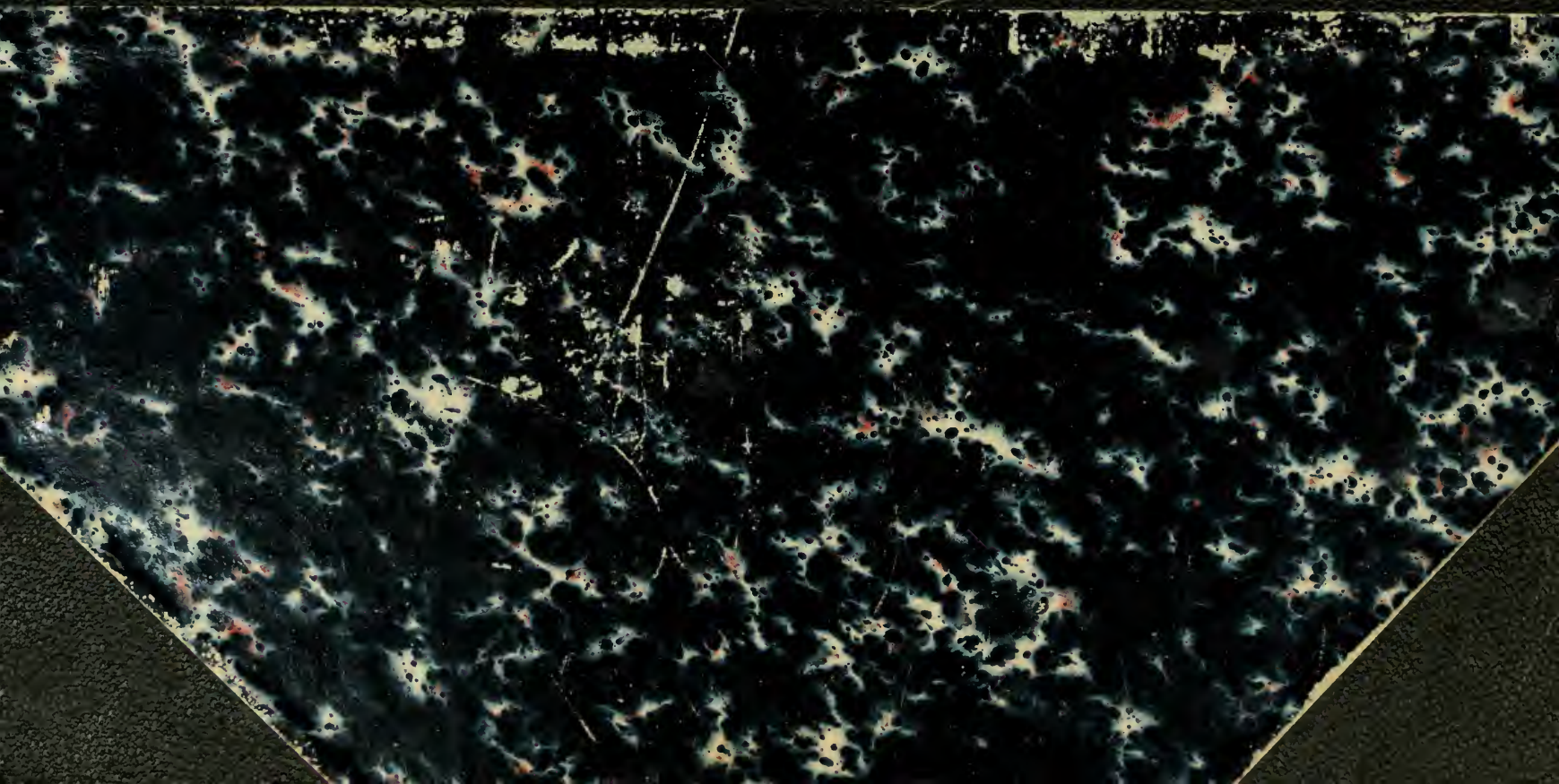

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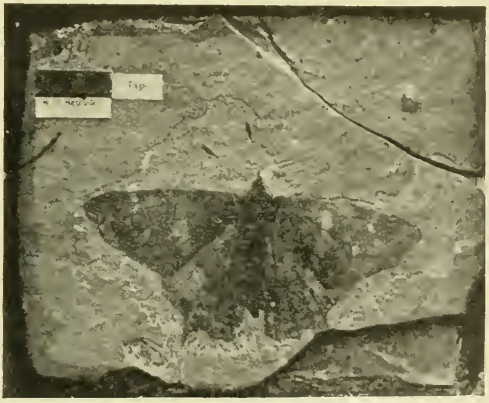

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THE DEVELOPMENT OF ANOPHELES PUNCTIPENNIS SAY.[1]

By Miss Cora A. Smith.

Anopheles punctipennis Say, is a strictly American form of the so-called malaria mosquito. *A. punctipennis* and *A. maculipennis*, as well as *A. crucians*, have been constantly associated as malaria carriers, especially since Dr. Duprée's discovery of the parasites of malaria in the salivary glands of all three. But in the case of *A. punctipennis* there is growing up a reasonable doubt as to whether in the north it is really a malaria carrier, or at least whether the malaria carried by it is not a different form from that conveyed by *A. maculipennis*. In 1903 Dr. J. B. Smith of New Jersey stated that in that state only *A. maculipennis* had been actually demonstrated to be a malaria carrier; and so far as known this has not been proved to be otherwise. In 1903, also, Hirshberg of Johns Hopkins published the account of his noteworthy inoculations of fifty-eight females of *A. punctipennis*. He allowed them to bite patients afflicted with estivo-autumnal malaria, without finding the parasites in the walls of the stomach, or intestine, in the body cavity, or in the salivary glands. In the opinion of the experimenter himself, however, the fact that out of forty-eight similar inoculations of *A. maculipennis* only eight were infected detracts from the certainty of the results with *A. punctipennis*.

Breeding Places. Larvæ, pupæ, and eggs have been taken from seven different pools near Ithaca, at Forest Home, from October to the middle of August. The people living close by do not have malaria, and on the evidence of reliable citizens, have not had it

[1] This study was carried on in the entomological laboratories of Cornell University under the kindly supervision of Dr. J. G. Needham, to whom I am greatly indebted for constant advice and help.

for at least fifteen years. Whereas, down on the flats at the head of Cayuga Lake, and where *A. maculipennis* is common, there is more or less malaria all the time. Forest Home does not produce *A. maculipennis* at all, while *A. punctipennis* is there in comparatively great numbers. This is not unlike the situation at Baltimore where in 1902 Hirshberg and Dohme reported that "*A. punctipennis* breeds in the higher sections, while *A. maculipennis* is to be found in lower localities."

Local Occurrence. On October 21 a great many full-grown larvæ, also many pupæ, were found in pool 1, which is a drinking place for cattle, fed by a spring, and never dry. It was covered with Lemna, although not densely. A few masses of Spirogyra and Cladophora were there. Larvæ of may-flies, dragon-flies and damsel-flies, various beetles, mostly Dytiscidæ and Hyrophilidæ, great quantitites of small crustacea and spring-tails, a great many chironomids of various species, and with some oligochæte worms, a few hydrachnids, and hydras—all these and some other forms, including Culex, were present in the pool. Water-striders and whirligig beetles were very few. The Lemna certainly furnished some food to the larvæ of *A. punctipennis*, for they were often seen to be brushing the leaves, after being brought into the laboratory. The larvæ were found in plentiful numbers, but always in separate groups, as if each had developed from a different laying of eggs.

Pool 2 was of an entirely different character, and about a quarter of a mile away. It was very small, not more than four feet in width at the widest place, and about a foot deep. The bottom was covered with dead leaves, and the water was clear, and there were no visible algæ or other plants in it. It was deeply shaded, and contained just one brood of larvæ, of less than fifty specimens, all of about the same size, and nearly ready to change to the pupa. They were almost black with a white mid-dorsal line. They were the largest larvæ that we have found. None found in the spring were so well developed as these October forms, from which came very large adults.

All the adults developing in autumn are exceedingly hardy. One female emerged from the pupa on November 3, and was left with no food or water. On December 2 it was still alive and eagerly drank water and fed on moistened dates. It lived for three weeks more with access to this food, never having tasted blood, having

spent its whole life in the cage. In the spring and summer they die within three days, under the same treatment of water and food.

A larva of *A. punctipennis* was frozen solid on December 3, was thawed out on December 4, and in an hour was apparently normal.

The full-grown larvæ found in the autumn differed more from one another than those found in the spring and summer, when they are mostly green or brown. In autumn there were many more of the striped and speckled forms. They all developed into *Anopheles punctipennis*, with some differences in size.

Pool 2 did not yield larvæ of *A. punctipennis* in the spring, having dried up completely, and pool 1 was much later in developing them than 3 which was near by—within a hundred feet.

Pool 3 on May 24 yielded larvæ of all sizes. Most of them, however, were ready to pupate. They represented the first laying of the spring. The water of this pool was several feet deep at one end, and clear and cool. No larvæ have been found at this spot, in the shade of an overhanging bank where Spirogyra grows deep, giving its clear green hue from below the surface. A few feet away, in shallow water with Spirogyra protruding from the surface, were plenty of larvæ. With the Spirogyra, and also in fruiting condition, was plenty of Zygnema. In and above these mats of fruiting algæ, many of them feeding down among the filaments, were larvæ of *A. punctipennis*, nostly full grown. And with them in great numbers were several species of Chironomid larvæ, weaving their houses of the delicate threads, and feeding there as well. This pool was visited at intervals, until on June 10 there were scarcely any larvæ, but a few pupæ and plenty of empty pupa cases. On June 17, however, great numbers of very small ones from 1 to 2 mm. and less were to be found again in pools 3 and 1. In 1 they were found only among the Lemna, and in 3 only in mats of Spirogyra and Zygnema. Meanwhile, multitudes of toad tadpoles had developed in pool 3, and along with their growth went the disappearance of the mats of algæ from the surface, and also of *Anopheles punctipennis* from that part of the pool. They were found a month later in almost the same place in great numbers among fruiting Chara, which had spread from the deeper part of the pool. There was protection and food among its filaments.

Pool 4 was a temporary pool beside Fall Creek, about six feet in length and three feet or less in width. It was sheltered by an overhanging stump, but was in the bright sunlight nearly all day. Pools 3 and 1 were sunny also. The only alga in it was Mougeotia which was in vigorous fruiting condition. Embedded within it were many masses of Chironomid eggs, as well as many full-sized Chironomid larvæ within their filmy homes. Many very small larvæ of *A. punctipennis* were at the surface of the water among the delicate filaments. A great many minnows were darting about below the algæ, also small Coleoptera. There were no water-striders or whirligig beetles, or other surface feeders. After two weeks the Mougeotia had sunken to the bottom and the larvæ of *A. punctipennis* had disappeared, excepting a few large ones.

Pool 5 was near 4 but in the deep shade, the larvæ being confined to a mat of Spirogyra. Here the water flowed slowly. Pool 6 was near, but in sunlight all day, and the larvæ were concentrated among the filaments of a mass of Mougeotia, and were to be found nowhere else in the pool. The water flowed quite rapidly by, but the Mougeotia was anchored.

All the larvæ found in the Mougeotia were exceptionally transparent, even in the older stages. Just after molting, they were almost as clear as glass, and were at all times the best ones to study. On the other hand, larvæ found in pool 7, a muddy dark pool in a very shady place, were always very dark and opaque. Here the larvæ were found among the large floating leaves of a Polygonum, and nowhere else in the pool.

Feeding Habits. A number of larvæ of all ages were put in a watch crystal with small masses of Zygnema and Mougeotia, all in fruiting condition. Cladophora was added also. A good deal of surface material was devoured by all the larvæ. The younger ones were more particular in the matter of particles, rejecting a good many. They moved around among the filaments, head bent downward, finding plenty to their liking on the Cladophora, as well as on the others. They merely brushed off the particles from the larger filaments. A larva of only 1.5 mm. was seen to swallow a filament of Zygnema, and to make an effort to swallow large ones of Spirogyra, of which it would merely chew the broken ends. Many small larvæ were seen eating the delicate Mougeotia. When the food is merely surface particles the head is turned a

half circle with mouth parts upward, next to the surface film; but when feeding on a filament, usually the mouth parts are underneath and the head is bent downward. When feeding in this position, the antennæ and maxillary palpi are spread wide apart, bristles and hairs all extended. The large lateral bristles, outside the antennæ are held out like a fan, and the six branched hairs on the top of the head are raised, making a complete hedge above the rotating brushes.

If particles of food are scarce in the surface film, the young larvæ bend and run their brushes over their own bodies as far as possible, the limit of their reach being apparent by the Vorticellæ and diatoms clinging to the anterior parts of some unlucky individuals. Naturally these are not so active in their movements as the others.

In eating the filaments they swing the brushes furiously until a filament is brought within reach. Or they dive in among the filaments, head down and brushes rotating. Sometimes they merely crush out the contents of the cells, at least in the case of large zygospores of Spirogyra, leaving the empty filaments. In that case they grasp the filament anywhere and run it through the mandibles, swallowing only the green parts. The delicate filaments of Zygnema and Mougeotia are swallowed entirely, also slender filaments of Spirogyra. They show considerable preference for the more delicate filaments. Usually they draw the filament into the mouth with the rotating brushes, bite it in two, and then rapidly draw in one broken end. They rarely leave a filament partly consumed, and often go back to the other broken end.

The food of the larva of *A. punctipennis*, is not necessarily entirely of an herbivorous nature. Once I saw two young water fleas (*Simocephalus*) almost dragged into the abyss. They struggled valiantly and escaped by setting up counter currents with their feet. The three currents could be seen close to one another. One went too near and lost an antenna which was broken and swept in by the brushes. It drew back but was temporarily incapacitated and unable at once to leave the vicinity. Finally, it escaped. A little *Chydorus* all but lost its life, being drawn in by the brushes, but escaped.

Fatalities. Dr. J. B. Smith in his report on the Mosquitoes of New Jersey (1904) gave a detailed account of the enemies of mosquitoes. He remarked that the larva actually faces greater dan-

gers than does the adult. He placed as enemies, first weather conditions; then diseases, of which we know little. We have seen several conditions which relate to this subject, however.

Four young larvæ that had passed their second molting were every one of them afflicted with a protruding intestine, which extended out from the body for fully half the length of the larva. This condition lasted for more than a day after they were taken from the pool. A scarcity of food,—for they were kept in clear water for twenty-four hours—evidently cured them. They were normal on the second day after.

Spirogyra furnishes food for the growing larva, but it also shelters enemies. It is the favorite habitat of several species of chironomids, and in just so far is it a check to mosquito development. The chironomid larvæ build their tubes of the algæ filaments, and seemingly of other things too.

In six different instances we have had evidence that some chironomid larvæ destroy the larva of Anopheles punctipennis, and feed upon its tissues, as well as using portions of its body to fill in the crevices of their houses. In all the cases, the Anopheles was in the quiescent state just preceding or following the molting process. In one case the chironomid built its tube close up beside the body of the dead *A. punctipennis*, and gradually transferred the tissues into the walls of its home. In another case a chironomid was seen to swallow a part of the dark mass of the dead mosquito larva, and the digestion in the chironomid was watched through the transparent organs. A healthy larva of *A. punctipennis* was supposedly alone in a dish of water with algæ for food. It was left over night. In the morning its head was torn from its body and was floating at a distance. The only living animal in the dish was a chironomid larva.

Development. Careful observations on the swarming of *Anopheles punctipennis* have been reported by Knab (1907). The males were seen to swarm a little before 5 o'clock of a sunny afternoon in October. They came from different directions to form the swarm which contained less than a hundred mosquitoes. They circled about above a projecting mass of foliage. Mating of a number of individuals occurred, and by 5.30 o'clock the swarm began to diminsh.

In the opinion of Kulagin (1907), based upon at least six years

of observation of Anopheles in Russia, mating occurs in the autumn except in a few isolated cases, where it occurs after hibernation. The hibernating females deposit the eggs during the whole of the next spring and summer, and the September and October larvæ result from the isolated cases. Accordingly, he is of the opinion that there is but one generation in a season, the newly developed forms not depositing eggs until after hibernation. There has been insufficient study of this subject.

The eggs are laid singly and a number of times by each individual during a single breeding season. Dr. Duprée found that specimens of *A. punctipennis*, which were kept in the laboratory and supplied with blood, would lay at six or seven different periods, with a total number of more than 2,000 eggs. As many as nine layings were noted in one case. The eggs, from 100 to 300 at a time, are deposited separately, or sometimes in clusters of just a few. They are apt to float below the surface, although some of them are on the surface. Stirring the water will bring a good many eggs to the surface, from which they soon disappear again. They seem not to possess so perfect a means of keeping afloat as is recorded of the eggs of *Anopheles maculipennis*, which has the light clasping membrane about the whole rim of the egg. In *A. punctipennis* this clasping membrane is restricted to the sides. It is very delicate, apparently, for in several instances it was badly broken, or had perhaps been eaten away. A young crustacean was seen to devour the clasping membrane from one side of an egg.

The egg (fig. 1) is .55 mm. in length, mottled in appearance, and dark brown in color with blotches of silvery white. At the end are scattered light and dark spots, the former of which have been called "knobs" and which are arranged in a more or less regular pattern. Sometimes the eggs lose nearly all their dark color, and float. They float with the concave surface underneath. The larva breaks through the convex surface at the larger end, leaving a little fragment of the shell cut out on three sides, and bending over like a little canopy at one end of a little boat.

First Stage of the Larva (fig. 2). At first the young larva spends periods of time quietly. Suddenly it will start a strong current of water by means of the rotary brushes, which are large in proportion to the remainder of the body. These are fully developed

from the first. With these it sweeps in any small particles in the surface film. It takes but a short time to exhaust the immediate supply, and so the larva moves from place to place. Frequently it bends and brushes over its whole body as far as it can reach, removing anything like vorticellæ or diatoms. Sometimes these develop too rapidly and it is not at all uncommon to find larvæ less than three days old, thickly fringed with these sessile forms. Of course, such as attach themselves to the head and anterior part of the thorax remain there, being out of range of the jaws.

If food particles are scarce, the larva will brush over any algæ or other plants that may be at the surface. One very small larva was seen to remain down below the surface film for about half a minute in search of food. One of these very young ones was seen to eat a short filament of fine Spirogyra, when the larva was less than two days old. It refused a row of diatoms. It started back from an on-coming rotifer immediately in front of it. The same rotifer ran into and over the long anterior bristles from the thorax and the young larva gave no response. But when it happened again from the front, the larva darted away. The most conspicuous movement of an Anopheles larva of any age is its turning of the head through an angle of 180 degrees, when feeding. The young larva does this with energy whenever feeding on surface particles. It turns the head always in the same direction—counter-clock-wise, as was determined by the periodical disappearance of a Vorticella which was attached to the side of the head. This always moved downward and out of sight before appearing at the other side.

The young larva measures from .7 mm. to .8 mm. in length, not including the hairs at either end of the body. The second and third segments of the thorax have not yet united and the head is very prominent. The dorsal surface is dark brown in color, except where there are conspicuous yellow spots, which are caused by the œnocytes within. On the segments of the thorax and on five of the segments of the abdomen these yellow spots are very noticeable, especially on the third segment of the abdomen. The head is colored an even gray, with a dark spot in the center, and one small spot on each side. The single eyes and "collar" are reddish in color and remain so during the first day. The branched

hairs from the sides of the head, outside the antennæ, are relatively longer than in any succeeding stage. The six bristles across the dorsal surface of the head (a) are unbranched, as are the two hairs which lie between the brushes and the central terminal hairs, which remain unbranched throughout the larval life.

The most conspicuous structures of the head of the young larva are the long simple hairs on the top, and the long lateral hairs at the side of the head, which with hairs of the antennæ form a barricade. Four simple hairs and the absence of a rudder-like tuft on the ninth segment (a) of the abdomen, are characteristic of the first stage.

When about two days old the larva will have changed considerably in appearance. It will measure by this time about 1.5 mm. in length. The thorax will have become distinctly formed and the long hairs will appear somewhat shorter. The head will have quite a different shape from that of the larva of one day. It will have become very dark, especially the "collar" which will be almost black. The head is much narrower and deeper. The integument has a snug, tight-fitting look (fig. 3). This figure shows a larva in the act of molting for the first time. In this case it died in the process, the integument of the thorax having failed to split apart.

For some time previous to each of the molting processes in the larval life, the head shows this peculiar narrowing, with the increased width and deepening color of the "collar." The larva measures just the same after the molting process as before it. In this case it was 1.5 mm.

Second Stage of the Larva. The changes at the time of the first molting are conspicuous. Although the thorax is distinct and large, the head is even larger (fig. 4). The four dorsal hairs of the posterior end have become eight (a), and the ventral tuft (b) has appeared, consisting of two rows of long branched hairs with a fan-like arrangement. On the head the simple hair just inside of each rotary brush (d) has become much branched, and is used for combing out the brush. The six simple hairs lying back of the brushes, on the top of the head, have become very much branched. The eyes are still little developed.

The yellow spots on the dorsal surface have increased in number and density, being most conspicuous on the third, fifth, and eighth segments of the abdomen, and on the thorax.

Within the thorax a clear specimen shows a number of parts: the anterior lobes of the heart with a large valve, the contractions of which synchronize with the throbbing between the tracheæ of the abdomen; the beginning of the arch of the tracheæ, surrounding the food tube, and from which branches are later given to the organs of the thorax; the three pairs of imaginal buds.

Within a few hours after the first molt, one larva was eating vigorously of fine filaments of algæ, and preferably of surface particles. It swallowed the filaments from the end, just as does the full-grown larva.

By the time the larva is six days old, it begins to show signs of the approaching second molt, which occurs from the seventh to ninth day. As before, the head becomes narrow and the "collar" dark and broad. One measured 2.2. mm. at this time, making a growth of .7 mm. in about two days.

Third Stage of the Larva (fig. 5). The most important changes which are evident after the second molt are: the rapid increase in the size of the thorax accompanied by the enlarged internal organs; the appearance of the ommatidia of the adult eye, around the larval eye; the disappearance of two pairs of the long hairs and the general shortening of all the thoracic hairs; the darkening of the integument of the head, which shows an unexpected pattern in the maculation. Eight specimens examined at this age showed almost exactly the same arrangement of pigment on the head. It may not be constant, but it is certainly more so than that of any other stage.

Respiratory Siphons (figs. 17, 18, 19). At this time it is possible to see, along with the rapid growth of the wing buds, the formation of the pupal respiratory siphons in the prothorax. From the time of the first molt, a pair of straight tubes in each side of the thorax has been evident. Now they have become more conspicuous. They seem to change their position, sometimes being close up to the anterior wall of the thorax, and sometimes they lie with the end quite away from the wall. Developing near by, at an angle with the first tube, and penetrating also through the wall, is another structure, tube-like at first, but after a time changed to form a part of the now plainly visible respiratory siphon. The siphons, also, are frequently drawn away from the integument, at other times being pushed up close to it.

Fourth Stage of the Larva. By the twelfth or thirteenth day the larva has increased in length to 4–5 mm., and it then shows the signs of an approaching molt, the darkening of the head and collar and the widening of the latter. Molting is getting to be a critical process and a great many lose their lives in the act. They are conspicuously large and cannot protect themselves meanwhile. Sometimes the integument of the head does not separate off easily. One was seen in which the head had not molted for more than twelve hours after the rest of the integument had been shed. For a day or more before the third molt, the changes about to occur are evident. They consist of the appearance of the palmate, or stellar hairs, which are of use in clinging to the surface film (fig. 7). The body needs more support in its horizontal position. The palmate hairs (ph) appear on the third, fourth, fifth, sixth, and seventh segments of the abdomen, and may be seen projecting out from the segments for more than a day before the molting. They appear quite suddenly. At the same time the reddish adult eyes have become very conspicuous and are seen to be increasing in the number of ommatidia.

After the molt, the maculation of the head appears to be different from that just after the previous molt. The pattern of the spots is the same, but the increased amount of pigment in the surrounding integument prevents the spots from showing clearly. The buds within the thorax have become very prominent by this time and in addition to the respiratory siphons and the wings, we may see the projecting buds of the legs beneath, and of the halteres. In the head, which remains especially clear for several hours after each molt, we may see now the forming buds of the antennæ (fig. 20), the main portion of the brain with nerves branching to the eyes, to the antennæ, and to the digestive tube. Numerous muscles to the mouth parts, with their relations to the muscular lining of the integument, may be seen at this time also, as long as the integument remains transparent. Now, too, the clear, dark spots between the abdominal segments first become visible (fig. 7,).

