.") (Lectotype male: Telang Borneo, M.C.Z.); [1] Krauss, 1911, Zoölogica, **23**:39 (= "*O. saundersii* Westw."); Davis, 1940, Proc. Linn. Soc. N.S.W., **65**:371, figs. 23–37 (establishes identity).[2]

Aposthonia vosseleri Krauss, *Ibid.*, p. 48, pl. II, fig. 14 (Holotype male: Pedang, Sumatra, Stuttgart Mus.); [3] Friederichs, 1934, Arch. Naturg., N.F., 3:409, 410 (*v. vosseleri*), 427 (♀); [4] Davis, *Ibid.*, p. 373 (= *borneënsis* Hagen).

Oligotoma vosseleri (Krauss). Enderlein, 1912, Coll. zool. Selys. Longch., 3:101, fig. 65; Silvestri, 1912, Tijd. voor Ent., **55**:334, fig. 6 (Java).

Aposthonia vosseleri intermedia Friederichs, *Ibid.*, p. 410 (as a form) (Kuala-Lumpur); [5] Davis, *Ibid.*, p. 374 (= *borneënsis* Hagen).

Aposthonia vosseleri obscura Friederichs, *Ibid.*, p. 412; Davis, *Ibid.*, p. 375 (= *borneënsis* Hagen).

Oligotoma jacobsoni Silvestri, 1912, Tijd. voor Ent., 55:334 (Holotype male: Semarang, Java; Silvestri Coll.); [6] Davis, *Ibid.*, p. 373 (= *borneënsis* Hagen).

Aposthonia vosseleri jacobsoni (Silvestri). Friederichs, *Ibid.*, p. 411.[7]

Oligotoma mærens Roepke, 1919, Treubia, **1**:5, figs. (Merbabu, Java); [8] Davis, *Ibid.*, p. 374 (= *borneënsis* Hagen).

Oligotoma nana Roepke, *Ibid.*, p. 20, figs. (Merbabu, Java); Davis, *Ibid.*, p. 374 (= *borneënsis* Hagen).

Aposthonia vosseleri nana (Roepke). Friederichs, *Ibid.*, p. 412.[9]

Oligotoma masi Navás, 1923, Mem. Pont. Accad. Romana Nuovi Lincei, (2) 6:39 (Holotype male: Vigan, Luzon, P. I., Paris Mus.); [10] Navás, 1932, *Ibid.*, 16:923 (Tonkin record); Davis, *Ibid.*; p. 374, fig. 32 (= *borneënsis*, Hagen, *vide.*, reference to *masi* type).

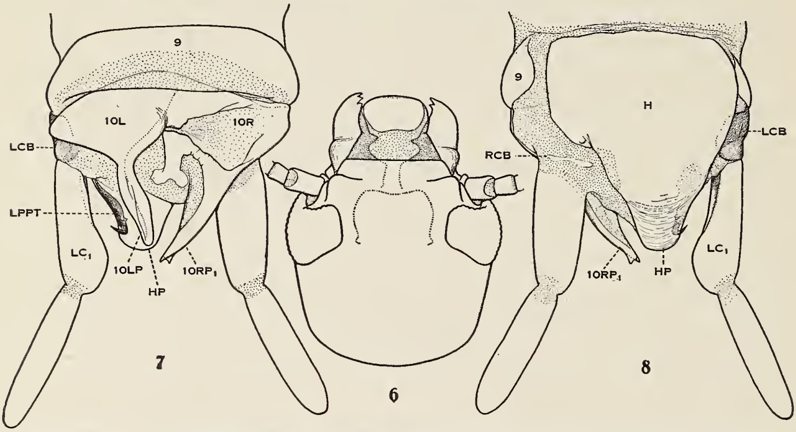
Davis (1940) has regarded as valid the name *borneënsis* which was first used by Hagen (1885, p. 146) but neglected by most later students of the order. Hagen had before him eight specimens of *Oligotoma* from Borneo which, from the wording of his discussion, he had at one time intended to name as a new species "*O. borneensis*," but at the time of writing decided it more prudent to assign to "*saundersii* Westwood." His description intended to apply to the name "*saundersii*" was apparently based solely on these Borneo specimens. It is now clear that this material did indeed represent a new species and not "*saundersii.*" Since Hagen's *borneënsis* was a new name associated with a description it appears that it must be recognized as valid.