From about the fifteenth day to the twenty-second, growth is rapid, if plenty of food is available. The record of one larva in the laboratory was as follows:

July 2—first molt (about 3 days old).
" 13—third molt (second not seen).
" 21—transformed to pupa.
" 23—adult female.

This makes the complete cycle occupy about twenty-four days, in midsummer in Ithaca. This specimen was taken from a spring-fed pool, was transferred to the laboratory and raised in a procelain dish in the water of the Cornell campus reservoir. Its food was Spirogyra, Zygnema, and Mougeotia, with Cladophora for browsing and to furnish surface particles. The adult which emerged was no smaller than many that have come from pupæ taken at the same pool. The only special care given was to prevent the afternoon sun from shining upon it, and to add fresh water frequently.

Some of the Records of Developing Larvæ.

A. July 26—hatched .825 mm. long.
27—10.30 A. M. 1. mm.
27—3 P. M. No change, head broad.
28—10.30 A. M. Collar wider, head dark, 1.55, mm.
29—11.30 A. M. 1.55 mm., collar still larger, 3 days old, not molted. (Died.)

B. July 26—hatched .825 mm. 4 hrs. old when measured.
27—head large 1.05 mm. 18 hrs. old, 10.30 A. M.
27—head large 1.17 mm. (About) 24 hrs. old, 2.45 P. M.
28—head narrower, collar wide, thorax more distinct 10.30 A. M.
" 29— 1.5 mm., 3d day 10.30 A. M.
" 30— 1.5 mm., 4th day *molted.* (Died.) 10.30 A. M.

C. July 25—had molted once 1.5 mm. 9 A. M.
29—*second molt*, about $4\frac{1}{2}$ days between 1st and 2d molt.
30—no palmate hairs, single eye spots, no antennal buds.
31—large eye beginning to show, 10 days.

Aug. 1—palmate hairs not started, respiratory siphon well developed 1 P. M.
1—palmate hairs not visible yet, 10 P. M.
3—palmate hairs visible, eyes distinctly double, collar wider, head narrower.
6—molted for the *3d time*, 15 days, 2 P. M.
D. July 23—1.6 mm., had molted once, about 4 days old.
30—4.5 mm., stellar hairs have appeared, 11–12 days.
31—4.6 mm., 13th day (Appr.) 8 P. M. Just molted for *3d time;* eyes double, palmate hairs; transparent areas of abdomen for first time.

Full-grown Larva (fig. 7). There is a period of about nine days between the third molting and the transformation to the pupa, during which there are few changes in appearance. The head usually grows darker, although in many specimens it never becomes really dark. The adult eyes show greater development of the ommatidia and the coming rounded eyes of the adult are being revealed. The "collar" becomes wider with age, and the thorax assumes a decidedly round appearance. Often the whole body is green, or an even brown, or with a white stripe, or spotted along the mid-dorsal line. These differences in color do not appear in the younger forms. Dr. Howard proved that in the case of *A. maculipennis* young larvæ fed on algæ will turn green.

The conspicuous structures of this last stage of the larva are the five pairs of palmate hairs of the abdomen, the transparent areas between the abdominal segments, and the little two-lobed projections of the prothorax, which are indications of the developing respiratory siphons of the pupa.

When not in use, the palmate hairs are folded against the body. They have been clearly described by Nuttall and Shipley (1900) for *A. maculipennis*. Like all the other forms of hairs of the larva's body, they are wonderfully fitted to their work of holding to the underside of the surface film. They are not found on the first and second segments of the abdomen. On about the last day before the change to the pupa, there suddenly appears on the first segment of the abdomen a large tuft of branched hairs, a certain indication of approaching pupation (fig. 7).

The transparent areas of the segments of the abdomen are like

windows into the interior. Here we may see the rhythmic pulsations of the long heart.

Notched Processes of the Thorax. On the prothorax are two notched projections just over the respiratory siphons. In one specimen, on the second day after the third molting, an opening was plainly visible at the base of both the first and the second hairs on each side of the thorax (fig. 19). The delicate two-lobed structure had developed between the hairs and the openings. After a time the two hairs fell off, the inner one falling several hours earlier than the outer. This left the third hair, which is branched, with the two delicate processes and the openings close to them. Each opening is rimmed with several little ridges placed parallel to the hairs. The transparent lobes would seem to protect the openings. Within, each leads into one of the two tubes before described, and which must lead into the tracheal system, although their connection with the tracheæ is not evident from the outside. The openings are situated just where the thorax is applied to the surface film, and are related to the respiratory siphons of the papa.

The Change to the Pupa. After the tuft of branched hairs has appeared on the first segment of the abdomen, we may look for the change to the pupa before many hours. The thorax will soon show a series of transparent spots, suggesting the areas in the abdominal segments, and due, doubtless, to the segmented structure of the thorax. The throbbing heart becomes plainly visible along the mid-dorsal line. The following record of the time was kept as one specimen changed: (8.30 P. M.) The larva was perfectly quiet for a long time, with the antennæ and hairs of the head drawn up close. The body expands frequently and the head is drawn in somewhat. The hairs on the thorax lie limp, pointing downward. The sides of the metathorax become somewhat sunken, as if parts beneath had changed position, (9.40 P. M.) Tiny dots on the rims of the respiratory siphons show through the transparent integument. (These may be identified later on the edges of the siphons of the pupa.) There is a rowing motion of the hairs of the whole body, and a regular pushing with the posterior end against the sides of the watch glass. In the abdomen, fine ridges or wrinkles appear across the segments, between the palmate hairs. (10.15 P. M.) The segments of the abdomen begin

to draw up, with a strong pulling away from the posterior end. (10.20 P. M.) The integument of the anterior end splits all at once, very quickly, and the two siphons are drawn out instantly, the rest of the body being drawn out with a sudden twist. (10.22) It has shaken off the skin and lies quietly expanding once more. The actual change has taken place in a little less than two minutes. After ten minutes, with a final jerk, it is a fully developed pupa, darting here and there.

The Pupa. The color of the pupa is similar to that of the larva, showing either the stripe or the blotch of white, or else being green or brown. They all turn quite dark before emerging. The pupal period is about two days.

One specimen which had changed to the pupa at 7.30 P. M. on July 1, at 5 P. M. on July 3 had emerged as the adult. The thermometer was above 90 degrees during both days. By the beginning of the second day the pupa showed evidence of the coming change.

At the anterior end of the pupa three parallel grooves appeared, the central one of which lengthened as the hours passed. Two dark spots suddenly appeared near the anterior end. Across the thorax between the respiratory siphons came a transparent place in the integument, in the center of which the heart was seen. Above the heart is a mass of striations arranged in a V-shaped structure. Each of the striations shows a dark rounded base or origin, and when compared with the thorax of the adult is plainly a hair. They appear at the beginning of the second day, and grow more distinct.

The Emergence of the Adult. After the changes mentioned above, the whole pupa becomes very dark in color, and remains very quiet, except for frequent quiverings. The heart beats more rapidly than hitherto, as may be seen through the transparent integument. Suddenly the abdomen becomes straight and the body erect. Through the skin the stigmata within the thorax may be seen in pulsation close to the wings. Before we are aware of any break in the pupa case, the head and mouth parts are completely out. They remain bent downward for considerable time, the wings, abdomen and legs being gradually drawn out. The wings come first and are kept flat and folded over one another, the spots being clearly visible from the first, although the whole wing

is pale in color. The abdomen, greenish in color and very flexible, begins to move backward and forward with a pushing motion. Here seems to be the center of all the motion. Finally the abdomen is completely extricated and pushed backward, outside the case. Now comes the most critical part of the process. The two fore legs are drawn out together, being kept parallel with one another. Similarly the second and third legs of each side are kept parallel. The second pair separate from the third pair, and are removed from the cases at exactly the same instant. Then the first and second pairs are spread out firmly on the water, or other support if possible, and all the effort is concentrated on the removal of the third pair which are much longer than the others. Unless an accident occurs, they will be pulled out together and placed firmly out backwards. Then the insect will rest quietly during the hardening of all the parts. The antennæ of a male mosquito were kept folded tightly for several hours after emergence. During all the process the pupa case rested up against the side of the watch glass. In one instance we moved the pupa case away from the glass as the process was going on, which apparently caused failure in extricating the hind legs, and death of the mosquito. Within the cast-off pupa case may be seen, at first, a large air bubble which is of service in balancing the emerging insect. (Nuttall and Shipley, 1907.)

The colors of the parts of the insect as it was emerging under electric light were remarkable, the eyes being a deep iridescent green, the legs dark green, the abdomen light green with gray edges, and the yellowish spots of the wings becoming more and more distinct. Within ten minutes from the beginning of the process of emergence, our mosquito had spread its wings.

DIFFERENTIAL CHARACTERS APPEARING DURING DEVELOPMENT.

	Growth (average).	Change.	Period.	Characteristics.
Egg	.55–.57 mm.	2d–3d day (hatching)	2–3 days	Irregular spots; clasping membrane on sides only.
Larva				
1st Stage	.8–1.5 mm.	4th day (molt)	3–4 days	Metathorax free at first; 6 simple hairs on head; 2 simple hairs inside brushes; rudder hairs absent; eyes single.
2d Stage	1.5–2.2 mm.	8th day (molt)	4–5 days	6 branched hairs on top of head; 2 branched hairs inside brushes; rudder hairs present; eyes single.
3d Stage	2.2–4.5 mm.	14th day (molt)	6–7 days	Head smaller than thorax; head dark with pigment; eyes double; respiratory siphons forming.
4th Stage	4.5–8.5 mm.	22d day (to pupa)	8–9 days	Palmate hairs on abdomen; transparent areas on abdomen; notched processes on thorax; dorsal tuft on abdomen. (Late in forming.)
Pupa		24th day (to adult)	2–3 days	

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EXPLANATION OF FIGURES.

Fig. 1. Eggs of *Anopheles punctipennis*. Actual measurement .55 mm.; (a) clasping membrane, (b) "knob."

Fig. 2. Larva just out of the egg. Actual measurement .825 mm.; (a) hair that is branched later, (b) lateral hair.

Fig. 3. Larva during the first molt, age 3–4 days.

Fig. 4. Larva just after the first molt. Actual measurement 1.5 mm.; (a), (b), (c), (d) branched hairs.

Fig. 5. Larva just after the second molt, age 8–10 days. Actual measurement 2.2 mm.

Fig. 6. Larva just after the third molt, age 13–15 days. Actual measurement 4.5 mm.

Fig. 7. Larva just before the change to the pupa, age 21–23 days. Actual measurement 8.5 mm.; (rs) respiratory siphon, (dt) dorsal tuft, (ta) transparent area, (ph) palmate hair.

Fig. 8. Dorsal view of head and larva; (a) antenna, (p) maxillary palp, (b) brush, (bh) branched hair, (ae) adult eye, ('e) larval eye, (lh) lateral hair.

Fig. 9. Ventral view of head of full-grown larva; (b) brush, (c) teeth of mandible, (m) maxilla, (p) maxillary palp, (a) antenna, (l) lateral hair, (t) mentum, (x) chitinous structures within the mouth.

Figs. 10, 11, and 12. Maculation of the head of the larva; (10) just before the third molt; (11) just after the third molt; (12) just before the change to the pupa. (Sometimes there is more pigment; often less.)

Fig. 13. Dorsal view of pupa on the second day; (d) dorsal tuft, (h) outline of one of the halteres, (r) dorsal hairs of adult, showing through the pupa case.

Fig. 14. Side view of pupa.

Fig. 15. The ninth segment of the abdomen from the side.

Fig. 16. Stigmata of eighth segment of the abdomen of a full-grown larva; (st) stigma, (p) plate which folds over the stigmata when the larva is below surface film.

Fig. 17. Showing buds of wings and of respiratory siphons in the thorax of the larva just after the first molt; (tr) trachea, (rs) bud of respiratory siphon, (wb) wing bud, (y) movable tube.

Fig. 18. Respiratory siphon just after the second molt; (y) movable tube, (t) tube, (rs) respiratory siphon, (tr) trachea, (o) opening.

Fig. 19. Respiratory siphon (rs) of larva just before the change to the pupa, (o) openings.

Fig. 20. Some of the organs of the head as seen just after the third molt; (ab) bud of antenna, (ph) pharynx, (br) brain with nerves to eye, antenna and pharynx, (m) muscles to mouth parts.

SOME NEW AND INTERESTING SPECIES OF SAPROMYZA.

By Charles W. Johnson.
Boston Society of Natural History, Boston, Mass.

The recent synopsis of the Sapromyzidæ by Prof. A. L. Melander (Psyche, vol. XX, pp. 57–88, 1913), induced me to go over some material that had accumulated for several years. The results were something of a surprise. The series represented by the following species is what one would expect to find if he had only the two extremes, but the fact that practically all of the intermediate species really exist is doubly interesting.

Two of the species suggest the remarkable posterior tarsi of Platypeza (*Calotarsa*), thus presenting an interesting case of parallelism.

It is also interesting to note the wide distribution of some species and the apparently restricted distribution of others. Their similarity in size and color is probably one of the causes why these new species have been overlooked so long, and more careful collecting will undoubtedly show that these are more widely distributed than here indicated.

Sapromyza ornatipes sp. nov. Pl. 3, figs. 1, 2, 3.

Male: Face, front and antennæ yellow, the front slightly darker than the face, arista black, base yellow, pubescence short. Thorax yellow, slightly pruinose, hairs black, with three dorso-centrals, scutellum yellow with four large marginal bristles. Abdomen dark yellow. Halteres and legs light yellow, posterior tarsi whitish, metatarsi with a row of short black bristles along the outer side and two long, curved, black subapical bristles slightly broader and flattened at the ends, the two following joints as broad as they are long, black, base white, thickly covered with black hairs and with two long curved bristles on each, similar to those on the metatarsi, the remaining joints brownish at the tips, with small black bristles and hairs. Wings hyaline, clouded with brown, the latter starting near the junction of the second and third veins and extending to a little beyond the anterior cross vein and along the costa from near the end of the first to the end of the fourth vein, with a partial interruption just beyond the end of the second vein, a band also extending across the wing covering the posterior cross vein. Length 3.5 mm.

Female similar to the male except that the posterior tarsi are not differentiated, although the second and third joints are black.

Six specimens. Holotype and allotype, Mt. Everett, Mass., June 27, and paratypes, Mt. Everett and BashBish Falls, Berkshire Co., Mass., June 28, 1912 (C. W. Johnson and J. A. Cushman), in the collection of the Boston Society of Natural History.

Sapromyza melanderi sp. nov. Pl. 3, figs. 4, 5, 6.

Male: Front and antennæ bright yellow, the face and occiput light yellow, arista pubescent, black, base yellow. Thorax dark yellow, with three dorso-centrals, scutellum yellow with four marginal bristles. Abdomen dark yellow. Halteres and legs light yellow, posterior tarsi whitish, tip of the metatarsus black and broadened, the following joint as broad as it is long, black with the basal third-white, the next joint only slightly broadened apically and these joints are each armed with two longer, curved black bristles as in *S. ornatipes,* but less flattened at the ends. Wings hyaline with the cloudings less distinct than in the preceding species, the costal clouded area being often obsolete beyond both the anterior cross-vein and the end of the second vein, and the band extending to the posterior cross-vein interrupted. Length, 3 mm.

The female resembles the male except that the posterior tarsi are simple, the tips of the metatarsi and the outer half of the following joints black.

Eight specimens. Holotype and allotype, Providence, Mass.. June 24, Paratypes, Eastham, June 27 and, Barnstable, Mass., July 5, 1904 (C. W. Johnson); Nantucket, July 4, 1906 (J. A, Cushman) and Aug. 7 and 15 (H. T. Fernald).

Sapromyza compedita Loew. Pl. 3, figs. 7, 8, 9.

A common and widely distributed species. The second joints only of the posterior tarsi black and as broad as they are long. The clouding of the wing is confined to the apical portion above the posterior cross-vein, with only a small clouding at the anterior cross-vein.

Sapromyza houghii Coquillett. Pl. 3, figs. 10, 11.

The posterior tarsi are similar to those of *S. compedita* except that the second joints are slightly smaller. The clouding on the wing however is closer to that of of *S. melanderi.*

I have collected and received this species from the following localities:—Blue Hills, June 16, Eastham, June 27, Edgartown, June 28 and Horse Neck Beach, Mass., July 30 (C. W. Johnson); Sharon, Mass., Aug. 3 (J. A. Cushman); Kingston, Aug. (John Barlow); West Thompson, Conn., July 12 (H. L. Viereck); Wash-

ington, R. I., June 19, Atco, N. J., June 12 and Suffolk, Va., June 11 (C. W. Johnson).

Sapromyza sheldoni Coquillett.

This has the clouding of the wings very similar to that of *S. ornatipes* except that both the costal and subcostal cells are clouded. The posterior tarsi are not differentiated.

Additional records for this species are Fort Kent, Me., Aug. 19 (C. W. Johnson); Orono, Me., Aug. 13 (C. P. Alexander); Wellesley, Mass., July 11 (E. P. Van Duzee).

Sapromy disjuncta sp. nov. Pl. 3, figs. 12, 13.

Male: Face, front and antennæ yellow, arista black. Thorax dull yellow, slightly pollinose, four dorso-centrals; scutellum yellow. Abdomen yellowish brown, lamellæ large, whitish, fringed with long, black hairs. Halteres and legs yellow, tarsi whitish, the second joints of the posterior tarsi black, scarcely enlarged, tips of the remaining joints brownish. Wings hyaline, a clouding at the anterior and posterior cross-veins, at the ends of the second, third and fourth veins, and a spot midway between the anterior cross-vein and the end of the second vein slightly fused with the clouding at the end of the second vein. Female similar to the male. Length 3.5 mm.

Twenty-two specimens. Holotype, Washington, R. I., June 19, and allotype, Buttonwoods, R. I., June 15, 1912. In the collection of the Boston Society of Natural History. Paratypes, Bretton Woods, N. H., June 25, Boston, June 6, Cambridge, June 21, Dedham, Sept. 4 and Mt. Tom, Mass., Sept. 22, Tiverton, R. I., July 31, Darien, Conn., May 27, June 11, Ithaca, N. Y., July 23, Delaware Water Gap, July 12 and Wildwood, N. J., Aug. 12, Philadelphia, June 20 and Frazer, Pa., July 24 (C. W. Johnson); Branford, Ct., (H. L. Viereck); Norway, Me. (S. J. Smith); "N. Y. and Ct."(Osten Sacken) Mus. Comp. Zoöl. A specimen from Jacksonville, Fla., collected by Mrs. A. T. Slosson and referred to *S. compedita* also belongs to this species.

The clouding of the wing is similar to that of *S. philadelphica* but the black second joint of the posterior tarsi distinguishes it from that species.

Sapromyza conjuncta sp. nov.

Male: Face, front and antennæ light yellow, arista blackish, base yellow, pubescence very short. Thorax dull yellow, slightly pollinose, with four dorso-centrals, scutellum noticeably lighter in color than the thorax. Abdomen reddish brown;

lamellæ small, red, margined with brown. Halteres and legs light yellow, tarsi not differentiated, middle femora with a row of four strong bristles on the under side near the tip. Wings a whitish, not yellowish, hyaline, the clouding like that of *S. compedita* from which however, it can be readily distinguished by its simple, unicolored tarsi. Female similar to the male. Length 3 mm.

Seven specimens. Holotype, Buttonwoods, R. I., June 18, 1912. Paratypes Auburndale, Mass., Blue Hill, Mass., Aug. 2, Manomet, Mass., July 26, Amsden, Vt., July 10, Jamesburg, N. J., July 4 and Avalon, N. J., June 8 (C. W. Johnson).

EXPLANATION OF PLATE.

1. *Sapromyza ornatipes* sp. nov. Hind tarsus, male.
2. *Sapromyza ornatipes* sp. nov. Hind tarsus, female.
3. *Sapromyza ornatipes* sp. nov. Wing.
4. *Sapromyza melanderi* sp. nov. Hind tarsus, male.
5. *Sapromyza melanderi* sp. nov. Hind tarsus, female.
6. *Sapromyza melanderi* sp. nov. Wing.
7. *Sapromyza compedita* Loew. Hind tarsus, male.
8. *Sapromyza compedita* Loew. Hind tarsus, female.
9. *Sapromyza compedita* Loew. Wing.
10. *Sapromyza houghii* Coq. Hind tarsus, male.
11. *Sapromyza houghii* Coq. Wing.
12. *Sapromyza disjuncta* sp. nov. Hind tarsus, male.
13. *Sapromyza disjuncta* sp. nov. Wing.

Nomenclature Note on the Mallophagan Genus Ancistrocephalus Paine.[1]

The fact has recently come to the notice of the writer that the name *Ancistrocephalus*, recently employed by him for a new genus of Mallophaga, is preoccupied, having been used by Monticelli for a genus of Cestode worms in about 1890; this name, therefore, cannot be used for the Mallophagan and is herewith substituted by the name *Physconella*. The type of this genus is *Physconella kelloggi* Paine, as described in the paper referred to in the accompanying footnote.

J. H. Paine, Washington, D. C.

[1] Paine, J. H. A New Genus of Mallophaga—Psyche, Vol. XX, No. 5, p. 158 (1913).

FOUR NEW NORTH AMERICAN CHLOROPIDÆ (DIPTERA).

By J. R. Malloch,
Urbana, Illinois.

Parectecephala dissimilis sp. nov.

Male: Yellow, subshining. Frons parallel-sided, a little less than twice as wide as either eye; frontal triangle not occupying whole width of vertex, glossy, reaching in a narrow line to the anterior margin of frons, sides concave, a large black spot mid way between ocelli and anterior margin, ocellar region brown; surface hairs black, long and fine; post-vertical pair of bristles erect; head in profile elongate, frons projecting over one-third the length of eye, face receding much as in *Ectecephala;* face and cheeks whitish yellow, height of latter equal to over one-half the breadth of third antennal joint; antennæ of good size, situated on almost apex of projecting frons, yellow, basal joints browned, third blackened above and at apex, third joint about one and one-half times as long as broad, upper surface at apex distinctly less rounded than lower; arista white, yellow at base, covered thickly with white hairs which give it the appearance of being thickened, length of arista equal to one and one-half tomes that of antenna; proboscis and palpi pale yellow, the former rather large and the apical portion folded back below the basal; eyes about one and one-half times as long as high, bare. Mesonotum with faint indications of three, almost confluent, reddish yellow stripes, the lateral margin of the outer stripe on either side brown, surface hairs dark, short; pleuræ immaculate, highly glossy; scutellum flattened, the surface roughened slightly and with numerous short, black hairs, 2 apical long bristles and a number of short ones on margin. Anterior margin of abdominal segments brown; hypopygium glossy, prominent, with a projecting ventral process. Legs slender, only the last joint of tarsi, and claws black. Wings clear, veins brown; all veins distinct, only the apex of fourth slightly less distinct than the others; cross veins separated by almost as far as length of last section of fifth vein; third vein slightly upward bent at apex; third costal section two-thirds as long as second; veins 3 and 4 distinctly divergent; outer cross vein but little longer than inner, the cell enclosed by it, therefore very narrow. Halteres pale yellow.

Length: 3.5 mm.

Type: Cat. No. 15968, U. S. N. M.

Locality: Chester County, Pennsylvania, July 22, 1893. No collector's name on specimen.

This species has much the habitus of some of the species in *Diplotoxa* and also those in *Ectecephala.* From *Diplotoxa* it may be separated by the less closely approximated cross veins, and the third vein being less distinctly upturned. From *Ectecephala* the flat frons readily separates it.

Parectecephala is likely to be confused with *Eutropha* Loew, the genera being very close, if *aristalis* Coquillett belongs to the former. Becker includes this species in his genus, but I can see no reason for separating the type from *Eutropha*. The frons is unprojecting and in other respects the type agrees very well in habitus with *Eutropha thalhammeri* Strobl, which is represented in collection United States National Museum.

Botanobia (=*Oscinis*) **marginalis** sp. nov.

Female: Yellow, slightly shining. Ocellar region, and back of head black; third antennal joint at insertion of arista slightly browned. Mesonotum black-gray, four equally wide reddish yellow stripes begin on anterior margin and extend to beyond middle of disk, becoming wedge shaped posteriorly; margin of disk laterally, on the posterior angle, reddish yellow; humeri and lateral margin of disk at middle pale yellow; pleuræ pale yellow, with a vertical black stripe on upper half below wing base, which joins a forwardly directed diagonal stripe extending to about midway up mesopleura, and another spot above hind coxa; scutellum black-gray on disk, the margin broadly pale yellow; postnotum black. Abdomen yellow, each segment with dark brown fore marginal band which is produced backward in center. Legs entirely yellow. Wings clear, veins brown. Halteres yellow. Hairs on body yellowish; bristles black.

Frons occupying one-third the head width; triangle ill-defined; surface hairs numerous, short, black, those near eye margin rather setulose; antennæ of normal size, third joint rather acute on upper surface at tip; arista barely longer than width of frons, pubescent; cheek at least half as high as width of third joint of antenna; eyes oval, distinctly pubescent. Mesonotum impunctate, the surface hairs short; scutellum with 4 marginal bristles, the apical pair largest, but barely longer than the length of scutellum; outline of scutellum rounded. Legs normal. Wings with third costal division slightly over one-half as long as second; veins 3–4 divergent.

Length: 1.5 mm.

Type: Cat. No. 15970, U. S. N. M.

Locality: Biscayne Bay, Florida. (Mrs. A. T. Slosson.) One specimen.

Botanobia (=*Oscinis*) **proxima** sp. nov.

Female: In coloration almost similar to *marginalis*. Differing in the following respects from that species: The insect over all is more slender; the head is more elongate; the eyes are elongate oval, whereas in *marginalis* they are placed with their long axis diagonal to the line of the body; the mesonotum has the two center yellow stripes reaching to short of the middle of disk, and the outer two reaching to distinctly beyond the middle, in *marginalis* the stripes are of equal length; and the mesonotum is more distinctly shining, the pollinosity being less distinct in *proxima*.

Length: 1.25 mm.

Type: In collection of W. L. McAtee.

Locality: Wallops Island, Virginia, June 1, 1913. (W. L. McAtee.)

Botanobia (=*Oscinis*) insularis, sp. nov.

Female: Black, slightly shining. Head yellow; frontal triangle black, slightly shining, the surface covered with gray dusting; third joint above, and both basal joints brown; proboscis glossy brown on basal portion; occiput concolorous with triangle. Mesonotum unstriped, and like the pleuræ thickly covered with gray pollinosity; scutellum gray pollinose. Abdomen generally yellowish on basal two segments, the others brownish black, shining. Legs yellow; darkened, brownish or blackish, on all coxæ, all femora except apices, indistinctly on mid tibiæ and distinctly on middle of hind tibiæ and apices of tarsi. Wings clear, veins brown. Halteres yellow.

Slender. Frons occupying one-half the head width, orange yellow; triangle as wide as vertex, and not reaching middle of frons, margined with hairs; surface of frons with scattered black hairs; antennæ larger than usual, third joint slightly angular at upper margin of apex, distinctly pilose; arista with basal joints about two-thirds as long as apical portion and thickened, pubescence short but distinct, length of arista equal to width of frons; cheek half as high as width of third joint of antenna; palpi large, almost bare; eyes distinctly higher than long, pubescent. Mesonotum unpunctured, surface with very few weak hairs; scutellum with weak discal hairs and four marginal bristles. Legs normal. Wings with third costal division two-thirds as long as second; veins 3–4 subparallel; last section of fifth vein twice as long as penultimate section of fourth.

Length: 1 mm.

Type: In collection of W. L. McAtee.

Locality: Wallop's Island, Virginia, June 1, 1913. (W. L. McAtee.) Three specimens.

FORMICA EXSECTA IN JAPAN.

By William Morton Wheeler,
Bussey Institution, Harvard University.

Among several Japanese ants recently handed to me for identification by Mr. W. M. Mann there are a few specimens representing an undescribed variety of *Formica insecta*. This species, though well known from northern and central Europe and Siberia, has not been taken hitherto east of the Altai Mountains of Mongolia.

Formica exsecta Nylander var. **fukaii** var. nov.

Worker: Length 5–6 mm.

Differing from the worker of the typical form in having the mesonotum in profile straight and sloping gradually to the mesoëpinotal constriction, instead of convex. The notch in the superior border of the petiole is distinctly narrower and shallower, the gaster is darker, being black throughout and not red at the base of the first

segment, and the posterodorsal portion of the head is much less deeply and extensively infuscated.

Described from four specimens taken by Mr. T. Fukai in the Saitama division of Japan.

OBSERVATIONS ON THE RELATION BETWEEN FLOWER COLOR AND INSECTS.

By E. M. East and R. W. Glaser.
Bussey Institution, Harvard University.

In 1909 a cross was made between the small red flowered *Nicotiana forgetiana* Hort (Sand) and *Nicotiana alata* Lk. and Otto var. *grandiflora* Comes, the large white N. affinis of horticulture, for the purpose of studying certain problems of heredity. About fourteen thousand plants of the second, third and fourth hybrid generation have been grown, and it has been established beyond a reasonable doubt that each plant is completely self-sterile though it crosses easily with any of its neighbors. Several hundred carefully controlled self-pollinations have not yielded a single seed, while histological studies have shown self-fertilization to be practically impossible. On the other hand, hundreds of artificial cross pollinations have yielded capsules full of seed in almost every instance, showing with what ease cross-fertilization takes place, for artificial pollination is usually not as successful as natural pollination. The fact that every capsule formed naturally on these plants must have resulted from a cross-pollination produced by an insect, serves to excuse our adding to the already huge literature on the relations between insects and plants. The sixteen different color forms that have segregated from the original cross permit observations on the percentage of flowers cross-fertilized and the selective value, if any, of distinct color varieties.

Our knowledge of the behavior of insects relative to flowers has been greatly extended during the past few years by the work of Plateau, Forel, Lovell, Grænicher and others, but it has resulted in that obscurity which precedes aggregation and precipitation by disclosing the marvelous complexity of the relation. The adjustment between certain insect forms and certain types of flowers is

just as obvious now as when pointed out by Sprengel, but few entomologists or botanists will admit its adequate interpretation by the simple natural selection idea as believed by Hermann Müller and his followers who did not see the obstacles to this view as plainly as did Darwin.

The attitude of botanists has been affected chiefly by genetic investigation. Mendelian research and hypotheses regarding mutational evolution have at least gained a serious reconsideration of the origin, inheritance, and cause of survival of flower forms. Investigations on cross- and self-fertilization, by giving a clear and reasonable interpretation of the vigor of first generation hybrids and the converse—the apparent deterioration through inbreeding hybrids—have caused us to view mechanisms for cross-pollination at a new angle. Self-pollination gives inherently stranger races (vigor not masked by heterozygosis) and insures reproduction, but practically precludes the trial of variations not of decisive value or of various recombinations of new variations with old characters. On the other hand, cross pollination, while permitting the survival of weak types through the vigor of heterozygosis, and while rendering reproduction more dubious, does assure a trial of all new variations in all the combinations possible in a mendelian sense.

The appreciation of the intricacy of the behavior of insects toward flowers is due primarily to the knowledge of insect sense organs, to the ingenuity of the experiments of animal psychologists, and to the passing of the tendency to interpret all the actions of the lower animals as tropisms.

For these reasons the question as to whether particular flower colors have a survival value due to the preference of certain insects for them, upon which we have gathered a few data, would probably be answered somewhat as follows by the majority of biologists. Excluding any question of olfactory sense, it may be assumed that insects perceive color differences from short distances but seldom if ever exercise a choice. Night flyers, of course, perceive white much more easily than colors. These conclusions are supported by the data in the following table:

Flower color.	Total number of flowers on 10 average plants.	Total number of flowers fertilized.	Per cent. of flowers fertilized.
White	18,035	7,052	39.10
Yellow	26,686	4,836	18.12
Red	14,165	2,154	15.21
Purple	9,721	1,628	16.74

Ten average plants of each of the four colors—white, yellow, red and purple—were selected at random. The total number of flowers produced on each color type during the flowering season (July 15 to October 15) was determined by counting the places on the racemes where flowers had been. The number of capsules present was assumed to be the number of flowers fertilized, although this count is not as accurate as the first by reason of the accidental loss of capsules. Long experience with Nicotianas, however, leads us to believe that this error is small.

The first point to be noted is the comparatively small percentage of cross-pollination by insects. Numerous experiments on artificial cross-pollination have shown that a very small amount of pollen causes normal development of the capsules, yet the yellow, red and purple types had only about 17 per cent. of their blossoms crossed. According to the table, the percentage of white flowers fertilized was more than twice as high as any of the colored types. The reason for this is obvious. From the beginning of the flowering period, about July 15, to the end period of summer heat, about September 15, the flowers opened at about 4 p. m. and remained open until about 7.30 a.m. During the last month of flowering, the weather was so cool that the flowers also were open throughout the day. Nearly two thirds of the fertilizations occurred during the last month as could be determined by the positions of the flowers on the racemes. Furthermore the percentage of fertilizations on the white type during the last month was about the same as on the colored types. Roughly, one might say then that about 6 per cent. of the pollinations of the colored types were made by night-flyers (Sphingidæ, etc.), while during the same period these insects pollinated from 20 per cent. to 25 per cent. of the white type. In

other words, there was a high rate of selection of white flowers during the period when the flowers were pollinated at night, but there was no selection of colors when daylight pollinations were made by the Hymenoptera and Diptera that frequented the plants.

PHILIPPINE MOSQUITOES.

By C. S. Ludlow

Army Medical Museum, Washington, D. C.

Myzomyia flavirostris sp. nov.

Female: Head dark, covered with dark brown and white forked scales, and white long slender scales on the vertex, extending forward as a long tuft; antennæ brown, verticels and pubescence white, basal joint brown but not so dark as the cephalic scales; palpi dark brown the ultimate joint white, except, a very narrow brown basal band extending as a tiny brown band on the apex of the penultimate, a broad white band on the base of the penultimate and the apex of the following joint, the remainder of the organ dark brown, except a very narrow white band, at the preceding joint, very heavily scaled at the base; proboscis light scaled on the apical half, often not noticeable from the dorsal aspect, and always more marked on the ventral side, the proximal half dark brown, very heavily scaled at the base; clypeus dark brown; eyes dark brown.

Thorax: prothoracic lobes dark, with brown chætæ; mesonotum has the median third of a light brown, sometimes almost yellowish, covered with the fine tomentum so often found on Anophelines, and sparsely with golden brown hair-like scales, a well marked dark median line broadening so as to cover the "bare space," and in some specimens suggestions of other laterad dark lines, a bunch of long white slightly curved scales extending over the nape; the lateral parts are a rich dark brown. Scutellum dark brown in the median portion lighter laterad; metanotum dark; pleuræ almost black.

The abdomen is very dark, almost black, with scattered brown to golden brown hairs.

Legs: the coxæ and trochanters are dark, covered with small dark scales and chætæ; femora of the fore legs light brown, tibiæ and tarsi darker brown, ungues simple; mid-femora light brown, the rest of the leg dark brown, but the terminal tarsal joint appearing fawn colored in some lights, ungues simple; hind femora light brown, tibiæ much darker, especially toward the apex, and some specimens showing a tiny white apical spot, all the tarsal joints brown, sometimes with a suggestion of apical light spots on the third and fourth joints.

Wings, clear, covered with brown and light yellow scales. The costa as a whole is dark with five small light spots, one at the apex of the first long vein; one, extending on the first long, about on a line with the base of the second posterior cell, the third, also extending on the first is well interior to a line through the base of the fork of the fifth long vein, and the last is a tiny spot between this and the root of the wing. The wing field has many small spots the third long vein is mostly light,

with a small dark spot at its apex and one near its base; there are light spots at the fourchette of each ford cell; the stem and lower fork of the fifth long vein are mostly light with a dark spot at its apex, and one at the base of the cell; the distal half of the upper fork of the fifth long vein is white with a very small dark spot at the very apex, the sixth vein is dark; the wing-fringe is dark except for light spot at the apices of all the long veins but the second and sixth. Halteres with light stem and dark knob.

Length: about 3mm.

Habitat: Camp Wilhelm, Tayabas, P. I.

Taken: November.

I am indebted to Dr. Malcolm Watson, Klang, F. M. S., for calling my attention to this species. The wing and palpal markings greatly resemble the dark form of *funesta*, and with the hand lens the light proboscis is not sufficiently marked to call attention to it, and I had laid it aside as being probably this form of a species so common on the Philippine Islands.

Popea palawanensis sp. nov.

Female: Head black, mostly covered with dark brown flat scales, a white border around the eyes, and a narrow median portion of curved scales, white at the vertex and brown at the nape; antennæ dark brown, verticels and pubescence brown, basal joint dark with a few slender hair-like brown scales on the median aspect; palpi about one fourth the length of the proboscis, dark brown; proboscis dark brown, eyes dark brown; clypeus brown.

Thorax dark; prothoracic lobes heavily covered with white flat scales and dark brown chætæ; mesonotum dark brown with silvery white slender curved scales very closely set to form a white spot covering the cephalic third, the caudad edge is irregular, and reminds one of the "solid W" described for *Lepidotomyia magna* Theo; the remainder of the mesonotum covered with slender curved, rich, dark brown scales, except an irregular white spot just cephalad of the wing joint, and white scales forming a line around and extending on the "bare space"; Scutellum dark, partly denuded, the mid-lobe having a few white flat scales in the median line, a few white rather broad curved scales laterad of the flat ones, and then brown curved scales. The lateral lobes are denuded, except for one white and a few brown curved scales. There have apparently been five marginal chætæ on the mid and three on the lateral lobes; pleura dark brown with five or six large bunches of silvery white flat scales; metanotum dark.

Abdomen covered with dark brown scales except for rather heavy basal lateral brilliant white spots. On the venter are also heavy basal brilliant white spots sometimes extending as basal white bands, and there are on several segments, bunches of *very* long brown scales, so much constricted on the basal part as to appear almost petioled.

Legs brown; coxæ and trochanters testaceous with a few white scales; the fore femora white on the ventral aspect nearly to the apex, fore tibia brown only on the dorsal aspect, the ventral and lateral aspects brilliantly yellowish white; all the tarsi

brown. On the femora of the mid legs the ventral white extends on the dorsal aspect to form a white spot near the apex, the very tip being brown; the tibia are brown except a white spot near the apex, the very tip being brown; first tarsal is basally white bands and has a white band near the apex, the tip being brown; second tarsal is basally white banded, the other tarsal joints are brown. The hind femora are silvery white except for a narrow basal brown band, a broad brown band a little beyond the mid-length of the femora, and a narrow brown band at the apex; tibiæ brown; first tarsal basally white banded, and a white band near the apex; the second tarsal basally white banded, and the remainder of the tarsi are brown. Fore and mid ungues equal and uniserrate, hind simple.

Wing clear, with brown, rather long and broad-ended scales, somewhat resembling *Tæniorhynchus* scales. Cells short, petioles about as long as the cells. First submarginal longer and narrower than the second posterior, bases nearly on a line; base of the third long vein and mid cross-vein meet, and the posterior cross-vein is more than twice its length interior. Halteres with white stems and heavy dark brown knobs.

Length: about 4.5 mm.

Habitat: Puerto Princessa, Palawan Island, P. I.

Taken: May.

Described from one specimen. A few specimens evidently of this mosquito have been previously received, but always in such bad condition that no description was possible.

MYZOMYIA (ANOPHELES) LUDLOWII THEOBALD.

By C. S. Ludlow,
Army Medical Museum, Washington, D. C.

For sometime there has been quite a good deal of discussion as to the breeding habits of this mosquito, different observers claiming that it bred in fresh water, in blackish or salt water, and that it bred in either.

Without wishing to question the observations of any of those who have studied this *Anopheline*, and merely because there has lately appeared the definite statement, the foundation for which I do not know, that "*ludlowii* is exclusively a saline breeder,"[1] it seems better to publish what I myself know on this point.

The specimens which I sent to Mr. Theobald, and on which the species was founded, were taken by Dr. Graves in the Province of

[1] The mosquitoes of North and Central America and the West Indies. L. O. Howard, H. G. Dyar and F. Knab. 1912.

Abra, Island of Luzon, on the Benguet Road during the construction of that road. The location is definitely inland; the camp was in a deep canyon, where Dr. Graves wrote me "the Mountains are so high we see the sun only between 9 a. m. and 3 p. m." The Benguet River runs through this canyon, and there is no sea or blackish water within many miles. These *Anophelines* were there in great numbers, the collection from which the specimens were sent to Mr. Theobald, containing about fifty specimens, *all* of them this one species.

It is also of interest to note that for a while no other species were taken, although no effort was made to that end, and during that time malarial fever was very prevalent.

This can only mean that *M. Ludlowii may* breed in fresh water, but this, by no means precludes its breeding also in salt or brackish water, for a sufficient number of other *Anophelines* are shown to breed indifferently in fresh or salt water to make it at least allowable to suppose that *ludlowii* may do the same.

NEW OR LITTLE-KNOWN NEOTROPICAL HEXATOMINI (*TIPULIDÆ, DIPTERA.*)

By Chas. P. Alexander,
Ithaca, N. Y.[1]

The following species were included in collections received for study from the American Museum of Natural History (Mr. Grossbeck); United States National Museum (Mr. Knab); Cornell University (Dr. Bradley); and the Muzeu Rocha (Señor Rocha). I express my sincere thanks to the above-named gentlemen for this and other favors received from them. The present paper deals with the *Hexatomini*, an extensive tribe of crane-flies, which reaches its maximum of specific development in the tropics. The study of these forms was conducted as research in Systematic Entomology at Cornell University under Dr. J. Chester Bradley, to whom I am indebted now, as before, for advice and many valuable suggestions.

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[1] Entomological Laboratory, Cornell University.

Eriocera Macquart.

1830. *Caloptera* Guerin; Voyage de la Coquille; Zoöl.; pl. 20; f. 2.
1838. *Eriocera* Macquart; Dipt. Exot.; vol. I, pt. 1; p. 74.
1838. *Evanioptera* Guerin; Voyage d' la Coquille; Zoöl.; vol. 2, pt. 2; p. 287.
1848. *Pterocosmus* Walker; List Dipt. Brit. Mus.; vol. I, p. 78.
1850. *Allarithmia* Loew.; Bernstein und Bernsteinfauna, p. 38.
1857. *Oligomera* Doleschall; Naturk. Tijds. v. Nederl. Ind.; vol. 14, p. 11.
1859. *Arrhenica* Osten Sacken; Proc. Acad. Nat. Sci. Phil.; p. 242. ♂
1859. *Physecrania* Bigot; Ann. Soc. Ent. Fr.; p. 123; pl. 3, fig. 1.
1912. *Androclosma* Enderlein; Zoöl. Jahrb; vol. 32, pt. 1, p. 34, fig. U, V.

Eriocera is one of the dominant genera of the crane-fly fauna in Neotropical countries. The key given below is based on a study of specimens of many of the species and a careful consideration of the original descriptions. It should, however, be supplemented by the original description wherever this is possible.

A Key to the Neotropical Species of Eriocera.

1. Wings dark colored with hyaline or yellowish cross-bands, or wings light colored with dark cross-bands 2
   Wings, whether dark colored or not, uniform, or nearly so, in color, not cross-banded 13
2. Wings light-colored with three dark cross-bands, [small species; length, ♀, 8 mm.]. (Porto Rico.) . . . . . *trifasciata* Röder[1]
   Wings dark colored with hyaline or yellowish cross-bands 3
3. Head dark colored, not red or yellow 4
   Head yellowish or reddish 5
4. Base of the wings pale; femora with the basal third and a ring at the second third yellow; first four abdominal segments bright yellow; head with a yellowish-grey bloom. (Colombia.) . . . . . *braconides* End.[2]
   Base of the wings dark; legs, abdomen (with the exception of the apical segments of the ♀) and head entirely black. (Guatemala.) . . . . *magnifica*, sp. n.
5. Tip of the wing dark colored 6
   Tip of the wing pale giving the wing the appearance of having an apical yellow cross-band. (North Brazil.) . . . . . *perpulchra*, sp. n.
6. Wings pale brown with a moderately narrow, hyaline band, whose distal edge is limited by the cord; a small brownish stigmal spot [antennæ bright brownish-yellow; thoracic dorsum brownish-yellow with three greyish brown stripes; femora with middle third and apical quarter brown on a ochraceous-yellow ground]. (Colombia.) . . . . . *virgulativentris* End.[3]
   Wings darker brown with the cross-band usually wider; stigma not distinct . . . 7

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[1] Roder, V. von; Stett. Entomol. Zeitung; vol. 46, p. 338; 1885.
[2] Enderlein, G.; Zoöl. Jahrbuch; vol. 32, pt. 1; p. 47, (f. B^1); 1912.
[3] Enderlein, G.; l. c.; p. 47, 48; (f. c^1); 1912.

7. Legs with the tibiæ, at least the posterior ones, with a broad white ring 8
   Legs without white bands 9
8. Thorax uniformly black; [head and base of antennæ uniformly fiery reddish-yellow; wing band yellow; anal cells a little less brown than rest of the brown band]. (Brazil.) ..... *tænioptera* Wied.[4]
   Thorax not uniformly black, dorsum very faintly striped, pleuræ sooty-brown; [abdomen black; a scoriaceous, bluish-black band at the base of each segment]. (Brazil.) ..... *caminaria* Wied.[5]
9. Femora banded with yellow rings on a darker ground; [large, ♀, length, 18 mm.; head yellowish-orange; first antennal segment brown; abdomen with segments 2, 3, 4 and the terminal ones yellowish-orange, the others black]. (Brazil.) ..... *faseiata* Guer.[6]
   Femora not banded with yellow rings; legs yellow, brown or black usually darkening toward the tips of the segments 10
10. Antennæ entirely orange; [larger; ♀, length 15 mm.; wing-bands pale yellow]. (Brazil.) ..... *rufieornis* Macq.[7]
    Antennæ with only the scape orange, flagellum brown; [smaller; ♀ less than 12 mm.] 11
11. Thoracic dorsum blackish-grey trivittate with black; [wing band and anal cells yellowish]. (Brazil.) ..... *melanaera* Wied.[8]
    Thoracic dorsum neither grey, nor trivittate with black 12
12. Abdomen black, at base of each segment a shining, scoriaceous, bluish-black band. [This species is also included in couplet 8; Wiedemann does not mention white tibial bands, but specimens which Schiner determined as being *caminaria* had white on the tibiæ]. (Brazil.) ..... *caminaria* Wied.[5]
    Abdominal segments 2, 3, and sometimes 4, with at least the caudal margins whitish; bases of the segments usually reddish. (Northern S. America.) ..... *longistyla* Alex. (= *erythroecphala* Fabr.) preocc.[9]
13. Abdomen mostly yellowish or yellowish-brown, usually with a black band before the tip 14
    Abdomen mostly black or blackish 26
14. Frontal tubercle black or blackish 15
    Frontal tubercle yellowish or reddish 18
15. Thorax red between the pronotum and the suture, with a dark median line; [abdominal segments 6 and 7 black; wings pale brownish; ♂, length, 15 mm.]. (Mexico.) ..... *mesoxantha* O. S.[10]
    Thorax yellow or reddish-yellow, without a dark median line 16

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[4] Wiedemann, J.; Aussereur. zweifl. Insekt; vol. I, p. 28; (*Limnobia*); 1828.

[5] Wiedemann, J.; l. c.; vol. I, p. 31; (*Limnobia*); 1828.

[6] Guerin, F. C.; Voyage de la Coquille.; Zoöl.; vol. 2, pt. 2; p. 287; pl. 20, f.2; (*Eva nioptera*); 1830.

[7] Macquart, J.; Dipt. Exot.; vol. 1, pt. 2; p. 176, 177; (*Cylindrotoma*); 1838.

[8] Wiedemann, J.; Aussereur. zweifl. Insekt; vol. I, p. 548; (*Limnobia*); 1828.

[9] Fabricius, J.; Syst. Antliar.; p. 31; (*Tipula*); 1805.