Hagen's eight Borneo specimens are today well preserved in the Museum of Comparative Zoölogy, Harvard University. Four of these, in alcohol, from "Telang Borneo, 12.81," labelled in Hagen's hand, "*Olig. Borneense* Hag.," may be regarded as the cotype series. Davis redescribed and figured two uncleared specimens from this series but failed to designate a lectotype. Through the kindness of Dr. Nathan Banks the writer has been permitted to clear and mount two of the cotypes on slides and to designate one as the lectotype. The following brief description and the accompanying figures are based on this specimen.

Lectotype male (on slide): *Color* — head pale golden-brown; basal antennal segment chocolate-brown, flagellar segments light brown at base becoming tan distad; mandibles dark mahogany-brown throughout; submentum dark golden-brown. Pterothorax, legs and wings tan; prothorax and abdomen (except terminalia) paler tan; terminalia varying shades of brown. *Dimensions* — length 10.5 mm., fore-wing length 6 mm., breadth 1.6 mm.

Head and *terminalia* as figured (figs. 6 to 8).

Salient features: Mandibles deeply excised just behind acute medial tooth; basal half massive, with a very pronounced, hirsute, dorsal elevation along outer margin which abruptly arises just within basal half and continues to the articulation point. *Terminalia* with left tergal process (10 LP) elongate, slender, narrowly rounded distad; right process (10 RP_1) with a small but distinct, subterminal outer point; hypandrium process (HP) simple, rounded; left paraproct (LPPT) narrow,



Figures 6 to 8, *Oligotoma borneënsis* Hagen, Lectotype male: fig. 6, head; fig. 7, terminalia (dorsal); fig. 8, terminalia (ventral). Explanation of symbols under figs. 1 to 5.

sclerotic, hooked outward and upward terminally and acutely pointed; left cercus-basipodite (LCB) represented only by a nearly black plate at outer base of left cercus; left cercus with basal segment (LC_1) dilated distad.

Lectotype: male, on slide, from "Telang, Borneo, 12.81," Hagen Collection, deposited in the Museum of Comparative Zoölogy.

Cotypes: three males, one on slide, two in alcohol, same data and disposition.

Additional specimens examined: 1 male, Nan, Siam, I–28 (Alice Mackie) (U.S.N.M.); 1 male, Pattam, Tonkin, IV–12–29, at light (R. E. Wheeler) (M.C.Z.); 3 males, Dwa Bi, and 2 males Ta Han, Hainan, VI–25, VII–5, 20, 25–35 (L. Gressitt) (M.C.Z.).

Recorded distribution [2] (based on males): Borneo — Telang,[1] Lambang Hiang,[1] Duson Timor; [1] Java — Buitenzorg,[2,4,5] Malang,[5,7] Gehassen,[9] Semarang,[6] Merbabu; [8] Suma-

[2] Exponential numbers refer to bibliographic citations on page 104.

TRA — Fort de Kock,[4,7] Padang [3] (? Simalur,[4]) Lasikin,[4] Laut Tawar,[4] Sibigo; [4] CEYLON [3] (misidentification?); KUALA LUMPUR; [5] TONKIN — Pattam; [2] HAINAN — Dwa Bi,[2] Ta Han; [2] CHINA — Canton.[5]

The synonymy treated above follows Davis (1940); the writer feels, however, that some portions require confirmation by examination of types. *Oligotoma mœrens* Roepke, for example, may prove to be related to *ceylonica* Enderlein (cf. shape of head, mandibles, and 10 LP) as a representative or relative of that species has been seen by the writer from Sumatra (Langkat, M.C.Z. Coll.). Particular attention should be given to mandibular structure for recognition of *borneënsis* as the terminalia characters of this series of species may be very similar.