[10] Osten Sacken, C. R. R.; Biologia Centr. Americana; Dipt.; vol. I; p. 10; 1886.

16. Antennæ with flagellum light yellow; thorax uniformly yellow; [abdomen with segments 3–7 with brown spots; wings brownish, lighter-colored in the interior of the cells]. (Mexico.) ..... *flavida* Will.[11]
Antennæ brown or black; thorax yellow with black lateral spots or stripes 17
17. Antennæ black; a large black spot on mesonotum above each wing; abdomen black excepting segments 1–4 and 9. (Mexico.) ..... *brunnicipes* Will.[12]
Antennæ brown; a short black stripe on each side of the mesonotum; abdominal segments 1–4 with a narrow posterior black band; remaining segments black excepting their yellowish bases. (Mexico.)
..... *willistoni* Alex. (=*fasciata* Will.) preocc.[13]
18. Cell 1st M_2 far out toward the wing-margin, so that Cu_1 beyond this cell is shorter than Cu_1+M_3; that portion of R_1 between cross-vein *r* and Sc_2, very thin, indistinct; [antennæ of the ♂ very long, filiform, twice as long as the body]. (Eastern Brazil.) ..... *macrocera*, sp. n.
Cell 1st M_2 nearer to the wing root, so that Cu_1 beyond this cell is as long or longer than Cu_1+M_3; R_1 between *r* and Sc_2 equal to the remainder of R_1 in thickness; [antennæ of the known ♂'s short] 19, 23
19. Males with the frontal tubercle produced into slender horn-like points which are directed laterad; [abdomen with a subterminal black band]. (Bolivia.)
..... *cornigera*, sp. n.
Males (as known) with the frontal tubercle normal 20
20. No conspicuous black subapical band on the abdomen; stigmal spot conspicuous; [length about 19 mm; wing 17 mm.]. (British Guiana—Eastern Brazil.)
..... *kaieturensis*, sp. n.
A conspicuous sub-apical dark brown or black band on the abdomen 21
21. Larger species; [length, 20 mm.; wing, 18 mm.; [Sc_2 longer than Sc_1]. (Ecuador.)
..... *ohausiana* End.[14]
Smaller species [length, 15 mm. or less] 22
22. Antennæ brown; body coloration dull brownish-yellow. (Peru.)
..... *peruviana*, sp. n.
Antennæ yellow; body coloration yellow and black. (Mexico—Costa Rica.)
..... *zonata* O. S.[15]
23. Females (as known) without a subapical black band on the abdomen; [length 25–28 mm.; wing, 20–21 mm.]. (British Guiana—Eastern Brazil.)
..... *kaieturensis*, sp. n.
Females (as known) with a subapical black or blackish band on the abdomen .. 24
24. Mesonotum uniformly reddish-yellow; [antennæ brown; wings tinged with brownish]. (Honduras.) ..... *obsoleta* Will.[16]
Mesonotum longitudinally striped 25
25. Scape of the antennæ yellow; legs yellow, segments tipped with black; Sc_2 longer and more conspicuous than Sc_1. (Mexico—Costa Rica.) *zonata* O. S.[15]

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[11] Williston, S.; Biologia Centr. Americana; (suppl.; Dipt.; vol. I); p. 227; 1900.
[12] Williston, S.; l. c., p. 227; pl. 4, fig. 5; 1900.
[13] Williston, S.; l. c., p. 226; pl. 4, fig. 10; 1900.
[14] Enderlein, G.; Zoöl. Jahrbuch.; vol. 32, pt. 1; p. 45, 46; fig. A^1; 1912.
[15] Osten Sacken, C. R. R.; Biologia Cent. Amer.; Dipt., vol. I, p. 10; 1886.
[16] Williston, S.; Biologia Cent. Amer.; Dipt.; vol. I (suppl.); p. 227; 1900.

Scape of the antennæ brownish-black; legs blackish-brown except base of fore femur; Sc_2 shorter than Sc_1. (Mexico.) ..... *townsendi*, sp. n.

26. Color metallic blue with head orange-red. (Panama.) ..... *lessepsi* O. S.[17]
Color not metalic blue 27
27. Thoracic præscutum red 28
Thoracic præscutum black 29
28. Frontal tubercle red; scutellum black. (Mexico.) ..... *hæmorrhoa* O. S.[18]
Frontal tubercle black; scutellum red. (Guatemala.) ..... *erythræa* O. S.[19]
29. Frontal tubercle orange 30
Frontal tubercle black 31
30. Abdominal segments 3–5 with basesred dish. (Mexico.) ..... *gracilis* O. S.[20]
Abdominal segments altogether black. (Colombia.) ..... *macquarti* Fnd[21]
31. Wings luteous, blackish toward the tips. (South America.) *chrysoptera* Walk[22]
Wings mostly blackish 32
32. Wings brown, darker along costa; cells uniform; wings not reddish-yellow at basis. (Mexico.) ..... *pretiosa* O. S.[23]
Wings brown, either reddish-yellow at base or else with hyaline in some of the cells 33
33. Wings a little reddish-yellow at base. (Brazil.) ..... *nigra* Wied.[24]
Wings blackish, some of the cells with nearly hyaline streaks. (South America.) ..... *tenebrosa* Walk.[25]

The following species are not included in the above key:

Penthoptera fuliginosa Schiner;[26] (Colombia) shining pitch-black; femora with a broad yellowish-red ring immediately beyond the base; head, antennæ and palpi black; wings tinged with brown, more saturated on costal margin. Osten Sacken, (Studies on Tipulidæ, pt. 2, p. 224), suggests that this is an *Eriocera*.

Limnobia flaviceps Wied.;[27] (Brazil) thorax and abdomen black, forehead fiery yellow; antennæ black. Venation (Pl. 6 b; fig. 10) like *Eriocera* but cell R_2 very short.

Eriocera magnifica sp. nov.

Dark brownish-black including the head; wings dark with a broad pale yellow postmedian band.

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[17] Osten Sacken, C. R.; Biologia Cent. Amer.; Dipt.; vol. 1, p. 13; 1886.
[18] Osten Sacken, C. R.; ibid.; p. 11.
[19] Osten Sacken, C. R.; l. c.
[20] Osten Sacken, C. R.; l. c.; p. 12.
[21] Enderlein, G.; Zoöl. Jahrb.; vol. 32, pt. I; p. 45; 1912.
[22] Walker, F.; Insecta Saundersiana; vol. I; p. 438; (*Limnobia*); 1856.
[23] Osten Sacken, C. R. R.; Biol. Cent-Amer.; Dipt.; vol. I, p. 12; 1886.
[24] Wiedemann, J.; Aussereur. zweifl. Insekt.; vol. I, p. 27; (*Limnobia*); 1828.
[25] Walker, F.; Inseeta Saundersiana; vol. 1, p. 439, 440; (*Limnobia*); 1856.
[26] Schiner; Reise Novara; p. 42. (*Penthoptera*); 1868.
[27] Wiedemann, Aussereur. zweifl. Insekt; vol. 1, p. 550; (*Limnobia*); 1828.

♂, Length, 14 mm.; wing, 12.4 mm.; antennæ about 3.8 mm.
Fore leg, fem. 7.6 mm.; tibia, 9.7 mm.; tarsus 1, 4.9; 2–5, 4.1 mm.
Middle leg, fem. 9 mm.; tibia, 9.6 mm.
Hind leg, fem. 9.8 mm.; tibia, 11.8 mm.

♀, Length, 21 mm.; wing, 16.3 mm.; antennæ about 5 mm.
Fore leg, fem. 9.9 mm.; tibia, 10.6 mm.; tarsus, 8.4 mm.
Middle leg, fem. 11.4 mm.; tibia, 10.9 mm.
Hind leg, fem. 12.8 mm.; tibia, 13 mm.

♂, Rostrum and palpi dark brown; antennæ, two basal segments brown; flagellum very dark brownish-black. Front, vertex and occiput deep brown. Frontal tubercle moderately broad, deeply notched.

Thoracic dorsum dark brownish-black without distinct stripes; pleuræ more brownish. Legs and halteres dark brownish-black.

Wings (fig. 7) brown with a broad light yellow band slightly beyond the middle, its outer margin just distad of the cord.

Abdominal tergum, basal half shiny, apical half dull black. ♀, similar to ♂ but larger and the genital segment reddish. Paratype paler and evidently newly-emerged; same place and date as the allotype.

Holotype, ♂. Trece Aguas, Cacao, Alta Vera Paz, Guatemala. April 5. (Schwarz and Barber.) Allotype, ♀ same locality and collector as the ♂, April 9. Paratype, ♀ with the allotype. Types in the U. S. Nat. Mus. Coll. Paratype in the author's collection.

In its blackish head, *magnifica* agrees most closely with *braconides* Enderlein (Zoöl. Jahrb., vol. 32, pt. I; p. 47; fig. B[1]; 1912) of Colombia; the remaining species with banded wings have the head conspicuously orange or yellow. *Braconides* differs very notably in its pale wing-basis, light bloom on the head, different leg-pattern, etc.

Eriocera perpulchra sp. nov.

Head reddish; frontal tubercle notched; wings yellow with two brown bands.

♂, Length, 20.8 mm.; wing, 16.6 mm.; abdomen about 16 mm.;
Antennæ 3.2 mm.
Middle leg, femora, 10.4 mm.; tibia 11 mm.; tarsus 8.3 mm.
Hind leg, femora, 11.8 mm.; tibia 13.6 mm.; tarsus about 8 mm.

♂, Rostrum and palpi dark brown. Antennæ, segments 1–2, orange-yellow; segment 3, yellow basally, passing into dark brown at the tip; remaining segments dark brownish-black. Front, vertex and occiput bright orange, rather obscured posteriorly. Frontal tubercle very broad, truncated in front and broadly notched.

Pronotum very dark brown. Mesonotum, præscutum, medially broadly dull chocolate-brown with three narrow darker lines, one median, the other two on the sides of the broad median band, these dark vittæ becoming indistinct behind; sides of the sclerite anterior to the pseudosuture brighter, orange; sides of the præscutum behind, dark colored; scutum, scutellum and postnotum dark brownish-black. Pleuræ dark brown, rather lighter colored on the ventral sclerites. Halteres, stem

brown, basally, darkening to brownish-black on the knob. Legs: coxæ and trochanters dark brown; femora dull brownish-yellow, tip broadly dark brown, an indistinct broad darker median band; tibiæ and tarsi brown, the former lighter colored basally.

Wings: pale light yellow; a broad brown basal band filling in the space from slightly beyond cross-vein *b* to beyond the origin of R_s; a second brown band filling in the space from the cord to the tip of R_1, down to the end of Cu_1. Venation (see fig. 8): *Sc* rather short, ending opposite cross-vein *r-m* before the middle of R_{2+3}; cross-vein *r* about equal to that portion of R_2 proximad of it; R_5 long.

Abdominal tergites reddish-brown, segments 6–7 rather darker, brown; segments 8–9, reddish. Sternites reddish-brown.

Holotype, Savannah, North Brazil. August 22, 1911. (Crampton.) Type in American Museum of Natural History.

Eriocera longistyla Alex.

1805. *Tipula erythrocephala* Fabricius; Syst. Antliar.; p. 31 (*non* T. *erythrocephala* DeGeer. 1776).
1821. *Limnobia erythrocephala* Wiedemann; Dipt. Exot.; vol. I, p. 17.
1828. *Limnobia erythrocephala* Wiedemann; Aussereur. zweifl. Ins.; vol. I, p. 30.
1838. *Cylindrotoma erythrocephala* Macquart; Dipt. Exot.; vol. I, pt. I., p. 67.
1866. *Eriocera erythrocephala* Schiner; Verh. Zoöl. bot. Ges. Wien.; vol. 16, p. 929.
1868. *Eriocera erythrocephala* Schiner; Novara Reise; Dipt.; p. 41.
1869. *Eriocera erythrocephala* Osten Sacken; Monographs Dipt. N. Am.; vol. 4; p. 248.

As I have shown elsewhere, the *Tipula erythrocephala* of Fabricius is homonymous with DeGeer's species and I have renamed it as above.

I have before me five specimens of this handsome little form, as follows:

(1) ♂, Waratuk, Upper Potaro R.; July 15, 1911. (Crampton.)
(2) ♂, Upper Potaro R.; July 17, 1911. (Crampton.)
(3) ♂ ♀, Tukeit, Upper Potaro R.; July 24, 1911. (Lutz.) (in cop.)
(5) ♀, Tukeit, Upper Potaro R.; July 24, 1911. (Lutz.)

I am including a few additional details in regard to measurements and coloration:

♂, Length, 9.1–10.3 mm.; wing, 9.9–10.4 mm.
♀, Length, 10.8–11 mm.; wing, 10.3–10.9 mm.

First and second antennal segments of the same bright orange color as the dorsum of the head; flagellum of antennæ and the palpi dark brown.

Mesonotal præscutum dark brown covered with a thick yellowish bloom which is less intense on the cephalic margin of the sclerite; three broad dorsal stripes, very indistinct. The thoracic dorsum, viewed with the naked eye, appears pearly-yellow; scutum and scutellum similar to the præscutum; postnotum darker brown, less pruinose. Wing shown in fig. 6.

Abdominal tergites, segment 1 very dark brown, only the extreme margin orange; segment 2 light orange-yellow, with a dark brown postmedian band; segment 3 orange, more yellowish on the anterior and posterior margins; segment 4, dark brownish-black, anterior quarter orange; segments 5–7 deep black, 8 and hypopygium orange. Sternites about as in the tergites; the lateral line dark on 2nd and

3rd segments. The last specimen listed above (♀) is similar but the abdominal tergum has the basal three-fourths of segments 1–3 almost black, the apical quarter yellowish. The ♀, in cop, has the first abdominal tergite black.

The specimens are in the American Museum of Natural History with the exception of specimen No. 2, in the author's collection.

Eriocera macrocera sp nov.

Head reddish-yellow; antennæ of the ♂ twice as long as the body; the section of Cu_1 beyond the outer end of cell 1st M_2 is shorter than the fused portion of Cu_1 and M_3.

♂, Wing, length, 8.3 mm.; breadth at widest point, 2.5 mm. Front, vertex and occiput bright orange-yellow; antennæ very long, brown.

Thorax and abdomen, brown. Wings with a slight brownish tinge; stigma darker brown, large but ill-defined; veins *C*, *Sc* and *R* rather yellowish; remaining veins brown. Venation (see fig. 4). Costa incrassated between ends of Sc_1 and R_1; Sc_2 near the tip of Sc_1; the portion of R_1 between Sc_2 and cross-vein *r*, delicate, indistinct; *Rs* strongly arcuated at origin; R_{2+3} nearly twice as long as that portion of R_2 before cross-vein *r*; the portion of Cu_1 beyond the outer end of cell 1st M_2 is shorter than the fused portion of Cu_1 and M_3 instead of distinctly longer as in all short-antennæd forms known to me; in other words, cell 1st M_2 (discal) is very far out toward the wing margin.

Holotype, ♂, Igarapé-assú, Pará, Brazil. January 30, 1912. (H. S. Parish.) Type in Cornell University Collection.

The only South American *Eriocera*, so far described, with elongate antennæ in the male. From the related Northern species, *E. longicornis* Walk., it differs in its reddish head and body-color. The type-specimen is not at hand and a more detailed description will be given later.

Eriocera cornigera sp. nov.

Frontal tubercle of the male produced into long, slender points; abdomen with a subterminal black band; general color yellow.

♂, Length, 12.8 mm.; wing 11.6 mm.; antennæ nearly 4 mm.
Middle leg, femora, 8.2 mm.; tibia, 8.8 mm.
Hind leg, femora, 9.4 mm.; tibia, 10.7 mm.

Rostrum and palpi dark, blackish; antennæ, first two segments brownish-yellow; third bright yellow; remaining segments dark brownish-black. Front brownish-yellow; vertex and occiput brownish-yellow, greyish near the eyes; frontal tubercle brighter, orange-yellow. Frontal tubercle extended into two elongate, pointed tubercles.

Pronotum prolonged into rather long obtuse points at the antero-lateral angles, brown. Mesonotum, præscutum, median line tawny; a large, dark brown stripe beginning near the cephalic margin, narrowing behind and gradually converging to near the suture. To either side of this, near the middle of the sclerite, begins a broad stripe which runs to the suture; ground color of the sclerite yellow. Scutum

largely brown, tawny in the middle; scutellum and post-scutum tawny; postnotum tawny. Pleuræ yellowish-tawny; sternum light yellow. Halteres tawny, knobs rather darker. Legs brownish-yellow, scarcely darker at the apices of the segments.

Wings: cells *C* and *Sc* tinged with yellow, rest of wing greyish; stigma very indistinct, rounded. Venation (see fig. 3.). *Sc* rather long, ending just beyond the level of cross-vein *r-m*; Sc_2 longer and much stronger than Sc_1 which is reduced in size and simulates a cross-vein (as in *zonata* O. S.); R_s very long, nearly straight; R_{2+3} long; cross-vein *r* oblique, inserted on R_2 just beyond the fork.

Abdominal segments 1–5, light yellow; 6–7 deep brownish black; hypopygium broken.

Holotype ♂. Songo, Bolivia. (Received from Staudinger-Bang-Haas). Type in author's collection.

Eriocera kaieturensis sp. nov.

Large species (wing 17–21 mm.); head yellow; thoracic dorsum striped; legs with a broad subapical yellow band; wings with an indistinct yellowish band before the cord, stigma distinct.

♂, Length, about 19 mm.; wing, 17 mm.; antennæ about 4 mm.
Hind leg, femur, 11.4 mm.; tibia, 11.5 mm.; tarsus, 7.4 mm.

♀, Length, about 25 mm.; wing, 20.8 mm.
Middle leg, femur, 11 mm.; tibia, 10.9 mm.; tarsus, 8.9 mm.
Hind leg, femur, 14.3 mm.; tibia, 14.8 mm; tarsus, 8.3 mm.

♂, Rostrum and palpi brown; antennæ short, segments 1 and 2 bright orange, remaining segments brown. Front, vertex and occiput bright orange-yellow.

Mesonotal præscutum light yellowish-brown pollinose with a broad darker brown median stripe, broadest in front, narrowed to a point near the suture, this broad band including a narrow, dark brown, median line; two broad lateral stripes of the same brown color on either side, beginning behind the pseudo-suture, continuing back across the suture onto the scutal lobes; scutum light yellowish-brown, each lobe brown medially, a continuation of the lateral præscutal stripes; scutellum light brownish-yellow. Pleuræ darker brown dorsally, beneath much paler, yellowish. Halteres, stem dull yellow, knob brown. Legs: coxæ and trochanters orange-yellow, the latter with a narrow black line; femora yellow, darkened at the tip and indistinctly and broadly darker beyond the middle producing a yellow subapical band; tibiæ dull yellow; tarsi dull yellow, each segment tipped with brown. Wings: of a pale yellow color, this color rather darker, more greyish, beyond the cord and near the base of the wing; stigma conspicuous, but not dark, brown, occupying the end of cell *1st* R_1; veins brownish-yellow. Venation as in figure 1.

Abdominal tergum, segments rich yellowish-brown, darker apically; segments 5 and 6 darker; lateral margin of the tergites dark brownish-black, producing a dark lateral abdominal line; sternum yellow.

♀, Quite as in the ♂, but larger.

Holotype, ♂. Kaietur Falls, Potaro R.; British Guiana. August 8, 1911. (F. E. Lutz.) Allotype, ♀. Savanna, North Brazil. August 20, 1911. (Crampton.) Paratype, ♀. Ceara, East Brazil. (Senor D. Rocha.) Holotype and Allotype in American Museum of Natural History. Paratype in Muzeu Rocha, Ceara, Brazil.

The paratype differs from the type ♂ and ♀ in having the first flagellar segment of the antennæ tipped with black, the wings more unicolorous; and femora without the broad indistinct yellow band. I believe that the specimen is merely a variant of the typical species. (Length, almost 28 mm.; wing, 21 mm.)

Eriocera peruviana sp. nov.

General color dull brown; frontal tubercle orange.

♂, Length, 11.8 mm.; wing, 11.2 mm.; antennæ about 2 mm.
Middle leg, fem., 8 mm.; tibia, 8.8 mm.
Hind leg, fem., 8.9 mm.; tibia, 10.2 mm.

Rostrum and palpi yellowish, the latter rather more brownish. Antennæ very short, brown; basal segments lighter colored. Frontal tubercle and region immediately behind it rich orange-yellow; frontal tubercle deeply furrowed. Remainder of front, vertex and occiput rich brown.

Pronotum dark brown. Mesonotum, præscutum, ground color light brownish-yellow; cephalic margin dark brown, continued backward as a stripe on either side of the narrow median line; a short brownish stripe on sides; scutum, scutellum and postnotum brownish-yellow. Pleuræ yellowish-white, a broad darker band extending from the root of the wings to the cervical sclerites. Halteres light brown. Legs: light brown, uniform. Wings: cells *C* and *Sc* brownish-grey, remainder of wings clearer grey. Venation (see fig. 5): *Sc* strong, Sc_2 remote from tip of Sc_1; R_{2+3} more or less on a level with *Rs*.

Abdomen dull yellowish brown; sub-terminal three segments darker; hypopygium reddish-brown.

Holotype, ♂. Callanga, Peru. (Received from Staudinger-Bang-Haas). Type in author's collection.

Eriocera townsendi sp. nov.

Frontal tubercle orange-yellow; scape of antennæ dark brown; legs black.

♀, Length, 18 mm.; wing, 13.6 mm.
Fore leg, femora, 6.3 mm.; tibia, 7.3 mm.
Middle leg, femora, 7.8 mm.; tibia, 7.2 mm.
Hind leg, femora, 9.1 mm; tibia, 9.5 mm.

Rostrum and palpi dark brown; scape of the antennæ dark brown, apice of segment one pale, silvery; segments 3 to 5, yellowish-orange; remaining antennal segments darkening to brown. Frontal tubercle moderately prominent and rather deeply notched, rich orange-yellow; sides of the vertex behind the eyes brown.

Mesonotal præscutum with a broad deep brown median stripe, margined with a narrow deep black line and divided by a narrow median line of the same black color; the lateral black stripe is forked near the pseudo-suture, the caudal branch ending at the pseudosutural fovea; sides of the sclerite somewhat brighter brown; scutum, lobes brown, blacker on the cephalic margin; scutellum and middle line of the scutum orange; postnotum dark brown laterally, broadly dull yellow medially. Pleuræ dark brown. Halteres deep brown, base of the stem a little paler. Legs: coxæ and trochanters deep brown except the fore trochanter which is dull yellow;

fore leg with basal quarter of femur conspicuously yellow, abruptly darkening to brownish-black; tibiæ and tarsi dark brownish black; middle and hind legs uniformly very dark brown. Wings almost uniformly brown; cells *C* and *Sc* a little darker colored. Venation: *Sc* long, Sc_1 much longer and more distinct than Sc_2; R_{2+3} rather long, a little longer than R_2 beyond cross vein *r* and about three times as long as R_2 between the fork of R_{2+3} and *r*.

Abdominal tergum, segments 1–4, orange-yellow; 5, extreme base orange-yellow; remainder of 5th and 6 and 7, deep velvety-black; genital segment orange. Sternum similarly colored but duller.

Holotype, ♀. Sierra Madre, Chihuahua, Mexico. Hd. R. Piedras Verdes. Alt. about 7,300 ft. (Coll. C. H. T. Townsend.) Type in U. S. Nat. Mus. Coll.

This species is closest to *zonata* O. S. but I cannot make the two descriptions agree. The basal segments of the antennæ in *townsendi* are very dark brown; there is more black on the abdomen; the legs are not yellow (except base of fore femora) but dark brown. The peculiar course of Sc_1 in *zonata*, apparently ending in radius rather than in costa does not obtain in the new species, where Sc_1 ends in costa, Sc_1 being about twice as long as Sc_2.

Eriocera erythræa Osten Sacken.

1886. *Eriocera erythræa* Osten Sacken; Biol. Cent. Amer.; Dipt. vol. I, p. 11.

One ♀ from Cacao, Alta Vera Paz. April 12, 1906. (Schwarz and Barber).