Borneënsis is a well-defined, wide-spread species in South East Asia and the East Indies (perhaps extended to this range by human transport). It is a member of the large group of species which have the left cercus-basipodite incomplete or obsolete, as opposed to the *saundersii* group (*vide infra*) in which this structure is a complete ring with a prominent inner lobe. Within this group it may be placed with those species which have the left paraproct (LPPT) sclerotized and caudally terminated as a small, sharp point which is turned outward, i.e., *varians* Navás (1923) from Kwantung, China, *scottiana* Enderlein (1910) from the Seychelles, and *thoracica* Davis (1940) from Burma. There may be additional species which have this combination of characters, if so it is not evident from available descriptions. *Albertisi* Navás (1930) from New Guinea is probably also a relative but the left paraproct is not produced as a sharp point. A brief key to these species follows:

1. Left tergal process (10 LP) tapered, narrowly rounded, or slightly hooked outward distally 2
   Left tergal process slightly expanded and obliquely truncate distad. Burma . . . . *thoracica* Davis
2. Left tergal process narrow, elongate, narrowly rounded at tip 3
   Left tergal process rather broad, obtusely angulate on inner margin, tip abruptly curved outward at apex (mandibles without dorsal elevations). China. . . . . *varians* Navás
3. Process of hypandrium (HP) with a subobtuse projection near right apical angle. Seychelles . . *scottiana* Enderlein

Process of hypandrium evenly rounded, without such a projection. S. E. Asia and East Indies . . *borneënsis* Hagen

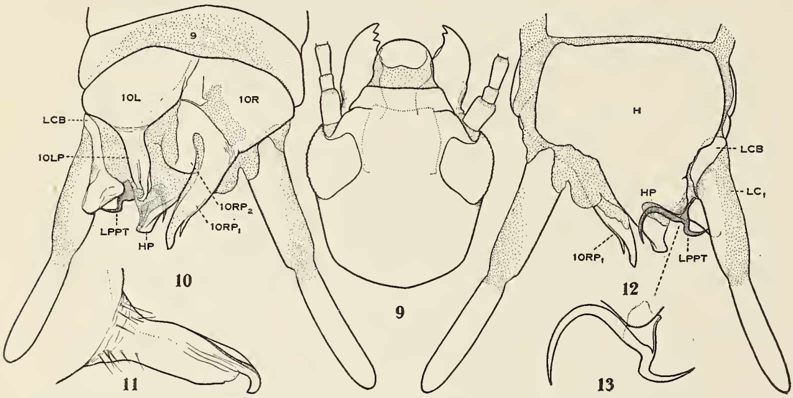
Oligotoma falcis Ross, new species

(Figures 9 to 13)

Holotype male (on slide) *Color* — Head and submentum blackish-brown, mandibles tan with brown inner margins and apices; remainder of body and appendages medium brown except terminalia which is dark brown. *Dimensions* — length 8.5 mm.; fore-wing length 5.2 mm., breadth 1.3 mm.

Head (fig. 9) with form illustrated.

Wings as throughout the genus; with three $C - R_1$ and four



Figures 9 to 13, *Oligotoma falcis* n. sp., holotype male: fig. 9, head; fig. 10, terminalia (dorsal); fig. 11, detail of 10 LP; fig. 12, terminalia (ventral); fig. 13, detail of LPPT (ventral). Explanation of symbols under figs. 1 to 5.

$R_1 - R_{2+3}$ cross-veins in fore-wing; five $C - R_1$ and six $R_1 - R_{2+3}$ cross-veins in hind-wing. Hyaline stripes narrow, sharply defined.

Terminalia (figs. 10 to 13) with left tergal process (10 LP) (fig. 11) rather broad, sides subparallel, abruptly, irregularly convergent distad, especially on left side, terminating as a hook directed to the left. Major right tergal process (10 RP_1) narrow, sclerotic apically, narrowly truncate; with a prominent, subapical, outer spine which is somewhat appressed. Left paraproct (LPPT) (fig. 13) developed as a complex, sclerotic, horizontal spine; inner portion narrow, sickle-shaped, crossing venter of HP; outer portion shorter, abruptly turned (90°)

caudad, thence abruptly turned (90°) laterad, tapered distally. Left cercus-basipodite (LCB) membranous laterad but very strongly pigmented and swollen mesad; the inner margin straight, broadly rounded at each end and at least half as long as basal segment of left cercus (LC_1).

Holotype: Male, on slide, from R. Tunga, at light, 1865 feet elevation, Shimoga, Mysore, South India (P. S. Nathan). Deposited in the Museum of Comparative Zoölogy.

Paratypes: Five topotypic males collected in May and July deposited in the above collection and that of the writer.