The mesonotal præscutum shows indications of darker brownish stripes of which the median is more double. Venation: *Sc* long, Sc_1 strong, ending about opposite the fork of R_{2+3}; Sc_2 weak, much shorter than Sc_1. *Rs* almost in a line with R_{2+3}; R_2 before cross-vein *r* a little less than one-half of R_{2+3}; cross-vein *r* a little more than one-half of R_2 before it; basal deflection of Cu_1 under the middle of cell *1st* M_2. The specimen is in the U. S. Nat. Mus. Coll.

Eriocera gracilis Osten Sacken.

1886. *Eriocera gracilis* Osten Sacken; Biol. Cent. Amer.; Dipt. vol. I, p. 12.

One ♂, Sierra Madre, Chihuahua, Mexico. Hacienda R. Piedras Verdes. Alt. about 7,300 ft. Coll. C. H. T. Townsend. Specimen in U. S. Nat. Mus. Coll.

The mesonotal præscutal greyish on dorsum, with three black stripes of which the median one is broadest in front, narrowed to a point near the suture; the lateral stripes which lie on the sides of the dorsal triangle are connected on the anterior margin of the sclerite with the median stripe; the sides of the præscutum are more yellowish than the grey dorsal triangle; scutum and scutellum, as well as the postnotum deep, rich brown. Venation: *Sc* rather short, ending far before the

fork of R_{2+3}; Sc_2 much shorter than Sc_1 but strong, in a line with the cord of the wing; R_{2+3} long, as long as R_2 alone; cross-vein r about as long as that portion of R_2 between it and the fork of R_{2+3}; basal deflection of Cu_1 as near to the fork of M as to the middle of cell *1st* M_2.

Penthoptera Schiner.

1863. *Penthoptera* Schiner; Wiener Entomol. Monatsschr.; vol. 7, p. 220.

1869. *Penthoptera* Osten Sacken; Monographs Dipt. N. Am.; vol. 4, p. 256.

A Key to the American Species of Penthoptera.

1. Small (wing less than 8 mm.); mesothoracic præscutum with the ground color obscured by a greyish or bluish pruinosity, dorsal stripes not distinct; metatarsi of the legs white; cell M_1 of the wings present, i. e., M_1 and M_2 separate at the wing-margin. (Eastern U. S.) ..... *albitarsis* O. S.[1]

   Large (wing more than 9 mm.); mesothoracic præscutum yellowish with four shining blackish marks; metatarsi of fore and middle legs more or less brown; cell M_1 of the wings lacking, i. e., M_1 and M_2 fused to the wing-margin. (Guatemala.) ..... *conjuncta*, sp. n.

The new species described below is a typical member of the genus *Penthoptera* as defined by Osten Sacken (Monographs, l. c., p. 256, 257). It agrees with *albitarsis* O. S. of Eastern North America, and *chirothecata* Scop. of Central and Southern Europe, in its snowy-white tarsi, a character not yet found in *Eriocera*, so far as I can discover. It differs from these two species, and comes closest to *cimicoides* Scop. of Central and Southern Europe in the lack of cell M_1 of the wings; from the last-mentioned species, it differs in tarsal and body-coloration, etc.

Mr. F. W. Edwards[2], in his recent comprehensive paper on the Seychelles Tipulidæ, has questioned the generic validity of *Penthoptera*. The group is, indeed, founded on rather trivial characters, but these, as defined by Osten Sacken, are numerous and apply very well to the typical group of species. *Penthoptera fuliginosa* Schiner, the only form ever described by the founder of the genus was considered by Osten Sacken to be a species of *Eriocera*. In case *Penthoptera* is reduced in rank, Schiners *fuliginosa* will require renaming.

Penthoptera conjuncta sp. nov.

Thoracic dorsum yellowish with four dark marks; tarsi white; cell M_1 absent.

♂, Length, 9.5 mm.; wing, 9.8 mm.

♀, Length, 10.6 mm.; wing, 10 mm.

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[1] Osten Sacken, Monographs, vol. 4, p. 257, 258. See Needham, 23rd Rept, N. Y. State Entomologist for 1907, plate 12, figure I, for photo of wing.

[2] Edwards, Trans. Linn. Soc. Lond ; 2nd series, Zoölogy; vol. 15, pt. 2; Sept. 1912. The Percy Sladen Trust Expedition to the Indian Ocean in 1905—No. 14—Diptera, Tipulidæ; p. 195–214; pl. 10–11.

Rostrum and palpi brown; scape of antenna light yellowish-brown, the basal segment slightly darker than the second segment; flagellum broken. Front, vertex and occiput dark-colored, thickly bluish-grey pruinose. Frontal tubercle prominent, not notched.

Mesonotum yellowish-brown, shiny, a narrow deep brown line on either side of the broad dorsal median portion, beginning above the pseudosutural region, narrowing behind and ending before the transverse suture; a large rounded brown spot on the sides of the sclerite before the transverse suture; scutum, scutellum and postnotum yellowish-brown with a faint greyish bloom; a rounded darker brown spot on the lateral lobes of the latter. Pleuræ very light yellow, a large rounded brown spot on the mesopleuræ underneath the wing-root and less distinct spots on the propleuræ and cervical sclerites forming an interrupted dorso-pleural band. Halteres deep brown. Legs: coxæ and trochanters light yellow; femora yellowish-brown, extreme tip darker brown; tibiæ brown; fore metatarsus brown on basal two-fifths, remaining portions of fore tarsi pure white except the last segment which is brownish; middle leg, with the basal third of the metatarsus brown; metatarsus of the hind legs entirely white. Wings: subhyaline or slightly tinged with darker, especially toward the tip; veins dark brown. Venation, see figure 2.

Abdominal tergum with the segments dark brown; segment 1 pallid at base, darker apically; extreme margin of segments 2–6 pallid; 7–8, not pale at tip; ♂ hypopygium reddish-brown; sternites dull yellow.

Holotype, ♂. Patalue, Guatemala, Central America. 700 ft. (Dr. G. Eisen.) Allotype, ♀, with the type. Received at the National Museum, January 6, 1903. Type in U. S. Nat. Mus. Coll.; allotype in author's collection.

EXPLANATION OF PLATE IV.

The figures are all drawn to scale by means of a projection microscope.

Fig. 1. *Eriocera kaicturensis* sp. nov.; wing.
Fig. 2. *Penthoptera conjuncta* sp. nov.; wing.
Fig. 3. *Eriocera cornigera* sp. nov.; wing.
Fig. 4. *Eriocera macrocera* sp. nov.; wing.
Fig. 5. *Eriocera peruviana* sp. nov.; wing.
Fig. 6. *Eriocera longistyla* Alex; wing.
Fig. 7. *Eriocera magnifica* sp. nov.; wing.
Fig. 8. *Eriocera perpulchra* sp. nov.; wing.

THERMAL CONDUCTIVITY OF COCOONS.

By Harry B. Weiss,
New Brunswick, N. J.

With a view toward determining the value of cocoons as a protection against extremes of temperature, thermometric tests of those of quite a number of species were made in the following manner: Normal empty cocoons were selected and the bulbs of ther-

mometers placed inside so as to occupy as nearly as possible the positions of the pupæ, that is, care was taken to have an air space surrounding each bulb. Each cocoon was fastened in place by elastic bands and then glued or sealed with wax.

The following tables show three different sets of conditions: one under normal field temperatures, one where a gradual rise takes place effected by placing the cocoon in an electric oven, and the other where a sudden drop occurs. The average length of time for the temperature of the inside of the cocoon to reach that of the surrounding atmosphere during a rise and fall was almost three quarters of an hour.

Cocoon of *Telea polyphemus*.

Field Conditions.

Outside temperature.	Temperature inside cocoon.
10°C.	15°C
8°	12°
7°	10°

Gradual Rise.

Surrounding temperature.	Time.	Temperature inside cocoon.
48°C.	0 min.	48° C.
51°	10 "	48°
55°	20 "	54°
57°	25 "	55°
60°	30 "	57°
61°	35 "	59°
62°	40 "	62°

Sudden Drop.

Surrounding temperature.	Time.	Temperature inside cocoon.
10°C.	0 min.	14°C.
2°	5 "	14°
0°	15 "	10°
0°	25 "	6°
0°	35 "	4°

Cocoon of *Bombyx mori*.

Field Conditions.

Outside temperature.	Temperature inside cocoon.
10°C.	15°C
9°	12°
7°	11°

Gradual Rise.

Surrounding temperature.	Time.	Temperature inside cocoon.
20°C.	0 min.	26°C.
44°	10 "	37°
61°	20 "	54°
66°	30 "	58°
68°	40 "	64°
75°	50 "	75°

Sudden Drop.

Surrounding temperature.	Time.	Temperature inside cocoon.
10°C.	0 min.	14°C.
0°	5 "	14°
0°	15 "	10°
0°	25 "	8°
0°	35 "	5°

Bag of *Thyridopteryx ephemeræformis*.

Field Conditions.

Outside temperature.	Temperature inside bag.
8°C.	13°C.
7°	11°
7°	7°

Gradual Rise.

Surrounding temperature	Time.	Temperature inside bag.
26°C.	0 min.	26°C.
38°	10 "	29°
48°	20 "	42°
50°	25 "	43°
53	30 "	48°
55°	35 "	52°
56°	40 "	53°

Sudden Drop.

Surrounding temperature.	Time.	Temperature inside bag.
10°C.	0 min.	26°C.
0°	5 "	25°
0°	15 "	13°
0°	25 "	5°
0°	35 "	3°

Cocoons of *Callosamia promethea* and *Tropæa luna* gave similar results. In spite of errors due to imperfect conditions, these tables show that the temperature inside a cocoon is practically the same as that of the surrounding air and that there is a constant tendency for the inside temperature to approach that of its surroundings.

One fact, however, which is readily apparent, is that sudden changes of temperature do not occur within the cocoon. When the outside temperature was suddenly lowered as from 10°C. to 0°C., the temperatures in the cocoons fell gradually and even during a gradual rise, the cocoon temperature lagged behind that of its surroundings. This is no doubt due to the poor conducting qualities of air and silk.

As the cocoon of *Samia cecropia* is double and the pupa thereby protected by two air spaces, this was somewhat more resistant to sudden changes of temperature than the others, a longer time being required for the inside temperature to reach that of the atmosphere, when either a rise or fall occurred.

From figures showing comparative conductivity[1] one can see that air is extremely poor conductor, and also wool, the thermal conductivity of which approaches that of silk, the exact figures for silk being unobtainable. It is worth noting that the rather thin paper-like covering of the bag worm was equally as resistant to sudden changes, as the well made heavier cocoons of *Bombyx mori* and *Callosamia promethea*.

From the standpoint of temperature alone it is doubtful if the pupa needs the protection afforded by a thick cocoon, especially when we consider that pupæ of the superfamily Papilionoidea are without such coverings.

From the standpoint, of moisture however, it is exceedingly necessary for the insect to have such a covering, especially if the pupal stage is passed on the ground among leaves or in situations likely to be moist.

Cocoons of *Callosamia promethea*, the layers of which tend to fray out toward the proximal ends, which are not finished inside with coatings similar to the remainder of the interiors, when partly

[1] The conductivities for heat of a number of substances is as follows: Copper, 1.041, Iron 0.167, Ice 0.0057, Marble 0.005, Glass 0.0025, Cork 0.0007, Wool 0.00012, Paper 0.000094, Air 0.000056.

submerged in water for seven hours, showed interiors perfectly dry, the water having penetrated only the outer layer. Those partly submerged in alcohol and sulphuric acid for the same time were wet clear through, the acid having softened the entire mass. Alcohol penetrated easily but did not have the disintegrating action of the acid. When totally submerged in the above liquids for one hour, the acid and alcohol readily entered the proximal end from which the moth escapes and also penetrated the sides, but water was effectually kept out, the fringe-like ends of the layers being bunched together sufficiently for that purpose, and the pressure of the air inside the cocoon undoubtedly helping also.

It is a generally accepted fact that the interiors of cocoons are coated all over with a gummy resinous substance, also that the emergence is usually effected by a fluid secreted by the insect, which has the property of softening the threads and gum.

The following paragraphs from Trouvelot explain how this is accomplished:

"*T. polyphemus* is provided with two glands opening into the mouth, which secrete during the last few days of the pupa state, a fluid which is a dissolvent for the gum so firmly uniting the fibres of the cocoon.

"This liquid is composed in great part of bombycic acid. When the insect has accomplished the work of transformation, which is going on under the pupa skin, it manifests a great activity, and soon the chrysalis covering bursts open longitudinally upon the thorax; the head and legs are soon disengaged, and the acid flows from its mouth, wetting the inside of the cocoon. The process of exclusion from the cocoon lasts for as much as half an hour. The insect seems to be instinctively aware that some time is required to dissolve the gum, as it does not make any attempt to open the the fibres and seems to wait with patience this event. When the liquid has fully penetrated the cocoon, the pupa contracts its body, and pressing the hinder end, which is furnished with little hooks against the inside of the cocoon, forcibly extends its body; at the same time the head pushes hard upon the fibres and a little swelling is observed on the outside.

"These contractions and extensions of the body are repeated many times and more fluid is added to soften the gum, until under these efforts the cocoon swells and finally the fibres separate, and

out comes the head of the moth. In an instant the legs are thrust out, and then the whole body appears; not a fibre has been broken, they have only been separated."

The cocoons of *Samia cecropia* and *Callosamia promethea* do not have a gummy coating over the entire interior. In each case the end through which the moth emerges is composed of silken fibres loosely pulled together and not covered with a gummy substance. It is as if each layer of the cocoon was spun into a fringe at this end, the fringes of all layers being bunched together forming a little cone. In the cocoon of *Samia cecropia*, it was possible to push a pencil through this fringe with apparently no effort. The fibres parted readily, it being necessary to break only a few in the extreme outside layer. The same can be said of *C. promethea's* cocoon.

This condition of affairs evidently enables the emerging insect to escape, without the aid of secretions or cutting apparatus, the struggles evidently helping considerably to enlarge the opening. It is rather strange how few text-books on entomology mention this method of emergence.

SITOWSKI'S NEW ABERRATION OF *COLIAS HYALE* L.

By P. W. Whiting.
Bussey Institution, Harvard University.

In the *Bulletin de L'Academie des Sciences de Cracovie* for May, 1913, L. Sitowski figures and describes an aberrant form of *Colias hyale* L. to which he gives the name *polonica*. The example, a male, was taken at Radlow in Galizia and appears to be different from any of the forms hitherto described. Besides minor differences of color distinguishing the aberration from the parental form, there is a great extension of the dark border on the upper side of the primaries into the disk, and an entire absence of the border on the upper side of the secondaries. A suffusion of dark scales over the light areas distinguishes the under sides of the wings from the type.

The scales of the wings are strikingly different from the normal, lacking altogether the apical processes and being smoothly rounded off instead. The scent-scales at the bases of the hind wings

are blunt rather than pointed and the striations are parallel to the sides rather than oblique as in the type.

Considerable discussion follows as to the causes which might be supposed to produce an aberration of this type. The hypothesis of Pictet, that one and the same factor may produce different changes of color, is adopted. Melanism and albinism are supposed to be brought about by the same environmental factor acting upon different individuals of the species. As evidence for this view, it is stated that dark forms and light forms occur in the same region, and the aberration *polonica* displays both the melanic and the albinic tendencies in the single individual. The author would seem to assume either that temperature, humidity and light must be constant in any given region or that the life histories of the various members of any species must be so adjusted that they are subject to exactly the same conditions at the same periods of development. It is also not at all clear why the breeding experiments with *Colias* should have been entirely overlooked. Harrison, Main and Frohawk have clearly shown that albinism is a segregating hereditary character in *C. edusa*, and Gerould in very extensive experiments upon *C. philodice* and *eurytheme* has demonstrated the laws of inheritance of albinism with large numbers. Judging also from our knowledge of spotting in general it seems much more probable that the aberrant coloration of *polonica* should be due in part if not wholly to hereditary rather than environmental factors.

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W. M. Wheeler, Bussey Institution,
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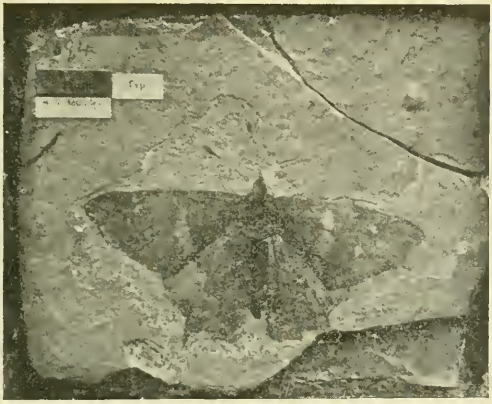

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THE NORTH AMERICAN FAMILIES OF LEPIDOPTERA.

By Wm. T. M. Forbes,
Worcester, Mass.

The following is an attempt to present in tabular form the differences in the families of Lepidoptera which occur in the United States, to which the few well characterized Central American families of Macros have been added for completeness. None of the accepted lists have been followed strictly in family delimitation. but on the other hand none of the changes is new. The butterflies are according to the system followed by Scudder and Comstock; the Macro-heterocera follow Dyar's list with a couple of changes; the Tineids are separated along the lines laid down in various papers by Busck, with the addition of the primitive families recognized by Spuler in the European fauna.

As compared with *Dyar's list* the principal changes are the following:

The Parnassiidæ are combined with the Papilionidæ.

The Agapetidæ, Heliconidæ, Ithomyidæ, Lymnadidæ, Libytheidæ, and Nymphalidæ are combined as Nymphalidæ.

The Megathymidæ with the Hesperiidæ.

The Nycteolidæ with the Noctuidæ, following Hampson. I am not at all sure that the union is justified, but no satisfactory family characters have been developed, and a number of the genera are doubtful. The most distinct characters of the Nycteolidæ are the slender male frenulum-hook, the peculiarly enlarged and bent basal joint of the antenna, the head-vestiture, and the raised scaling. The last is shared by various Noctuids, and intergrades seem to occur in the case of the other characters. The peculiar wing-form, which seems to have first given Nycteola its family status, is not shared by our second species, *Characoma nilotica* (=*N. proteella*).

Apatelodes is transferred to the mainly tropical family Eupterotidæ, on both larval and adult characters, but it makes a very distinct subfamily, largely developed in South America. So far as I can see the Australia Chelepteryx will also belong to it, and probably other Australian genera. It seems to be one of the interesting types, like the marsupials, which have survived only in America and Australia.

Psychophora fasciata is a normal Noctuid, with large ocelli and typical trifid Noctuid venation; on the other hand, so far as I can see, Curtis' figures of *P. sabinii* represent the common arctic Hydriomenid geometer which Hulst considered it to be.

The Pyromorphidæ and Chalcosiidæ have been treated as subfamilies of the typically European family Zygænidæ. Acoloithus, of our species, might about as well be placed in the typical Zygæninæ, next to Ino, as among the Pyromorphinæ.

The following partial generic list will explain the disposition of the Tineina:

Yponomeutidæ
Simæthis
Choreutis
Allononyma
Setiostoma
Glyphipteryx
Atteva (Œta)
Yponomeuta
Plutella
Cerostoma
Trachoma
Scythris ?
Argyresthia ?
Zelleria ?
Epermenia ?
Schreckensteinia ?
Gelechiidæ
as in Dyar's list
Œcophoridæ
as in Dyar's list
also Eido
Endrosis
but not Ethmia
Ethmiidæ
Ethmia

Stenomatidæ
Stenoma
Ide
Brachiloma
Blastobasidæ
as in Dyar's list
exc. Endrosis
Cosmopterygidæ
Coleophora ?
Batrachedra ?
Cosmopteryx
Lymnæcia
Stilbosis
Mompha (Laverna)
Walshia
Theisoa (Cacelice)
Chrysopeleia
Psacaphora
Leucophryne
Erineda ?
Elachistidæ
Elachista
Heliozelidæ
Heliozela
Antispila

Cycloplasis ?
Coptodisca ?
Douglasia ?
Tinagma ?
Heliodinidæ
Heliodines
Acrolepiidæ
Acrolepia
Gracilariidæ
Chilocampyla
Acrocercops
Parectopa
Gracilaria
Lithocolletis
Cremastobombycia
Ornix
Leucanthiza
Marmara
Lyonetiidæ
Bedellia ?
Proleucoptera
Philonome
Lyonetia
Phyllocnistis
Bucculatrix ?

Tineidæ
Argyresthia ?
Zelleria ?
Monopis
Tinea
Trichophaga
Tineola
Scardia
Xylesthia
Amydria
Setomorpha
Anaphora
Acrolophus
Hypoclopus
Pseudanaphora
Tischeriidæ
Tischeria
Coptotriche
Opostegidæ
Opostega
Nepticulidæ
Nepticula
Ectoedemia
Trifurcula
Adelidæ
Incurvaria
Brackenridgia
Cyane ?
Isocorypha?
Graya ?
Nemotois
Adela
Prodoxidæ
Prodoxus
Pronuba

I acknowledge considerable help from Mr. Busck in this part of the table, and regret he was unable to take time to contribute the Tineina as a whole. The interrogation points indicate some of the principal points where the family positions are uncertain, either from lack of study of dissections, or from failure to develop characters of true family rank. Most of the genera I have not seen I have simply omitted from the list, unless their position was quite evident. The Heliozelidæ, as they stand here are heterogeneous, with little doubt. Part of the genera may be distributed among the recognized families, while some may need to become typical of new ones. There are indications of a connection between Tischeria, Opostega and this group, through such forms as the Old-world genus Opogona, which may or may not be significant. Opostega is certainly aculeate, Tischeria has structures corresponding to aculeæ, but so enlarged and modified that their status is doubtful, while I am unable to see any at all in Antispila. The whole range of structure in the five families Gelechiidæ to Blastobasidæ is hardly as significant as that within the Tineidæ, even as here restricted.

The principal difference from the arrangement in *Comstock's Manual* is the treatment of the Tortricina, Geometrina and Pyralidina; (except the feathered forms) each as a single family. His Cymatophoridæ is the Thyatiridæ of this table, and his Zygænidæ are here called Syntomidæ, following general European usage in treating Zygæna as the group related to Pyromorpha. The Auzatidæ have been combined with the Drepanidæ (Platypterygidæ).

Kirby's Bibliography is so different in its treatment of family

lines that a detailed comparison is not worth while; for instance his Lasiocampidæ are here divided among the Saturniidæ, Lonomiidæ, Eupterotidæ, Lasiocampidæ, and Megalopygidæ, members of most of which also occur in others of his families.

The characters used are in general familiar, and fully explained, for instance, in Smith's Glossary of Entomology, but the following points may not be clear. The "quadrifid" venation is that in which M_2 and M_3 are so closely associated with the stem of cubitus as to appear more or less dislocated branches of it, as well as the two true branches of cubitus; in the trifid venation only M_3 is associated with cubitus, and M_2 is free, associated with the radial stem, or lost; of course in primitive forms, where the medials keep their basal connection direct, the cubitus has only the two branches that properly belong to it.

When only one pair of palpi are developed they are the labial; but in a few primitive forms, such as Prodoxus, the maxillary palpi are the larger and more conspicuous—they can be easily distinguished by their attachment to the tongue, and in these primitive forms by their larger number of joints (5) and free movability, being folded near the middle in repose, and usually in dead material.

Aculeæ are minute spinules scattered over the wing-membrane. They are several times as numerous as the scales, but so small as only to be visible with higher powers of the microscope, and being covered by the scales can only be seen in bleached and stained or denuded wings. In the Micropterygidæ, Hepialidæ, Prodoxidæ, Adelidæ and Nepticulidæ they are generally distributed; in the Heliozelidæ, Tischeriidæ and Opostegidæ they are mostly in the region of the base of the cell of the fore wing, and somewhat difficult to find; while in all the other Lepidoptera they are absent, except for a patch of enlarged modified ones near the base of the inner edge of the fore wing.

The antennæ in the great majority of Lepidoptera have regularly imbricated scales on the upper side of the shaft, while the sides, pectinations when present, and under side are covered only with minute sensory hairs. In the lowest families, however, such as the Tineidæ, the whole surface is scaled, and on the other hand the Saturniidæ have lost all the scales except on the basal joint.