One additional male at hand, from Nedungadu, South India, IV–6–(P. S. Nathan), is tentatively assigned to this species. However, if a study of a series reveals that its peculiarities are constant in a definite geographic area, it may be regarded as a subspecies of *falcis*. This male differs from the above series as follows: Much larger in size, head light brown, submentum golden in color, eyes more strongly inflated sides of head more strongly convergent (the head of the type series varies in form in this direction, but the color is constant); spine of LPPT stouter (this spine though constantly narrow in the series, varies considerably in size and curvature, especially the arm directed laterad).

Falcis is a close relative of *saundersii* (Westwood) which has been collected at the same locality, but is very distinct from it in many details, e.g., 10 LP is parallel-sided (sides not curved), 10 RP_1 has the subapical tooth more prominent; LCB is more broadly lobed mesad; the spine of LPPT is much narrower, with its lateral extension greatly developed.

Both species are members of a very natural group of *Oligotoma*, centered in distribution in the Indian Region (aside from the spread of three species by man, i.e., *saundersii*, *nigra*, *humbertiana*), which is characterized by the prominent, ring-like left cercus-basipodite with its mesal lobe, and a sclerotic, spine-like development of the left paraproct. These species may be separated as follows:

Key to Species of *Saundersii* Group of *Oligotoma* (Males)

1. 10 RP_1 with a prominent subapical spine on outer side ... 2
   10 RP_1 without a subapical spine, or when present it is very small and inconspicuous ... 3
2. LCB with inner lobe prolonged caudad along inner side of

left cercus as a narrow process; LPPT without a sickle-shaped spine crossing beneath HP .... *humbertiana* (Saussure)

LCB with a simple, broad inner lobe, without a caudal process; LPPT with a sclerotic, sickle-shaped spine crossing beneath HP .... *falcis* Ross

3. LPPT with a broad sickle-shaped spine extending mesad beneath HP; 10 LP broad, spatulate, simple with curved sides .... *saundersii* (Westwood)

LPPT not as above; 10 LP narrow, acuminate or sinuous with apex complex 4

4. 10 LP narrow, gradually tapered distad, simple; .... *nigra* (Hagen)

10 LP broad in basal half, abruptly tapered distad, apex complex .... *greeniana* Enderlein

There is a possibility that *falcis* is identical to *Embia bramina* Saussure described from Bombay (1896, p. 352) the type of which was incompletely figured by Krauss (1911 pl. I, figs. 6, 6A). Davis (1939, p. 184) regarded this species as a synonym of *saundersii* but noted that this view should be confirmed by an examination of Saussure's poorly known holotype in the Geneva Museum. For the present it seems more advisable to apply a new name to these specimens than to refer them to such a doubtful and poorly described species as *bramina*.

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———, 1930, Insectos del Museo de París V, Apéndice 2°, Insectos neuvos del Museo de Génova, Broteria, Série Zoológica (Lisbon) **26**:20–23, figs. 2–4.

A NEW BEE OF THE GENUS HERIADES FROM PANAMA (HYMENOPTERA, MEGACHILIDÆ)

By Charles D. Michener

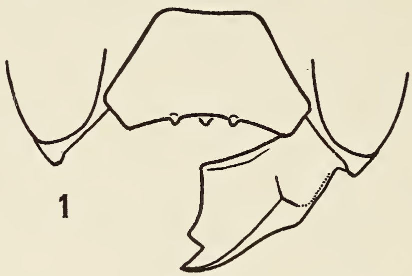
American Museum of Natural History, New York City

The bees of the genus *Heriades* are primarily confined to North America, Eurasia, and Africa. In the western hemisphere the most southern known species has been *Heriades bruneri* Titus from Costa Rica. It is therefore of interest to find in the collection of the American Museum of Natural History a distinct new Panamanian species of this genus.