At the base of the abdomen, on each side, there is a large cavity, which, to judge by its position and gross structure, is probably auditory in function. This is called the tympanic cavity here, and its outlet, which lies at the boundary between thorax and abdomen, the tympanic opening. Usually it is high up, about on the level of the wings in a spread specimen, but in the Geometridæ it is lower, and generally very conspicuous. In the Pericopidæ, where it is also particularly large, it is as high as in most families, and projects slightly above the general surface of the abdomen.

In counting the number of anals in the fore wing (alternative No. 8) an imperfect and rudimentary first anal, which only forms a short bar near the margin, is often met; in the Macros (forms with the wing-membrane three or four times as wide as its fringe or more, and generally hairy or deep vestiture) such a rudiment is not counted; in the Micros (where the wing-membrane is not more than twice as wide as its fringe, and the vestiture, except on the head, is scaly) it is. Doubtful cases have generally been entered twice in the table, but no attempt has been made to make the part referring to the Tineina complete.

Table of Families.[1]

1. Winged 2
1. Wingless 52
2. Hind wings with four or five radials, with at least ten veins besides anals, wing-membrane spinulated 3
2. Hind wings with only one free radial (two in the otherwise much reduced Douglasia group); with at most six (or with Sc, 7) veins from cell 4
3. Wings hardly wider than their fringe, expanse about one-half inch ..... MICROPTERYGIDÆ
3. Wings ample, fringe narrow, expanse over one inch ..... HEPIALIDÆ
4. Each wing deeply cleft into six narrow strips ..... ORNEODIDÆ
4. Fore wing moderately cleft into two, and hind wing deeply into three feathers ..... PTEROPHORIDÆ
4. Wings entire, or fore wing only, moderately cleft 5
5. Inner margin of fore wing and costal margin of hind wing narrowly folded, and interlocking; fore wing at least four times as long as wide, and base, at least, of hind wing transparent ..... ÆGERIIDÆ
5. Wings not interlocking at middle of margin, very rarely transparent, and if so with broader fore wings 6

[1] The New England families are indicated by small capitals.

6. Hind wing lanceolate, without marked anal angle, or notched below apex and trapezoidal; the fringe almost as wide as wing, or wider. . Tineina in part 55
6. Hind wings much broader than their fringe, never lanceolate and rarely trapezoidal with produced apex 7
7. A double series of enlarged and divergent scales along Cu of hind wing below *Pterophoridæ* (*Agdistinæ*)
7. No such specialized scales 8
8. Fore wing with two anals at margin 9
8. Fore wing with only one anal reaching margin, 1st A rudimentary, or represented by a fold; 3d A at most by a short spur 15
9. Antennæ strongly clubbed . . . . . *Castniidæ*
9. Antennæ tapering regularly 10
10. Sc and R of hind wing independent, parallel, connected by a strong cross-vein near middle of cell or beyond 11
10. Sc arising from cell near middle (sometimes free also for a short distance near base . . . . . Eucleidæ
10. Sc arising near tip of cell 14
10. Sc arising separate from R, running closely parallel to it to well beyond end of cell, or fused with it beyond end of cell; the base of R in that case either complete, showing as a short spur, or lost . . . . . Pyralidid.æ in part
10. Sc. entirely independent of R, or connected by a weak cross-vein, or one near base of wing, Sc and R sharply divergent before end of cell, Tineina in part 55
11. Fore wing with accessory cell 12
11. No accessory cell 13
12. Wings lanceolate, strong; body heavy, far exceeding the hind wings when spread . . . . . Cossidæ
12. Wings ample, rounded, body short and slender . . . . . *Dalceridæ*
13. Tongue developed, palpi scaled . . . . . *Zygænidæ* (*Chalcosiinæ*)
13. Tongue absent, palpi small and hairy or absent . . . . . most Psychidæ (♂s)
14. R 5 long-stalked, colors light, the northern species with crinkly hair on fore wing . . . . . Megalopygidæ
14. R 5 from cell, dark, smoothly scaled forms . . . . . Zygænidæ (Pyromorphinæ)
15. Hind wing with three anals, the first often fading out toward base 16
15. Hind wing with two anals or less, at most with a short spur of 1st A at margin in broad-winged forms 17
16. Sc and R of hind wing closely parallel or fused beyond end of cell Pyralidid.æ in part
16. Sc and R strongly divergent from before end of cell . . . . . Tineina in part 55
17. Antennæ distinctly swollen toward tip, and frenulum wanting, (Butterflies) 18
17. Antennæ not swollen toward tip, or if so (Agaristidæ, Sphingidæ) with a strong frenulum 23
18. Fore wing with all veins present, from cell, eyes strongly lashed in front, antennæ separated at base by a distance greater than half width of eyes Hesperiid.æ
18. Fore wing with some radials stalked or absent, eyes rarely lashed, antennæ closer together 19
19. Hind wing with only one anal . . . . . Papilionidæ

19. Hind wing with two well-developed anals....20
20. M_2 from middle of end of cell in both wings, or obsolete, fore wing in northern species with ten or eleven veins....21
20. M_2 distinctly associated with radial stem, in one, and usually in both wings; lower discocellular vein often obsolete, with at least a trace of a humeral vein....22
21. A humeral vein in hind wing....*Erycinidæ* (*Riodinidæ*)
21. No humeral vein....Lycænidæ
22. Butterfly walking on four legs (except female of Hypatus), radius five-branched, M_1 from cell....Nymphalidæ
22. Butterfly using all its legs for walking, radius usually four-branched, M_1 stalked with it....Pieridæ
23. Our species very stout and two inches or more in expanse, the hind wings rarely reaching beyond middle of abdomen, Sc and R of hind wing connected at the middle of the cell or rather before by a vein (R_1) which is as strong as any; and then closely parallel to end of cell or beyond....Sphingidæ
23. Wings proportionately larger, Sc and R rarely connected by a strong cross vein, and if so, strongly divergent beyond it....24
24. Sc and R separate, but connected by a more or less distinct cross-vein; accessory cell fused with discal cell, but with the line of separation (R_4+_5) indicated by a slight thickening, starting from an angulation in the stem of R; species under one inch in expanse....a few Tineina 55
24. Accessory cell separated by a full-sized vein, or completely absent....25
25. Cu of fore wing apparently three-(in a couple of Lithosians two-) branched..26
25. Cu of fore wing apparently four-branched....40
26. Frenulum normal....27
26. Frenulum rudimentary (less then one fifteenth length of hind wings) or absent 33
27. Sc and R fused from base of hind wing beyond middle, swollen at the base, then rapidly diverging; very slender....Lithosiidæ in part
27. Sc and R separate at extreme base, then closely approximate or fused a greater or less distance....28
27. Sc and R sharply divergent from close to base....Uraniidæ (Epipleminæ)
28. Stout-bodied moths, the thorax at least a sixth as wide as length of fore wings 29
28. Slender moths....32
29. A strong brace vein from an angle near base of Sc to root of frenulum Geometridæ in part
29. Sc moderately thickened and curved at base....30
30. Cu apparently three-branched in hind wing....31
30. Cu apparently four-branched in hind wing....Thyatiridæ
31. Tongue wholly absent, the northern species with hyaline subterminal spots Eupterotidæ (Apatelodinæ)
31. Tongue distinct, usually strong; wings fully scaled....Notodontidæ
32. Tympanic opening at base of abdomen small and subdorsal, 1st A usually partly present, Sc of hind wing slightly bent at base and but little enlarged; the humeral angle not expanded. Usually with M_3 and Cu_1 stalked in both wings....*Dioptidæ*

32. Tympanic opening with a few exceptions conspicuous, lateral; 1st A wholly absent in both wings; Sc of hind wing sharply bent or much enlarged at base, almost always with a brace vein running across to base of frenulum ..... most GEOMETRIDÆ
33. Sc and R of hind wing fused for a very short distance, then sharply divergent, separate from base, or connected by a weak cross-vein; tympanic opening inconspicuous 34
33. Sc sharply divergent from R at extreme base, then sharply bent and touching, fusing or closely parallel to it or connected by a strong cross-vein; tympanic opening conspicuous, lateral ..... a few GEOMETRIDÆ
34. Antennæ not scaled beyond basal joint 25
34. Antennæ closely scaled on upper side 36
35. Two anals; M_1 of fore wing connate or stalked with radial stem, CERATOCAMPIDÆ
35. M_1 separate from radial stem; with only one anal, or upper discocellular vein long and longitudinal ..... SATURNIIDÆ
36. Sc of hind wing sharply divergent from R from close to base 37
36. Sc and R parallel at base, connected by a weak cross-vein 39
37. R_{4+5} widely separated from R_3 all the way from cell to margin .... LACOSOMIDÆ
37. R_4 and R_5 arising from cell closely associated with R_3 38
38. R_5 and M_1 stalked or closely approximate at base, and separate from R_4 ..... *Uraniidæ* (*Uraniinæ*)
38. R_5 separate from R_4, which may be stalked with R_3 ..... *Lonomiidæ*
39. Frenulum about one-sixteenth length of hind wing .. *Eupterotidæ* (*Eupterotinæ*)
39. Frenulum obsolescent, not exceeding humeral angle, or absent ... *Bombycidæ*
40. Cu_2 of fore wing arising from cell about a third way out from base, or even nearer base; R_5 stalked with M_1, with humeral veins in our species; no frenulum ..... LASIOCAMPIDÆ
40. Cu_2 of fore wing arising well beyond middle of cell; usually with frenulum .. 41
41. Sc and R of hind wing strong and parallel to beyond end of cell, and then approaching very close or fusing a short distance ..... DREPANIDÆ
41. Sc and R fusing before end of cell or wholly independent 42
42. Fore wing with complete venation (twelve veins) all the radials, medials and cubitals arising separately, or with R_2 and $_3$ shortly stalked ..... THYRIDIDÆ
42. R_3 and $_4$ or R_4 and $_5$ long-stalked or with some veins absent 43
43. Sc apparently absent (fused except at extreme base with R) ..... SYNTOMIDÆ
43. Sc and R separating before end of cell 44
44. Antennæ swollen toward tip ..... AGARISTIDÆ
44. Shaft of antennæ regularly tapering 45
45. Ocelli present 46
45. Ocelli absent 50
46. Sc and R of hind wing fused to middle of cell or beyond ..... most ARCTIIDÆ
46. Sc and R fused for more than a fifth length of cell, but the fusion not reaching middle 47
46. Sc and R fused for less than a fifth length of cell, the fusion sometimes imperfect 48
46. Sc and R connected by a strong cross-vein ..... a few *Lymantriidæ**

* The Hypsidæ, distinguished by the well developed tongue, are represented by an unidentified and aberrant species in the Barnes Collection.

47. Hind tarsus ordinarily not more than eight times as long as thick, often with reduced tibial spurs; M_2 reduced only in *Eubaphe;* in the rest of full strength and associate with cubital stem; moths often stout; Sc very much swollen at base.....many ARCTIIDÆ
47. Hind tarsus ordinarily much more slender, the tibia with long spurs; M_2 usually well separated from cubital stem, though nearer it than radial, and often weaker than the other veins; Sc not more than twice as thick as R in their basal portion; usually slender moths.....some NOCTUIDÆ
48. Tympanic bullæ enlarged dorsally, showing from dorsal side as two rounded bosses on the first segment of the abdomen; brilliantly marked species PERICOPIDÆ
48. Tympanic bullæ inconspicuous.....49
49. White or yellow species with palpi not reaching the middle of the smooth-scaled front, and four-branched Cu in both wings.....ARCTIIDÆ (*Haploa*)
49. Species with longer palpi, three-branched Cu in hind wings or gray ground color.....most NOCTUIDÆ
50. Fore wing with raised scale-tufts, small, with Sc and R ordinarily fused to near middle of cell but free at base.....NOLIDÆ
50. Fore wings smoothly scaled.....51
51. Sc and R of hind wings fused for a point about middle of cell, or connected by a cross-vein.....most LYMANTRIIDÆ
51. Sc and R fused from base to middle of cell.....most LITHOSIIDÆ
52. Legs lost, never leaving cocoon.....PSYCHIDÆ (♀s in part)
52. With normal legs.....53
53. Cocoon seedlike, with a valve at one end (being formed of the larval case), the moth normally not leaving it.....PSYCHIDÆ (♀s in part)
53. Cocoon normally felted of the larval hair, or rudimentary and underground..54
54. Abdomen closely scaled, or spined, or with bristling dark gray hair GEOMETRIDÆ (a few ♀s)
54. Abdomen smoothly clothed with fine light woolly hair; moth not normally leaving the cocoon, which is composed of the larval hair LYMANTRIIDÆ (a few ♀s)
55. Fore wing with three or four unbranched veins only.....56
55. Fore wing with some branched veins.....57
56. A large eyecap.....OPOSTEGIDÆ
56. No eyecap.....HELIOZELIDÆ in part
57. A well-developed eyecap, fringed with overlapping scales; labial palpi small, cell slender or wanting.....58
57. Eyecap not developed,—at most with first joint of antenna large, a little hollowed on inner side, and fringed with a single row of bristles (pecten)...59
58. Cell very small, less than a tenth area of wing, or wholly absent; membrane aculeate.....NEPTICULIDÆ
58. Cell larger, membrane not aculeate.....LYONETIIDÆ
59. Maxillary palpi twice as long as eye, folded, conspicuous.....PRODOXIDÆ
59. Maxillary palpi shorter than eye, or porrect.....60

60. Vestiture of thorax of deep hair and spatulate hair, also similar on palpi and legs, the palpi usually strongly sexually dimorphic, large in both sexes; wings scaled, venation complete, with base of media preserved
TINEIDÆ (ANAPHORINÆ)

60. Palpi barely reaching middle of front or shorter, tongue absent; vestiture of thorax and tibiæ dense and hairy ..... (*Cossidæ* in part)

60. Thorax, at least, scaled or slender, palpi also in the majority of cases, and fore and middle tibiæ; often minute moths with lanceolate wings 61

61. Hind wing lanceolate, much narrower than its own fringe, fore wing much broader but also lanceolate 62

61. Hind wings with well-marked anal angle and rounded or somewhat pointed apex, not strongly concave below it; when narrower than fore wings, with three well-developed anals 76

61. Hind wings various in size with produced apex, strongly concave below apex, and again produced more or less on M_3 and Cu_1, with well-marked anal angle ..... most GELECHIIDÆ

62. Maxillary palpi present and folded in repose 63

62. Maxillary palpi obsolete, or three-jointed and porrect 65

63. Head extremely rough, with bristling vestiture 64

63. Head smooth-scaled, except narrowly behind ..... ACROLEPIIDÆ

64. Aculeate; R_1 of hind wing much stronger than base of main stem of R, and appearing as a basal fork of Sc ..... a few ADELIDÆ

64. Not aculeate; R_1 of hind wing no stronger than basal portion of Rs, well out from base, connecting Sc and R, which are closely parallel toward base
a few TINEIDÆ

65. Head very rough and bristly on both vertex and face, second joint of palpus with lateral bristles toward tip ..... TINEIDÆ (Tenaga)

65. Lower part of face, at least, smoothly scaled; palpus without bristles 66

66. Fore wing with four veins or less, either free or stalked, to costa from cell, and five or six veins to inner margin (R_3 running to outer margin)
some YPONOMEUTIDÆ

66. Fore wing with five veins to costa from cell or with only three or four to inner margin (R_3 to costa) 67

67. Vertex rough-bristled 68

67. Vertex smooth-scaled, or with a few erect scales behind 70

68. Accessory cell very large, extending nearly half-way to base of wing, fore wing with heavy spinules on base of Sc and base of cell ..... TISCHERIIDÆ

68. Accessory cell small, or more often absent; not aculeate 69

69. A of fore wing forked at base, costa of hind wing not lobed ..... BEDELLIA

69. A of fore wing perfectly simple, costa of hind wing strongly lobed, with the obscure basal parts of Sc and R closely parallel to the edge of the lobe
GRACILARIIDÆ

70. Sc and R of hind wing nearly straight and parallel toward base, usually connected by a distinct, but weak cross-vein R_1, a short distance out from base, in a few cases where Sc is very short, with R_1 independent of it, reaching the costa beyond its tip; when the costa is lobed with Sc fairly straight, and ending at the commencement of the concave portion 71

70. Sc and R sharply divergent at base, R_1 when traceable appearing as a basal fork of Sc, oblique, short, and heavy, and R_5 running nearly through the axis of the wing; or with Sc and R both obscure, closely parallel to the basal lobe of the costa, and R functionally replaced by the base of M.....72
71. Balpi upturned to vertex.....COSMOPTERYGIDÆ
71. Palpi minute, drooping.....HELIODINIDÆ
72. Maxillary palpi present, porrect.....GRACILARIIDÆ in part
72. Maxillary palpi absent.....73
73. Cu-stem of hind wing at least two-branched, palpi usually smoothly upturned to vertex, hind tibiæ loosely hairy.....ELACHISTIDÆ
73. Cu-stem of hind wing simple, free, no cell, or with very short palpi.....74
74. Basal joint of antenna broadened with overlapping scales (a rudiment of an eyecap), tongue weak, Cu of hind wing simple; hind tibia with a regular series of bristles.....*Lyonetiidæ* (*Phyllocnistis* in part)
74. Basal joint simple or with a slight pecten of bristles.....75
75. Palpi if upturned not reaching middle of front, usually hanging, HELIOZELIDÆ
75. Palpi moderately long and usually slender, upturned in life GRACILARIIDÆ in part
76. Cu_2 of fore wing arising less than two-thirds way out on cell, most TORTRICIDÆ
76. Cu_2 of fore wing arising further out on cell.....77
77. Wing-membrane aculeate; Sc of hind wing with a strong basal fork (the lower fork being R_1), or considerably swollen at base, R and Sc usually sharply divergent from base, antennæ often extremely long, vertex very rough ADELIDÆ in part
77. Wing-membrane not aculeate; antennæ never much longer than fore wing; R_1 rarely as strong as the other veins, and when distinct separated from the base of the wing by several times its length.....78
78. Maxillary palpi four- or five-jointed, folded.....79
78. Maxillary palpi porrect, three-jointed or rudimentary.....80
79. Head only slightly rough behind.....ACROLEPIIDÆ
79. Vertex with long bristly vestiture.....TINEIDÆ in part
80. M_1 and $_2$ of hind wing both absent.....TORTRICIDÆ (Carposina)
80. M_1 of hind wing present.....81
81. Labial palpi with bristles on side of second joint, or vertex and front both with extremely long rough vestiture, and second joint of palpus heavily tufted and third long; R and M_1 of hind wing widely separate..TINEIDÆ in part
81. Labial palpi without bristles, head with short, fairly smooth vestiture or third joint of palpus inconspicuous.....82
82. R and M_1 of hind wing widely separate at base, at least half as far apart as at margin.....87
82. R and M_1 of hind wing closely approximate or stalked.....83
83. Palpi as long as head, with second joint triangularly scaled, and third less than half as long normally porrect.....84
83. Palpi upturned to beyond middle of front often far beyond vertex, the third joint more than half as long as second, and upturned.....85
84. R_4 and $_5$ separate.....TORTRICIDÆ (PHALONIINÆ)
84. R_4 and $_5$ stalked, to costa.....GELECHIIDÆ (male *Anarsia*)

85. Veins of fore wing all present and R_5 running to outer margin
YPONOMEUTIDÆ in part
85. R_5 running to costa or lost....86
86. Fore wing with all veins from cell separately, hind wing wider, with R and M_1 long-stalked.... STENOMATIDÆ
86. Fore wing with R_4 and $_5$ stalked, the hind wing trapezoidal and usually wider, strongly rounded out at end of M_3 and Cu_1.....a few GELECHIIDÆ
86. Hind wing lanceolate, narrower than fore wing.....COSMOPTERYGIDÆ
87. R_2 arising at apex of cell, and M_3 and cubitals also closely crowded from lower angle, male usually with strong sexual modifications; five radials run to costa.....BLASTOBASIDÆ
87. R_2 arising less than nine tenths the length of the cell, and well away from the origin of R_3.....88
88. Five veins run from cell to costa in fore wing.....89
88. Four veins run from cell to costa in fore wing, R_5 ending decidedly below the apex.....90
89. Hind wing with M_2 arising decidedly nearer M_1 than M_3.....ETHMIIDÆ
89. Hind wing with M_2 arising decidedly nearer M_3 than M_1 or rarely half way between them.....ŒCOPHORIDÆ in part
90. R_4 and $_5$ stalked; ocelli rudimentary or absent.....ŒCOPHORIDÆ in part
90. With all veins of fore wing arising separately or (Allononyma) with R_4 and $_5$ stalked and large ocelli.....YPONOMEUTIDÆ in part

EXPLANATION OF FIGURES.

Fig. 1. Typical primitive Lepidopterous venation (*Eriocephala thunbergella*, with the addition, in dots, of a few veins lost in Eriocephala, but generally preserved), the veins numbered according to the Comstock-Needham and German systems.

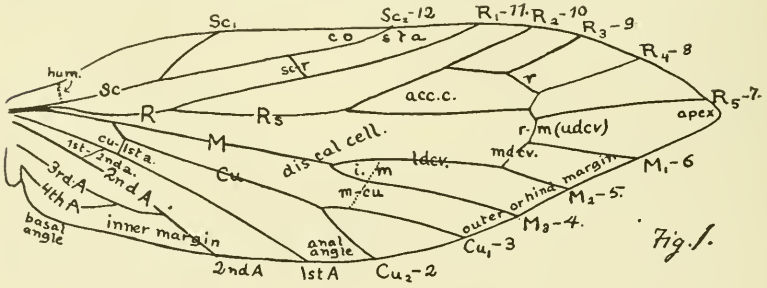

Fig. 1.

Sc, Subcosta.
R, Radius.
M, Media.
Cu, Cubitus.
A, Anal.
hum, humeral cross-vein.
udcv, upper discocellular vein (cross-vein radius-media).

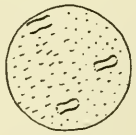

Fig.

mdcv, middle discocellular vein (in this case, and usually, a portion of media-one).

ldcv, lower discocellular vein (the portion so marked is a portion of the stem of media one-plus-two, but as ordinarily defined the short cross-vein m. would also be considered part of it).

1st A is a concave vein, and when it becomes rudimentary is known as the submedian fold.

The veins, hum., Sc^1, sc-r, r, cu-1st a, 1st-2d a, and 4th a, are lost in almost all higher forms.

i, Intercalated cell (reckoned as part of the discal cell).

acc. c, Accessory cell (reckoned as part of the discal cell in micros- and butterflies, where it is more or less completely fused with it, but not in most moths, where it is perfectly separated, when present).

Fig. 2. Portion of bleached wing-membrane, showing points of attachment of scales and aculeæ.

THE ALIMENTARY CANAL OF A CERCOPID.

By J. C. Kershaw.

The following brief notes refer to *Tomaspis saccharina* Dist., a pest of sugar cane in Trinidad, West Indies, where the nymphs feed on cane roots and the adults on the leaves. In the nymph of this Cercopid the air, which all sucking insects doubtless imbibe in quantity along with the liquid food, appears to pass through the alimentary canal and be utilized in forming the air-bubbles coated with mucinoid which are emitted from the anus and form the froth in which the nymph lives. After examining this Cercopid I am the more inclined to believe that (as stated in a previous paper on Flata in Psyche) the "food-reservoir" in the head of Flata functions in part as an air-separator to rid the liquid food of superabundant air before it passes through the alimentary canal. In the Cercopid nymph, however, the air is directly utilized, as mentioned above. In this Cercopid and in Cicada the diverticulum or pouch of the midgut (forming the "food-reservoir" of the head in Flata and the filter-chamber of the thorax in Cercopid and Cicada) is almost filled up by the zigzag course through it of the posterior part of the midgut and the anterior part of the malpighian tubes. This diverticulum, pouch or filter-chamber is entirely situated in the thorax, as are also the diverticula of Perkinsiella and other Homoptera mentioned in the paper referred to above; only entering the head in Flata, Pyrops and Dictyophoro-

delphax, so far as I have had the opportunity to ascertain, and in these genera the diverticulum does not enclose other portions of the alimentary canal. But although the alimentary canals of these Homoptera are all on the same plan, yet the simple arrangement of Aleyrodes and Psyllid seems to lead up to and culminate in the very complex system of Cercopid and Cicada. On considering the diverticula and zigzags of these two latter one must, I think, conclude that Berlese's theory (of filtration or osmosis in order to get rid more quickly of innutritious liquid) is correct. Dr. Licent's opinion that the anterior portion of the malpighian tubes is producing the froth or spume of the nymph is, in my opinion, certainly correct.

The alimentary canal of the nymph of Tomaspis, when just hatched, is practically like that of the adult, so that the enwrapping of other parts of the midgut by the diverticulum takes place in the embryo. There is a well-marked œsophageal valve, and behind and laterally to this the midgut forms a recurved diverticulum or pouch somewhat U-shaped in transverse section, the external cavity of the pouch enclosing the zigzag ascending anterior portion of the midgut and descending straight portion; also the straight ascending and zigzag descending portions of the malpighian tubes. But the whole pouch and all parts of the alimentary canal are covered by the peritoneal membrane, muscular and connective tissues. Thus the zigzags of the various parts of the gut do not pierce the walls of the pouch in order to enter or leave it, but are merely enclosed between its exterior walls (fig. 1, d′, ex), the peritoneal membrane, muscular and connective tissues sealing up their entrances and exits and the narrow gap or slit-like opening (fig. 1, d′, so) between the exterior walls of the pouch. I thus differ from Dr. Licent in believing that the basement-membrane of the epithelium of the pouch does not separate or split off therefrom and enclose the other portions of the midgut, but that it is the peritoneal membrane which encloses the whole hermetically. The pouch is a diverticulum of the midgut, and the lips of its long, narrow internal aperture leading from the pouch to the sac are bounded by a broad and thick band of fat-cells (fig. 3, f) on each side, which may probably act as a valve to regulate the flow of food from the pouch to the sac; and as the latter is somewhat askew to the large and more or less conical sac of the midgut, the

muscle connecting the œsophagus and top of the sac may—by pulling the pouch and sac still more askew—contract the opening further, or by relaxing open it wider. The pouch lies ventrally and medianly within the mesothorax. The sac lies more dorsally and chiefly within the meta-thorax, but projects at times into the abdomen. The œsophagus runs through the pro-thorax. In figures 2 and 3 the anterior end of the pouch is not quite in a natural position, since it is usually more pulled over and downwards to the top of the sac by the large muscle attached to the latter and to the œsophagus. Figures 2 and 3 are slightly diagrammatic to avoid confusion of parts. The lines of the organs in the transverse section if projected to the longitudinal view (fig. 3) would not all agree as they strictly should; for instance the ascending midgut, to agree with the transverse section strictly, should have been dotted in right behind the malpighian tubes, instead of being shown just clearing them, but this would altogether have confused the sketch. The epithelium of the pouch not only tucks in longitudinally between the malpighian tubes, midgut, etc. (fig. 3, trans. sec.), but also—in a plane at right angles to the longitudinal tucks—between the several zigzags of the various tubes (fig. 3, i, k). This is only just indicated for the longitudinal tucks in the transverse section; in reality the epithelium follows all the interspaces of the organs very closely indeed, and more or less adheres to, but does not fuse with, the latter. Thus it presents a very large area for filtration or osmotic action.

The total length of the alimentary canal is about fifty mm., made up as follows:—the œsophagus is about 1 mm.; the pouch and sac together 3 mm.; the tubular part of the midgut from the sac to the constriction or midgut sphincter [1] 10 mm.; from thence to its entrance into the pouch 15 mm.; the zigzag portion within the pouch 11 mm.; from the anterior end of the zigzag to the origin of the malpighian tubes (rectal valve) 1 mm.; thence to the anus 9 mm. The length of the lobulate portion of the malpighian tubes is about 7 mm.; the smooth portion to their entrance into the pouch 3 mm.; the zigzag portion within the pouch 7 mm.; the straight portion to the origin of the tubes 1 mm.; total length about 18 mm. All measurements were taken with the organs straightened out but not unduly stretched.

[1] This constriction is provided with annular muscles.

The appearance and contents of the posterior part of the alimentary canal of the nymph—from the mid-gut sphincter to a little within the pouch—differ from that of the adult in being of an opaque white (due to the contents) and swollen with a great quantity of semi-translucent, colorless or whitish granules varying from one to fifteen microns in diameter, the majority being about five; the contents of two nymphal posterior guts were analyzed at the Trinidad Government Analyst's Laboratory and the granules were found to be amorphous insoluble calcium phosphate and to constitute about 80 per cent. of the contents of the gut; the remaining contents consisted of organic matter (which would be chiefly old, detached cell fragments from the epithelium of the gut) and sodium chloride and potassium phosphate. A quantity of the roots of the grass on which the nymphs chiefly feed was also analyzed by the Government Laboratory; they contained small quantities of calcium salts and phosphates, but there was no evidence of the presence of insoluble forms of calcium phosphate. The Cercopid, very shortly after moulting to adult, voids a quantity of a white substance like plaster-of-paris, which dries on the leaf or other object and takes its impress, afterwards drying and becoming hard and brittle. This is often left under the old froth and moulted skin, as the adult usually remains in the spittle until its integument becomes hard and fully colored. This white substance is chiefly calcium phosphate, and gives canary-yellow crystals when heated with a solution of ammonium molybdate in nitric acid. Thus it seems that the greater part of this phosphate is retained in the posterior part of the gut of the nymph and only evacuated after the final moult. Each insect voids about two milligrams of this substance.[1]

The epithelial cells of the posterior portion of the gut are usually loaded with dark granules (food in process of absorption); those of the anterior part—before the sphincter—are fairly clear and the gut is semi-translucent pale yellowish-brown, as it is throughout in the adult as a rule: rarely an adult also has the posterior portion of the gut white as in the nymph, due to its contents being of the same nature.

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[1]9.4 milligrams of this excrement was dried at 100° C. when its weight was 6 mg., and was analyzed by Mr. Shrewsbury of the Trinidad Government Laboratory. "Percentage composition of excrement: organic matter, 20.0; water, 36.0; ash calcium potassium phosphate with minute trace of iron, 44.0. The organic matter was largely ammonium urate. The microscopic appearance of the globular particles of which this excrement was composed was exactly similar to that of urinary calculi."

The froth or spittle of the nymph appears to be a mucin or mucinoid, since it reacts to the usual tests for mucin; it granulates with sub-acetate of lead and stains deeply with methylene blue in glycerine and alcohol; the material taken from the malpighian tubes before it is poured into the gut also gives the xanthoproteic reaction. This mucinous substance is produced by the anterior or smooth portion of the malpighian tubes, which in the nymph is of larger diameter than the lobed part through being swollen with the secretion, whilst in the adult the reverse is usually the case. The nuclei of the smooth part of the tube take Delafields haematoxylin heavily; those of the lobed part mostly stain but faintly. If the smooth part of a nymphal tube is placed in alcohol, the contained mucinoid shrinks and coagulates and can be dissected out as a very pale yellowish, stringy substance. If this coagulated material is then placed in water, it quickly swells and becomes viscid, pale bluish-translucent and just like the untreated material fresh from the tubes. The alcohol and water treatment several times in succession leaves the material practically unaltered after again placing it in water. The secreted froth is a very stubborn material, though it consists merely of air-bubbles coated with an exceedingly thin film of the mucinoid; in this, however, are numbers of crystals; those of calcium oxalate are numerous; uric acid, leucine pellets and urates are also present; also sodium and potassium chlorides. In fact every substance excreted from the anus of the nymph is found in the froth, but it is the mucinoid substance which accounts for the froth retaining its form more or less for three or four days after the nymph has abandoned it. Fragments of shed epithelium from the gut occur in the excrement of both nymph and adult.

I could find but few crystals in the lobed portion of the malpighian tubes; those of uric acid are large and there are numerous urate granules. But some of the œnocytes contain uric acid and calcium oxalate crystals and urates. These cells are exceedingly large, situated in a cluster on either side of the abdomen, and their outer membrane granulated with a claret-red color. They are, as usual, connected intimately to the tracheæ near the spiracles and also to the fat-body, which also contains urates, etc., in some of the cells.

The blood of the nymph differs conspicuously from that of the adult; in the former it is nearly colorless, in the latter of a bright and clear oil-yellow.

The salivary glands are highly developed and differ somewhat in the nymph and adult. The great length of coiled, chitinous duct situated entirely within the upper part of the head acts, I believe, as a salivary-reservoir. At its distal end is a small and irregularly shaped flattened gland, also within the head. Eleven of the tubular glands reach, when straightened out, beyond the end of the abdomen, and, therefore, are somewhat serpentine within the body, or their ends are recurved and lie at the posterior end of the abdomen amongst the fat-body and other organs. The twelfth tube is shorter and thicker and lies partly within the head,being apparently entangled and drawn in by the coil of salivary-reservoir and muscles of the head. The anterior lobes of the glands lie within the pro- and meso-thorax. The secretion of the glands seems to be neutral or very faintly alkaline.

In the nymph of the Cercopid there is a curious arrangement of the spiracles, primarily, no doubt, for the purpose of preventing them from becoming choked with the glutinous froth or spume in which the nymph lives. The tergal plates and pleura of the abdomen are greatly produced and bent around the underside of the abdomen till the opposing ends touch one another. Thus is formed—for the whole length of the abdomen—on the underside of the nymph a large air-chamber or reservoir. The spiracles open into the upper part of this chamber, so that although the whole chamber and spiracles are, of course, integumentary and external, nothing can be seen of them by viewing the nymph on the exterior, unless the ends of the plates closing the chamber are turned up. Apparently the whole sternal surface of the abdomen has been invaginated and has thus drawn inwards the pleural region with the spiracles, and pulled around the ends of the tergal plates, as shown in the diagrammatic sketch. In the adult the tergal and sternal plates with the pleura have returned to a normal position, and consequently there is no air-reservoir. The nymph appears to hermetically seal itself with the froth, but the amount of air contained in the chamber is sufficient to last for a considerable time. I think, however, that from time to time the nymph breaks through the covering of froth—generally with one of the fore legs —and thus admits a fresh supply of air, afterwards resealing the rent with fresh mucinoid. At each moult, also, the nymph usually

but not invariably leaves its old froth and covers itself with fresh spittle on a new rootlet.

The total length of an adult *Tomaspis saccharina* is 7—8 mm., or a full quarter-of-an-inch, from the head to the tips of the tegmina.

In Cicada (a moderate-sized species common in Trinidad was examined) instead of the rectum descending from the posterior end of the diverticulum, it descends from the anterior. The malpighian tubes, also, descend from the anterior part of the diverticulum to the rectal valve without any return portion within the pouch, as there is in Cercopid; so that on the whole, perhaps, the alimentary system of Cercopid is slightly more complicated than that of Cicada. The malpighian tubes of Cicada fork very near their point of origin, as shown in fig. 5.

In the Psyllid (*Freysuila dugesii* Aleman, also common in Trinidad on the so-called Cedar) the arrangement of the alimentary canal is as simple as in Aleyrodes, but there are four malpighian tubes; these originate from the rectum at a great distance apart from one another.[1] The two middle tubes were much shorter than the end ones in the specimens dissected.

I send these notes to PSYCHE chiefly because the figures form a continuation of a former paper therein on the alimentary canal of various Homoptera, and owing to pressure of economic work on this Cercopid in Trinidad I shall probably be unable to add much to them. Unfortunately I have neither a copy of Licent's paper nor of my own previous paper in PSYCHE, in which, however, Dr. Licent's paper is referred to. In conclusion it must be added that I am greatly indebted to Prof. P. Carmody, Director of Agriculture, Trinidad, who very kindly had the foregoing analyses made in the Government Laboratory, and, moreover, gave valuable suggestions and assistance in the chemistry of this Cercopid. I have also to thank Mr. H. S. Shrewsbury, who made the analyses.

EXPLANATION OF FIGURES.

1.

a, diagrammatic longitudinal section of diverticulum or pouch.

b, diagrammatic transverse section of diverticulum or pouch.

c, external diagrammatic lateral view.

d, diagrammatic transverse section of pouch, much simplified.

2.

d, exterior view of alimentary canal of adult *Tomaspis*.

e, exterior view looking on anterior end.

[1] "Text-book of Entomology," Packard, 1903, p. 320.

f, exterior view of midgut at sphincter; and cells of epithelium. More enlarged. Dark portion posterior, light portion anterior gut.
g, part of malpighian tube of nymph, junction of smooth and lobed parts.
h, the same, more enlarged.

3.

Longitudinal section through pouch and part of œsophagus and sac. Only two malpighian tubes shown fully. Transverse section through pouch; both sections are slightly diagrammatic.
i, ventral view of part of zigzag of midgut.
k, lateral view of part of a malpighian tube.

4.

To left, adult salivary glands; to right, nymphal glands.

5.

Alimentary canal of Cicada.

6.

Alimentary canal of Psyllid.

7.

a, diagrammatic transverse section of nymph of Cercopid feeding on rootlet.
b, diagrammatic transverse section of adult abdomen.

LETTERING OF FIGURES.

a = anus.
ac = air-chamber.
ag = abdominal salivary gland.
alc = parts of midgut enclosed in pouch.
am = ascending midgut.
amp = ascending malpighian tube.
boe = base of œsophagus and upper part of sac.
c = exterior cavity of pouch or diverticulum of midgut.
ca = cavity of abdomen.
cs = constriction of midgut sphincter.
d = dorsal part of abdomen.
dm = descending midgut.
dmp = descending malpighian tube.
dr = descending rectum.
ep = epithelium of pouch.
ex = external wall of pouch.
f = fat-cells bounding aperture between pouch and sac.
fc = filter-chamber or diverticulum or pouch.
hg = gland of salivary reservoir in head.
id = interior cavity of pouch.
lm = longitudinal muscles.
m = muscle connecting œsophagus and sac.
mi = midgut.
miv = midgut valve or aperture between pouch and sac.
mp = malpighian tubes.
ms = mucinoid secretion.
n = nucleus.
œ = œsophagus.
œv = œsophageal valve.
p = peritoneal membrane.
pl = pleurum.
r = rectum.
rd = salivary reservoir duct.
re = salivary reservoir.
ro = rootlet of plant.
rv = rectal valve.
s = spume or froth of nymph.
sd = salivary gland duct.
se = sternite.
so = slitlike opening to exterior cavity of pouch.
sp = salivary syringe or pump.
spe = spiracle.
te = tergite.
tg = thoracic salivary gland.
tm = transverse muscles.
tr = trachea.

FOUR NEW AMERICAN HEMIPTERA.

By E. Bergroth,

Turtola, Finland.

Among some determinanda communicated by Prof. C. F. Baker were the following undescribed species.

Family Pyrrhocoridæ.

Largus latus sp. nov.

Broadly ovate, black, above remotely punctured, shortly and sparingly pilose, the impunctate head and the middle of the venter more longly pilose, an oblong impunctate lateral spot near the anterior angles of the pronotum, the commissure of the clavus, the membrane (except border and veins), the posterior border of the metasternum, the whole first ventral segment and the border of the abdomen buff, the broadly pale ochraceous lateral border of the corium not reaching the base, inwardly angularly dilated a little before the middle. Head narrower than anterior lobe of pronotum, eyes shortly stylated, rostrum reaching middle coxæ, second and third antennal joint together shorter than first joint but a little longer than fourth, second half as long again as third. Pronotum at the base twice as broad as the head. Breast rugose. Hemelytra a little shorter than the abdomen, laterally strongly rounded. Anterior femora beneath with one strong spine and some smaller ones. Middle and posterior femora unarmed. Length, ♀ 15 mm.

Locality: Bolivia.

Structurally allied to *L. balteatus* Stål which I know only from description, but it is so quite differently colored that it cannot be a variety of that species.

Dysdercus fervidus sp. nov.

Red, above crimson, antennæ, lateral margins of prothorax, a broad subbasal fascia to pronotum, clavus, a fascia just behind the middle and the apical angle of the corium, membrane, and legs (except coxæ and trochanters) black, membrane bordered with white, rostrum gradually becoming piceous towards the tip. Head behind with a fine longitudinal impressed line extending to the base of the tylus, rostrum passing the middle of the third ventral segment, first joint of antennæ distinctly longer than the head, second joint somewhat shorter than first and twice as long as third, fourth rather thick, about as long as first. Pronotum, clavus, and corium punctate, underside of body impunctate. Sixth male ventral segment in the middle very little shorter than fifth and fourth together. Length, ♂ 9.5 mm.

Locality: Cuba (Havana).

Among the numerous American species of this genus I am unable to find a description fitting this pretty little species. Its nearest ally seems to be *D. fervens* Walk.

Family Myodochidæ.

Pamera hondurana sp. nov.

Sparingly pilose, black, hind lobe of pronotum dark castaneous, clavus with a white streak near the outer margin, corium white, in the basal half with two longitudinal blackish streaks meeting anteriorly, and a little behind the middle with a rather broad transverse cinnamon-brown band which turns black at the costal margin, an exteriorly widening black fascia occupying the apical margin of the corium, membrane fuscous black with an oval rather obscure whitish spot behind the middle, hind acetabula and posterior angles of metasternum white, abdomen fuscous toward the base, antennæ testaceous, last joint fuscous, rostrum and fore legs dark ferruginous, fore femora blackish toward the base, middle and hind legs black, trochanters and base of femora whitish, tarsi pale fuscous. Head extremely finely rugulose, a little broader than anterior lobe of pronotum, postocular part very short, eyes rather large but moderately prominent, first joint of antennæ reaching apex of head, second joint more than twice the length of first, third distinctly shorter than second, fourth as long as second. Pronotum impunctate, very strongly constricted and deeply transversely impressed behind the middle, basal margin straight, anterior lobe subglobose, not quite twice the length of posterior lobe. Scutellum sloping backwards, its basal half shining, transversely convex, finely and sparsely punctate, apical half dull, impunctate. Hemelytra reaching apex of abdomen, corium with a few almost colorless punctures, its costal margin slightly and broadly sinuate a little before the middle. Fore femora strongly incrassated, with a double row of spines beneath, fore tibiæ slightly curved; first joint of hind tarsi two times longer than the other joints conjoined. Length, ♂ 4.5 mm.

Locality: British Honduras (Belize).

This elegant species is very distinct from the other Central American forms. Owing to the very strongly constricted pronotum it differs somewhat in habitus from most species of the genus.

Family Veliidæ.

Rhagovelia bakeri sp. nov.

Above black, beneath greyish black, legs greenish black, somewhat aenescent, pronotum with an apical whitish fascia interrupted in the middle, abdomen at the sides immediately within the margin narrowly and obscurely streaked with yellowish brown, basal part of first antennal joint, anterior acetabula, all coxæ and trochanters, and basal part of fore femora yellow, hind femora at the base above and beneath also tinged with yellow. Head with an impressed median line in front, rostrum passing the middle of the mesosternum, antennæ with the first two joints pubescent, with scattered longer hairs, outer margin of the last three joints straight, inner margin slightly convex, first joint one-half longer than second, third a little shorter than second, fourth hardly shorter than third, pointed at tip. Mesosternum with the ridges between the anterior and the middle coxæ well marked, pubescent, curved inwardly, strongly divergent posteriorly. Abdomen gradually tapering to the tip, not carinated beneath. Legs pubescent, with scattered longer hairs, middle femora thickened toward the base, middle tarsi a little longer than the tibiæ, the second joint a little shorter than the third, posterior tibiæ with a short straight spur at the apex.

Apterous male: Pronotum a little broader than long, rounded behind. Last dorsal segment of abdomen truncate at apex, last ventral segment arcuately emarginate at apex. First genital segment ferruginous beneath at the base. Posterior, femora very strongly incrassate, not reaching the tip of the apical genital segment spined beneath from the apex to a little beyond the middle, the first spine (near the middle) the longest, the following gradually diminishing in length toward the apex. Posterior tibiæ straight, finely denticulate beneath down their whole length, without large teeth, the teeth of the middle third slightly longer, the apical third slightly narrower than the rest. Length, 4 mm.

Locality: Nicaragua (Granada).

Allied to *Rh. femoralis* Champ., but the antennæ are differently constructed; the venter is not ridged in the middle; the posterior tibiæ have no large teeth, etc.

NOTE ON THE HABITS OF LIOMYRMEX.

By William Morton Wheeler,
Bussey Institution, Harvard University.

The ant genus *Liomyrmex* comprises four described species, *cæcus* F. Smith, *gestroi* Emery, *aurianus* Emery and *carinatus Stitz*, all from New Guinea, except *aurianus*, which has been taken hitherto only on the island of Tenasserim, off the coast of Burmah. *L. carinatus* and *gestroi* are known only from female specimens, the other two species only from workers. The complete absence of eyes in the latter phase and its testaceous coloration show that these ants must be decidedly hypogæic, but no account of their habits has been published.

Recently Prof. C. F. Baker has sent me from Mt. Makiling, on the island of Luzon, Philippines, several worker specimens, which, except in their slightly smaller size, agree perfectly with Emery's description of the Burmese *L. aurianus* (Ann. Mus. Civ. Genova, XXVII, 1889, p. 504). Prof. Baker states in his letter that these ants were found in the forest, "abundant with termites—living in the same chambers with these in entire amity." The termites, of which a number were included in the same vial with the *Liomyrmex*, are workers and soldiers of *Termes* (*Macrotermes*) *gilvus* Hagen, which is widely distributed in the East Indies (Singapore, Java, Sumatra, Borneo, Philippines, etc.). This must be a formidable species, for the larger soldiers measure nearly 10 mm. and are furnished with acute and powerful jaws.

Prof. Baker's observations leave no doubt that the species of *Liomyrmex* are true termitophiles and suggest that their relations to the termites are more intimate than those of the species of *Carebara*, *Aëromyrma*, *Erebomyrma*, etc., which seem to be thief-ants, living in chambers of their own in the solid masonry of the termitaria and feeding surreptitiously on the termites and their brood.

THE PHORID GENUS PLATYPHORA IN AMERICA.

By Charles T. Brues,
Bussey Institution, Harvard University.

In 1877 Verrall described from England a peculiar species of Phoridæ for which he erected the genus Platyphora, calling the insect *P. lubbocki* in honor of its discoverer, Sir John Lubbock, who had found it in an ant nest. Although Verrall's description has often been quoted, no further observations on this genus appeared till 1912, when Becker described as *Psalidesma pyrenaicum* an European form which he later ascertained was congeneric with *Platyphora lubbocki*, although specifically distinct. Becker has figured and carefully described this form and by comparison of a drawing of Verrall's type, obtained from Collin, has been able accurately to characterize the genus. Since this, Collin has published a figure of *P. lubbocki* and noted its occurrence in other parts of England.

From Becker's account I have been able to place in Platyphora two American species which have been in my collection for a number of years, that I had considered as probably representing a new genus. The two American forms differ from *P. lubbocki* only in minor characters, but are distinguished from *P. pyrenaica* by the third vein being bristly and distinctly forked at apex. All are so similar, however, that there can be no question that all should form a single genus.

Platyphora Verrall.

1877. Journ. Linn. Soc., London, Zoöl., vol. 13, p. 259.
1901. Becker, Abh. zool.-bot. Ges. Wien., vol. 1, p. 88.
1903. Brues, Trans. Amer. Ent. Soc., vol. 29, p. 386.
1906. Brues, Genera Insectorum, fasc. 44, p. 13.
1908. Enderlein. Zoöl. Jahrb. Abth. f. Syst., vol. 27, p. 148.
1910. Malloch, Ann. Scottish Nat. Hist., p. 17.

1912. Becker, Wiener Ent. Zeit., vol. 31, p. 329 (*Psalidesma*).
1913. Becker, *ibid.*, vol. 32, p. 19.
1913. Collin, Entom. Monthly Mag., vol. 24, p. 174, fig.

Type: *P. lubbocki* Verrall.

The four species so far recognized may be distinguished as follows:

1. Third vein of wing entirely bare and not forked at apex.....*P. pyrenaica* Becker
   Third vein bristly to the fork, which is indicated at least weakly.....2
2. Fork of third vein very delicate; segments of abdomen becoming shorter after the second.....*P. lubbocki* Verrall
3. Fork of third vein well developed; second and sixth segments of abdomen elongated.....4
4. Legs and antennæ brownish yellow; scutellum shagreened. *P. coloradensis* sp. nov.
   Legs and antennæ black; scutellum polished, shining.....*P. eurynota* sp. nov.

Platyphora pyrenaica Becker.