Heriades (Neotrypetes) currani new species

Female: Length 5½ mm. Pubescence white. Labrum with one basal tubercle; mandible with two longitudinal carinæ, lower one extending from apex nearly to base and somewhat elevated about three-fifths of distance from apex to base, upper extending about half way from apex to base and terminating basally in a low transverse elevation, distance between first and second mandibular teeth about one-half distance between second and third; malar area below and behind produced to an angle; clypeus with apical margin subtruncate, with a pair of small premarginal tubercles separated from one another by less than basal width of clypeus; surface of clypeus evenly convex, punctation of apical portion fine and dense, of basal portion as coarse as that of supraclypeal area; punctation of vertex and mesepisterna slightly finer than that of mesoscutum and mesoscutellum; base of propodeum with the usual transverse row of very large depressions; wings slightly dusky; abdominal terga middorsally with punctures separated by slightly less than their diameters, somewhat coarser on posterior than on anterior segments, terga one to five with apical fasciæ of white pubescence.

Male: Length 5 mm. Similar to female. Shortest distance between eyes slightly more than half length of eye; first flagellar segment nearly twice as broad as long; outer margin of mandible straight basally seen from front; labrum with basal raised area; abdominal terga more closely punctured than in female, abruptly more coarsely punctured on third and following terga than on first two, punctures contiguous on posterior terga; profile of sixth tergum slightly elevated apically; first abdominal sternum with posterior margin rounded, in profile with gentle convexity about two-thirds of its length from base to apex; fifth



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2

Fig. 1, Lower part of face of female *Heriades currani*, one mandible omitted; Fig. 2, Profile of first abdominal sternum of male *Heriades currani*, base at left.

sternum with an acutely pointed median process laterad of which lie the usual rows of long capitate hairs; sixth sternum but little down-curved at apex, subapical hairs rather numerous and long, extending beyond margin of sternum.

Holotype female, Panama, Republic of Panama, February to March, 1915; allotype male, Patilla Point, Canal Zone, Panama, January 15, 1929, collected by Dr. C. H. Curran after whom this species is named. Both specimens are in the collection of The American Museum of Natural History.

In the revision of American *Heriades* (Michener, 1938, Ann. Ent. Soc. Am., 31: 514–531) this species runs clearly to the subgenus *Neotrypetes*. In the key to the species of that subgenus the male runs best to *leavitti* Crawford, a form differing from *currani* by the dark wings, longer first flagellar segment, etc. The female as well as the male seems most closely related to *H. crucifera* Cockerell from New Mexico and Arizona, although because of the proximity of the premarginal tubercles of the clypeus it will not run to that species in the key. It differs further from *crucifera* by the less strongly angular malar area, the somewhat differently arranged carinæ near the bases of the mandibles, etc. From *H. bruneri* Titus, the species geographically closest to *currani*, the latter differs by its coarsely punctate abdomen and white rather than yellow pubescence. Like *H. texana* Michener, and unlike other species, *currani* has an elevation on the ventral mandibular carina of the female, but it is not nearly so conspicuous as in *texana*.

A NOXIOUS SPECIES OF PHLEBOTOMUS IN THE OKEFENOKEE SWAMP, GEORGIA

By O. A. Johannsen

Cornell University, Ithaca, N. Y.

A group of biologists from Cornell University, on a collecting expedition, visited the Okefenokee Swamp in southern Georgia in the summer of 1912, establishing headquarters on Billy's Island. On July first a trip was made to Minnie's Island in one of the remoter parts of the swamp. Here during the night the members of the party were tormented by tiny gnats which the natives called "Merry Wings" because they were "all wings and no body." The following morning one member of the party counted over 75 punctures on his body, another's hands and arms were swollen to abnormal size, the swelling not subsiding for a day or more, and a third seemed to develop a slight fever. No specimens were obtained that night, but after the party had returned to Ithaca some were sent to the department of entomology, by a Mr. Lee, a native of the swamp. The flies, which proved to be a species of *Phlebotomus*, bore the label "Merye winges," a retention of Elizabethan spelling that is quite in accord with the prevailing language of the region. The Lees are such keen observers of natural phenomena and were found so dependable in their statements that there can be no question as to the specimens sent being the same species that proved so troublesome to the party on Minnie's Island. One of the Lees who acted as guide was so hesitant about going to the island that he was suspected of some ulterior motive until he confessed that he dreaded the "merry wings." I am indebted to three members of the expedition, Professors J. C. Bradley, W. D. Funkhouser, and A. H. Wright, for the foregoing statements.

Only two or three defective female specimens in alcohol were sent to us, and of these only one is now available for study, and this lacks vestiture, legs, and part of the antennæ. When first received it was determined as *Phlebotomus vexator* Coq., agreeing in all characters given in the description. Since then I have had an opportunity to compare it with a female specimen of *P. vexator* from Plummer's Island, Maryland, the type locality, and find that the two differ distinctly in wing venation and palpal proportions. I have been informed by Dr. J. Bequært of Harvard University that Dr. Marshall Hertig, who kept and bred P. *vexator* in captivity for several years was not able to make it bite man, although it fed readily on reptiles. At Dr. Bequært's suggestion this note is published, calling attention to the Georgia species which is certainly noxious to man, and with the hope that some entomologist may find opportunity to collect and describe it.

THE APPEARANCE OF *VESPULA SQUAMOSA* DRURY IN MISSOURI

By Phil Rau, Kirkwood, Missouri

Carl D. Duncan [1] regards as *Vespula maculifrons* Buyss. the yellow jacket about which I have published two papers as *Vespa germanica*.[2] Recently Miss Grace A. Sandhouse likewise named specimens submitted to her for examination as *Vespula maculifrons*.

In the spring I have always liked to watch the queens hunting for nesting sites, and for many years the clay bank in my garden, with its many crevices and old wasp and bee burrows, was a favorite hunting area. During the past three years, however, I occasionally saw searching about the clay bank a Vespula queen that differed somewhat in color from what I was accustomed to seeing. Upon submitting a specimen to Miss Sandhouse for identification, I learned that the species is *Vespula squamosa* Drury (= *V. carolina*). This I think is the first record for this wasp in Missouri.

Lewis, in his paper on "Vespinæ of the U. S. and Canada" (Trans. Amer. Ent. Soc. 24:180–181, 1897) gives its habitat under the name *V. carolina* as Pennsylvania, and under the name *V. squamosa* as New York. Turner, in his paper "The Workers of *V. carolina* resemble in Coloration the Males" (Psyche 15:1–3, 1908), records digging up a large nest at Atlanta, Georgia.

How generally *V. squamosa* is established in Missouri is not known, but at Kirkwood I am sure I have seen the queens for at least three years.

[1] A Contribution to the Biology of N. A. Vespine Wasps, Stanford Univ. Press, 1939.

[2] "Behavior Notes on the Yellow Jacket, *V. germanica*" Ent. News, 41:185–190, 1930, and "An Unusual Nest of the Yellow Jacket, *V. germanica*," Bull. Brooklyn Ent. Soc. 26:85–89, 1931.

SUPPLEMENTARY NOTES ON CALISTO (LEPIDOPTERA: SATYRIDÆ)[1]

By Harry K. Clench

Cambridge, Mass.

In a recent number of Psyche I published a paper on *Calisto*[2] in which five new forms (one species and four subspecies) were described. While this paper was in press, too far advanced to be recalled, I received a copy of Dr. C. D. Michener's paper on the same genus.[3] Thus, by an unfortunate coincidence (neither of us was aware of the other's work), a slight confusion has arisen. This confusion is not so serious as it might have been, and is easily corrected. Below are given the forms described by me that are likely to be confused.

Calisto batesi Clench (*op. cit.*, p. 23) is a homonym of *Calisto hysius batesi* Michener (*op. cit.*, p. 3). In place of this name, which is thus no longer valid, I propose **Calisto micheneri**, new name.

Calisto hysius montana Clench (*op. cit.*, p. 24) is unaffected and still stands, being something other than Dr. Michener's subspecies.

Calisto confusa debarriera Clench (*op. cit.*, p. 25) is correctly placed by me under *confusa*, of which it is possibly only an altitudinal modification. Michener (*op. cit.*, p. 5) erred in referring Bates' "Variety B" (1935, Occ. Papers Boston Soc. Nat. Hist. 8, p. 240(239)) to *obscura* Michener, "Variety B" is still to be placed in the synonymy of *debarriera*.

Calisto obscura Michener is an exceedingly interesting discovery, which I must confess I completely overlooked when preparing my paper, although the species is well represented in the collection of the Museum of Comparative Zoölogy. Localities for *obscura* in the M. C. Z. collection (other than those given by Michener) are as follows: Puerto Sosua (Rep. Dom.); Mt. Rouis; Dessalines; Ennery (all Haiti).

[1] Published with the aid of a grant from the Museum of Comparative Zoölogy at Harvard College.

[2] Some New Callisto from Hispaniola and Cuba. Psyche 50, pp. 23–29, March–June 1943. (Issued August, 1943.)

[3] A Review of the genus Calisto, Am. Mus. Novit. No. 1236, June 22, 1943.

Book Review

The Carnivorous Plants, by Francis E. Lloyd. xv + 352 pp., 39 plates. Waltham, Massachusetts, The Chronica Botanica Co.; New York, G. E. Stechert & Co. $6.00.

Although this is primarily a botanical treatise, it deals with a series of peculiarly modified plants that are of great interest to zoölogists and especially to entomologists. Most generally known as insectivorous plants, they have long excited much speculation in the minds of many observers and aroused the interest of numerous professional biologists. Most noteworthy of the previous accounts is, of course, Charles Darwin's "Insectivorous Plants" published in 1875. This treatment reveals the great selectionist as an experimental biologist, a rôle usually overlooked and overshadowed by his contributions in other fields.

Lloyd's book gives a very complete account of all of this literature from the earliest accounts by travelers, botanists and many others before Darwin, as well as the subsequent period during which numerous students have added much information, notably the German botanist Goebel. Formerly a student of Goebel, Lloyd himself has contributed a number of papers, particularly on Utricularia. The historical account includes many controversial matters relating to the anatomy and physiology of the plants, some of which have not even yet been fully clarified. The text is restricted to plants which actually catch or trap living animals (usually insects) and omits the numerous parasitic fungi and bacteria on the basis that they are not carnivorous in the sense of being really predatory. The several plants are dealt with in the order of increasing complexity in the structure of trapping devices, each genus or type forming a separate chapter.

Of the flowering plants, members of six families, numbering 450 species in fifteen genera are referred to. Their distribution is remarkable, two genera are nearly cosmopolitan (Drosera, Utricularia); several are very widespread (Aldrovandra, Nepenthes, Pinguicula), while at least seven are confined to restricted or very small areas, culminating in Dionæa whose range is included in a stretch of hardly 100 miles in the coastal lowlands of North Carolina. Three families and six genera are native to the United States, including the pitcher plants (Sarracenia and Darlingtonia) of the Sarraceniaceæ, the sundew (Drosera) and Venus' fly-trap (Dionæa) of the Droseraceæ, butterwort (Pinguicula) and bladderwort (Utricularia) of the Lentibulariaceæ.

The traps are classified by Lloyd as "pitfalls" represented by the tubular leaves of the pitcher plants; as "lobster pots" in Genlisea; as "bird-lime" or "fly-paper" traps in Drosera, Pinguicula, *et al.*; as "steel trap" in Dionæa and finally as "mouse-trap" in Utricularia. The last is described at great length since Lloyd has found their underwater contraption to be more complicated and still more remarkable than had previously been supposed.

Particularly instructive is a chapter devoted to fungi that catch Protozoa, nematodes, and minute crustaceans by means of snares and feed on them by mycelial outgrowths that pierce their bodies. There is a full discussion of the mechanism involved in the movements shown by the several types of active traps and a critical examination of the mass of evidence relating to digestive secretions, actual digestion of captured prey and utilization of nitrogen. The presence of digestive enzymes has been demonstrated generally in the true carnivorous plants, but their elaboration by the plants themselves rather than by secondarily invading microörganisms is considered in great detail. In many cases no final conclusions have been reached, leaving a number of interesting and not too difficult problems still open to investigation.

The book is very attractively printed, with an extensive, well classified biobliography attached to each chapter, and a good index. The illustrations are grouped into 38 plates, with a great many well executed line figures of anatomical details. There are a few photographs of the plants, but unfortunately they do not possess the same degree of excellence, excepting some very fine frames of motion pictures showing the action of the trap in Utricularia.

Although very clearly written, the text appears somewhat tedious in many places by the meticulous description of anatomical details and a recitation of the statements of many observers whose conclusions have since been controverted and disproven. This failure to emphasize the present status of knowledge renders the text at times difficult to use as a reference book.

Entomologists will find the book indispensable in answering all sorts of questions that arise concerning these remarkable plants and in suggesting fruitful problems that await investigation.

Charles T. Brues

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