Wiener. Ent. Zeit., vol. 31, p. 330, figs. (1912) (*Psalidesma*).
Becker, *ibid.*, vol. 32, p. 19 (1913).

Platyphora lubbocki Verrall.

Journ. Linn. Soc., vol. 13, p. 259 (1877).
Lubbock, Ants, Bees and Wasps, p. 371 (1883).
Bezzi. Rendic. Istit. Lom. Sc. Lett., vol. 33, p. 11 (1900).
Becker, Abh. zoöl.-bot. Ges. Wien, vol. 1, p. 88 (1901).
Brues, Trans. Amer. Ent. Soc., vol. 29, p. 316 (1903).
Shelford, Journ. Linn. Soc., London, Zoöl., vol. 30, p. 152 (1908).
Enderlein, Zoöl. Jahrb, Abth. f. Syst., vol. 27, p. 148 (1908).
Becker, Wien. Ent. Zeitg., vol. 32, p. 19 (1913).
Collin, Entom. Monthly, Mag., vol. 24, p. 174, fig. (1913).

Platyphora eurynota sp. nov.

♂. Length, 2.8 mm. Entirely black, except the trochanters which are brownish yellow, and the hypopygium which is piceous, with the lower projection fusco-ferruginous; wings hyaline. Head from above slightly more than twice as broad as thick, the hind margin straight and finely margined; anteriorly receding on each side to the margin of the large eye which occupies the entire side of the head when viewed in this position. Laterally the head is very much narrowed below, and not quite so high as the height of the nearly horizontal front. Antennal cavities shallow, each with four small reclinate macrochætæ along its lower margin and a group of three reclinate ones just to the side of the insertion of the palpus. Antennæ with the third joint rounded, rather small, bearing a long, bare arista, fully as long as the width of the front. Cheeks each with a series of minute bristles below the eye, extending upwards to join with the postocular cilia which are very weakly developed. Palpi extremely small, with a tuft of four or five small bristles at the extreme tip. Front highly polished, with scattered hairs, but no macrochætæ although there are a few stouter, bristly hairs along the posterior margin of the vertex. Ocelli large; no frontal groove. Mesonotum large and broad, shining and clothed like the

front; no dorsocentral macrochætæ, although there is a pair of larger bristly hairs on the posterior margin at this place. Scutellum large, truncate at the sides; shining, without bristles, but with a series of short bristle-like appressed hairs in a close series along the hind margin; twice as broad as long. Mesopleura smooth, bare below, above polished and hairy like the mesonotum, with a large macrochæta at its upper hind angle. Abdomen broad and flat, the second and sixth segments lengthened as in *P. pyrenaica;* basal segments pruinose, but the sixth shining; no hairs or bristles, except at the sides of the fifth and sixth segments which bear hairs, and the posterior margin of the sixth which bears a series of short bristles. Hypopygium small, with a rounded upper surface, two finger-like processes from the left lobe; and several shorter processes from the right lobe. Legs rather slender, without bristles; tibial spurs represented by several minute bristles on the fore leg; those of the middle and hind tibiæ small, but quite distinct; fore and middle coxae below with a few bristles and hairs. Fore tibia much shortened and its tarsus flattened; the metatarsus nearly as long as the tibia. Wings large, with the costa reaching the middle, its bristles very short; third vein bristly as far as the fork, its

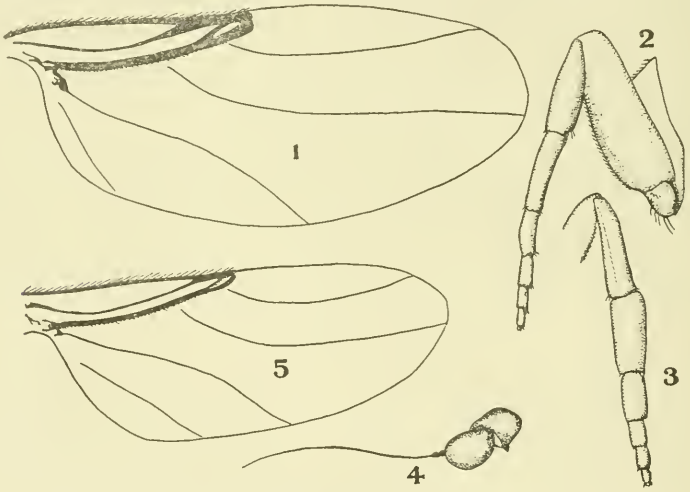

Fig. 1. *Platyphora eurynota* sp. nov., wing.
2. Front leg of same side view.
3. Front tibia and tarsus of same, external view.
4. Antenna of same.
5. *Platyphora coloradensis* sp. nov., wing.

bristles almost as long as those on the costa. Third vein distinctly forked; thickened for its entire length; costa thickened beyond the first vein which is very thin except on the extreme apical portion; heavy veins black; light veins fuscous. Fourth vein slightly curved and faintly recurved at apex; fifth running nearly parallel to the fourth and entering the wing margin just beyond the wing-tip; sixth much bent down on its apical half; seventh distinct. Halteres black, with the extreme base pale.

Described from a single male collected at Forest Hills, Mass., May 30, 1910, by Mrs. C. T. Brues. The insect was moving about among fallen leaves in an open wooded area. Ants of various kinds are abundant in the vicinity and it is possible that the species may be myrmecophilous like its European congener, *P. lubbocki.*

Platyphora coloradensis sp. nov.

♂. Length 1.8 mm. Black; antennæ dark fulvous, darkened on the tip of the third joint; palpi pale yellow; legs testaceous, tinged with fuscous on the tibiæ and fuscous on the tarsi. Pleuræ pale fuscous, piceous on the posterior half of the mesopleura. Hypopygium retracted, but apparently brownish as in *P. eurynota.* Head structurally as in *P. eurynota,* and also the mesonotum, except that the dorsocentral bristles are larger. Scutellum dull, not at all shining, with shagreened surface; the series of bristles along its margin larger than in *P. eurynota.* Abdomen with the second and sixth segments lengthened, slightly pruinose and nearly bare on the first to fifth segments; sixth shining and clothed with sparse hairs. Pleuræ and legs as in *P. eurynota.* Wings hyaline; heavy veins pale brown, except the apex of the costal vein which is fuscous; light veins very pale; costal bristles larger than in *P. eurynota;* third vein bristly to the fork and second vein bristly; third vein thickened, but not much stouter than the costa, light veins much as in *P. eurynota,* but the fourth and fifth are less divergent at tip and the seventh apparently farther from the margin. Halteres black, except at extreme base.

Described from a single specimen collected on a window at Boulder, Col., by Mrs. T. D. A. Cockerell, July 17, 1908, and sent to me by Prof. Cockerell.

This species is very similar to *P. eurynota* in structure, although entirely different in color and much smaller. It might perhaps be considered as a mere color variety, but the scutellum is dull and the wing venation is not identical, so it appears to be a perfectly distinct, but allied species.

DESCRIPTIONS OF TWO NEW GENERA OF PARASITIC HYMENOPTERA.*

By S. A. Rohwer.

The following new genera and species are parasites of two insects which have been proven to be of economic importance in relation to the chestnut. The descriptions are offered at the present time

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* A contribution from Branch of Forest Insects, Bureau of Entomology, Washington, D. C.

so the names of these two parasites may be available for economic purposes.

Anomopterus gen. nov.

This genus belongs to the subfamily Liophroninæ and is related to the genus *Centistes* Haliday as defined in Szépligeti's classification of the Braconidæ (Gen. Insect. 1904) but may be separated from Haliday's genus by the different venation, the different abdomen and the other characters embodied in the following description.

Malar space fully as wide as the width of the mandibles at the base; mandibles simple; clypeus well defined, separated from the front by a deep furrow; inner margins of the eyes parallel; antennæ inserted above the middle of the front, posterior orbits approximately as broad as the diameter of the eye; eyes coarsely granular; scape cylindrical, subequal in length with the second and third antennal joints; body coarsely granular; notauli obselete; propodeum subtruncate posteriorly and without any well defined areolation; venation as in Fig. 1; legs rather stout, especially the posterior pair; the posterior tibiæ thickening apically; abdomen with five segments; ovipositor well exserted.

Type: The following new species.

Anomopterus fasciipennis sp. nov.

Female: Length, 2 mm.; length of the ovipositor 0 5 mm. Head and thorax coarsely granular; postocellar line slightly shorter than the ocellocular line; the lateral ocellar line subequal in length with the diameter of the anterior ocellus; antennæ 20-jointed, the third joint distinctly longer than the fourth; first ten flagellar joints longer than wide, beyond that the length and width become subequal and the apical five joints are moniliform; mesoscutum coarsely granular; the metanotum more coarsely granular than the scutellum, about the same sculpture as the dorsal aspect of the propodeum; dorsal aspect of the propodeum with two faint lateral carinæ and with a faint median furrow, separated from the posterior aspect by an irregular faint carina; mesepisternum shining; practically impunctate; abdomen shining, impunctate. Ferruginous; the eyes, the ocelli, posterior aspect of the propodeum, the metanotum and the two apical abdominal segments black; the basal five joints of the antennæ pale ferruginous, the remaining, black; legs the color of the body; anterior wings hyaline with two broad dusky bands, in the region of the bands the venation is pale brown, in the hyaline portion of the wings it is pallid; stigma pale yellowish; posterior wings hyaline, iridescent, the venation pallid.

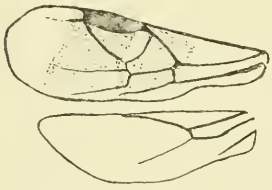

Fig. 1.
Anomopterus fasciipennis sp. nov., wings.

Male: Length, 2 mm. Agrees well with the above description of the female.

Falls Church, Virginia. Described from two females (one type)

and two males recorded under Bureau of Entomology No. Hopk. U. S. 11245 x, which refers to a note stating that this species is a primary parasite of *Ectædemia phlœophaga* Busck. Material collected by T. E. Snyder and reared September, 1913, by Carl Heinrich.

Type: Cat. No. 18051, U. S. National Museum.

Centistidea gen. nov.

Related to *Anomopterus* but may be separated from that genus by the embossed area on the first tergite, by having the second discoidal cell more widely opened and by having 14-jointed antennæ.

Head as in *Anomopterus;* scape cylindrical, subequal in length with the pedicellum; body shining with distinct separate punctures; venation as in Fig. 2; legs not robust; first tergite with an elongate embossed area basally.

Type: The following new species.

Centistidea ectœdemiæ sp. nov.

Female: Length, 1.75 mm. Head subopaque, with separate, rather poorly defined punctures; third antennal joint distinctly longer than the fourth; postocellar line a little more than half as long as the ocellocular line; mesoscutum shining with separate distinct punctures; scutellum more sparsely punctured; metanotum shining, practically impunctate; propodeum shining with sparse separate punctures, laterally with two well defined carinæ, medianly with faint, poorly defined carinæ, no carinæ separating the dorsal and posterior aspects; the lateral posterior aspect with four or five strong rugæ; mesepisternum and sides of the propodeum shining impunctate; embossed area of the first tergite slightly wider basally. Black; mandibles pale ferruginous; scape and pedicellum piceous; tegulæ and first tergite fulvous; legs except the posterior tarsi fulvous; wings hyaline, iridescent, venation pale brown, stigma black.

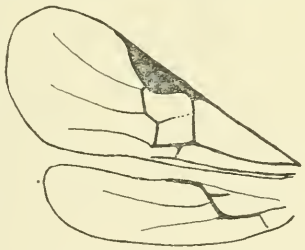

Fig. 2,
Centistidea ectoedemiæ
sp. nov., wings.

Male: Length, 1.5 mm. Agrees well with the above description of the female.

Ballston (Veitch), Virginia. Described from one female (type) and one male recorded under Bureau of Entomology No. Hopk. U. S. 11236a, which refers to a note stating that this species is a primary parasite on *Ectædemia castaneæ* Busck, the material collected and reared by T. E. Snyder, adults issuing April 23 and 24, 1913.

Type: Cat. No. 18052, U. S. National Museum.

SOME REMARKS ON AMERICAN LAUXANIIDÆ.

By Dr. K. Kertész,
Hungarian National Museum, Budapest.

1. In his article "A Synopsis of the Sapromysidæ" (Psyche, XX, No. 2, 1913, pag. 76) A. L. Melander gives a key to the American species of the genus *Camptoprosopella* and considers *C. xanthoptera* Hend. as a synonym of *C. verticalis* Lw. which is quite wrong. I have both species before me; besides the type of *C. xanthoptera* two other specimens, also from Peru, and four specimens of *C. verticalis* from North America—Drayton Island, Fla.

C. xanthoptera is distinguished at first sight from *C. verticalis* by the quite black, shining abdomen as well as by the orange color of the thorax; besides, the third joint of the antennæ is blackish beneath and about the tip. But there are also very good differential characteristics in chætotaxy; *C. verticalis* has three pairs of strong dorsocentral bristles, and *C. xanthoptera* only two. All bristles are distinctly stronger in *C. verticalis* than in *C. xanthoptera*, but the rays on the upper side of the arista are shorter, the ratio between the basis of the third joint of the antennæ and the longest rays in *C. xanthoptera* being 5: 10, in *C. verticalis* 5: 7.

2. *Lauxania latipennis* Coq. Of this species I have before me only one specimen in bad condition, from Jacksonville, Fla. From the whole habitus, the elongated antennæ, but especially from the very characteristic course of the second longitudinal vein, I think that this species will find its best place for the present in the genus *Steganopsis* Meij.

3. *Caliope signatifrons* Coq. In Melander's key (page 63) to this genus I think these words "center of front shining" should be omitted because neither in my specimen from Philadelphia is it to be seen, nor does Coquillett mention it in his description. Or should Melander's specimen belong to another species?

Anasa repetita Hiedemann in Massachusetts.—A specimen of this species was taken by the writer in Allston, Boston, September 11, 1911. Last summer three specimens were collected by Mr. H. M. Parshley, one at Beach Bluff, June 23, and two at Jamaica Plain, June 13 and August 9, 1913.

Erratum.—In February Psyche, page 21, for "Providence, Mass." read Provincetown, Mass. C. W. Johnson.

BOOK NOTICE.

Entomology, with Special Reference to Its Biological and Economic Aspects. By Justus Watson Folsom, Sc.D. (Harvard), Assistant Professor of Entomology at the University of Illinois. Second revised edition, with four plates and 304 text-figures. Philadelphia: P. Blakiston's Son & Co. $2.25 net.

Doctor Folsom's work is appropriately described in its title, which shows it to belong among those important books to which a student may turn for information concerning insects as material for experimental research. There are too few books of this sort, particularly in the English language. The first edition was widely welcomed, and its worth is so generally known as to make unnecessary any attempt at extended review. Comment may, therefore, be restricted to changes appearing in the new edition.

In this connection a comparison of chapter headings is illuminating:

Number.	Title in First Edition.	Title in Second Edition.
I	Classification.	Classification.
II	Anatomy and Physiology.	Anatomy and Physiology.
III	Development.	Development.
IV	Adaptations of Aquatic Insects.	Adaptations of Aquatic Insects.
V	Color and Coloration.	Color and Coloration.
VI	Adaptive Coloration.	Adaptive Coloration
VII	Origin of Adaptations and of Species.	Insects in Relation to Plants.
VIII	Insects in Relation to Plants.	Insects in Relation to other Animals.
IX	Insects in Relation to other Animals.	Transmission of diseases by insects.
X	Interrelations of Insects.	Interrelations of Insects.
XI	Insect behavior.	Insect behavior.
XII	Distribution.	Distribution.
XIII	Insects in relation to Man.	Insects in relation to Man.

It will be seen that Doctor Folsom has not increased the number of his chapters, but has sacrificed portions of the older text in the interest of new features. Most noteworthy amongst the latter is the discussion of disease transmission by insects, which now constitutes a whole chapter. One misses nearly all of the extended and somewhat academic treatment of the factors of evolution, and the conception of species, which was in the earlier edition; but probably that was the least important part of the volume. Certainly in its revised form, with its much greater wealth of concise and well-indexed data, the book is farther removed from competition than before.

A lighter grade of paper has been used this time, and the number of lines on a page has been increased from 36 to 40. These innovations have resulted in a slightly thinner and lighter volume.

The book will be a very valuable addition to the working equipment of any biologist.

W. L. W. F.

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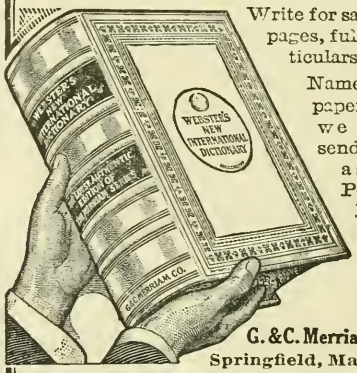

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PSYCHE

VOL. XXI. JUNE, 1914. No. 3

A NEW DIPLOPOD FROM THE GALAPAGOS ISLANDS WITH NOTES ON THE CHILOPODS.

By Ralph V. Chamberlin.

The type specimens of the interesting new diplopod here described were collected on Chatham Island in the Galapagos Archipelago in 1898 and 1899, presumably by R. E. Snodgrass as a member of the Stanford Expedition of 1898–1899.

Of the five species of chilopods known from the Galapagos Islands, specimens of all of which were secured by the expedition mentioned, four appear to be indigenous. The five species are as follows.

1. **Orphnaeus brevilabiatus** (Newport).

One female from Hood's Island (May 18, 1899), between which and specimens from Central America, the West Indies and elsewhere I fail to detect any essential differences. A very common geophiloid throughout the warmer parts of both hemispheres.

2. **Mecistocephalus parvus** Chamberlin.

I at first regarded the specimen of this species, which were from Clipperton Island (November 23, 1898), as belonging to *M. punctifrons* Newport; but a more critical study of material from India, the East Indies and different parts of warmer America has convinced me that Newport's species has been too broadly conceived by Haase and others and that several clearly distinct species have been confused under the name. The confusion has resulted largely because the species agree in having the number of pairs of legs constantly 49, and do not differ in various other characters that ordinarily serve for the discrimination of species in related families. The species dominant in Java and the Malay Peninsula is a different one from the typical *punctifrons* of India; and the species occurring in the Bermudas, West Indies and South and Central America is also different and must bear the name *guildingi* applied

by Newport to specimens from St. Vincent. The types of *M. parvus* are small slender specimens, near 20 mm. in length. The cephalic plate is proportionately broader than in the other species mentioned, being from 1.61 to 1.63 times longer than wide; whereas in *guildingi* it is from 1.98 to 2.1 times longer than wide, and in the Javan species (for which Meinert's name *cephalotes* must probably be resurrected) from 1.68 to 1.71 times longer, while careful micrometer measurements of numerous specimens of *punctifrons* from India showed the cephalic plate in adults to vary from 1.88 to 1.91 times longer than wide, the plate in partly grown specimens being near 1.85 and in the youngest ones 1.8 times longer than wide.

3. Pectiniunguis albemarlensis Chamberlin.

This species is very close to *P. americanus* which is apparently common on both the Pacific and eastern coasts of Mexico and has been taken on the Florida Keys. The Galapagos species has near the same number of legs (61 pairs) as *americanus* and is also marked with a similar geminate dark stripe along the dorsum. The head is distinctly broader, the ratio of length to breadth in the type being 57: 52, while the basal plate is longer, being but 2.5 times wider than long as against 3 times in *americanus*. The ventral pores are more numerous and the area occupied on each sternite materially greater. Of the two other known species of Pectiniunguis as now restricted, one is from Cuba and the other from Colombia. In California occur several species of a related genus which I have recently named *Nyctunguis*. One female of *P. albemarlensis* was secured on Albemarle Island at Iguana Cove (December, 1898).

4. Cryptops navigans Chamberlin.

Two specimens taken on Clipperton Island November 23, 1898.

5. Scolopendra galapagoensis Bollman.

Specimens of this species were taken on Hood, Chatham, Bindloe, Narborough and Albemarle Islands. It seems to be much the commonest chilopod of the Archipelago, being the only one in fact that was taken on more than one island. Its affinities seem to be closest to the group of the division Collares occurring in the warmer parts of America.

The new diplopod *Nesodesmus* is a member of the Pyrgodesmidæ.

Nesodesmus gen. nov.

Head strongly granulo-tuberculate. Antennæ short, clavate, with the fifth article thickest and much the longest.

Dorsum strongly elevated and convex; strongly sculptured, being densely granular and tuberculate over the entire surface of keels as well as remaining portion of metazonites; a longitudinal row of larger tubercles each side of the median line, the tubercles increasing in size caudad with a tendency to be confluent. Spiracles on segments 5, 7, 9, 10, 12, 13, 15 and 16, each opening through a thick, subcylindrical papilla borne on the marginal lobe second from the caudal corner. Keels large, depressed, covering the legs from above, almost contiguous, laterally mostly deeply lobate, the lobes either 3, or by subdivision of the anterior one, 4 in number, the caudal border of keel also deeply lobate and the anterior one of most less strongly lobed.

First dorsal plate broadly extended and covering the head as in *Lophodesmus*. Typically showing 12 rounded teeth or crenations along the anterior margin corresponding to the twelve lobules marked off on the border by 11 radial sulci.

Anal tergite short and broad, its caudal margin convex in general outline; a broader median portion notched at the middle on each side of which are two sharply separated narrow lobes or teeth. In the type species the keels of the nineteenth tergite are produced caudad a little beyond the caudal margin of the anal plate.

Genotype: *N. insulanus* sp. nov.

This genus is apparently most closely allied with *Lophodesmus* as represented in Central America and Mexico. It is separated chiefly because of the difference in the position of the spiracle and the form of its papilla on the carinal margin, this occurring near the middle of the side instead of at the caudolateral corner; in the deeper lobation of the lateral border and the larger number of its divisions and in the lobation of the anterior as well as of the caudal border; and in having the entire dorsal surface of the keels as well as of the median portion of the metazonite strongly tuberculate. The first tergite has its anterior border divided into 12 lobules instead of the 10 characteristic of species of Lophodesmus thus far known.

Nesodermus insulanus sp. nov.

Dark brown, irregularly dusky. Vertex of the head like the dorsum, but the remaining portions together with the antennæ and legs a paler brown or brownish yellow. Prozonites ventrally yellow.

Vertex and upper frontal region of head tuberculate with corresponding dusky or black areolation. Other parts with corresponding areolæ limited by a network of impressed lines.

Antennæ short, strongly clavately thickened distad, the fifth article being much the longest and thickest; sixth article next in thickness and length, with the seventh more slender and much shorter. Hairs on distal articles subdense, all very short.

First dorsal plate with its border projecting horizontally anteriorly and laterally widely beyond the head. Much longer than the other tergites. Caudal margin mesally straight. Border divided by radial sulci into 12 lobules each of which projects as a wide, low, rounded tooth or crenulation at the margin. Lobules finely granular, the convex median portion of the plate appearing more coarsely and densely tuberculate.

Sides of body parallel or nearly so excepting towards ends. Keels of dorsal plates large, extending laterally over the feet. Keels of the second tergite bent conspicuously cephalad, those of the next three less and less so and the remaining ones back to the eighteenth with anterior and caudal margins nearly straight and parallel and at right angles to the long axis of the body. Keels of the eighteenth segment bent caudad. Keels increasing in length (*i. e.*, in longitudinal diameter) from the third caudad, those of the second being longer than those of the third. Each keel of the second plate with lateral margin showing 3 rounded teeth with corresponding divisions of border separated by sulci; the third and fourth plates with borders of keels similar but teeth better separated. On keels of the fifth tergite the lateral incisions of keels extend mesad along sulci much farther, dividing the border into 3 narrow, distally rounded lobes from the median of which projects the pale subcylindrical spiraculiferous papilla; in all succeeding plates the anterior lobe is subdivided thus giving 4 distinct lobes separated by deep narrow incisions replacing the sulci of the most anterior plates; the most anterior lobe extending farthest ectad, the posterior one least. Caudal edge of keel of all plates

showing 2 (or 3) smaller lobes and the anterior margin presenting a corresponding number of still smaller lobes or teeth excepting on the second and third plates, the lobes or teeth becoming larger caudad. Spiraculiferous papillæ smooth, the dorsal surface of the rest of the keels and of the remaining portion of metazonites densely and strongly coarsely granular and tuberculate. Caudal margin of metazonites between keels presenting 9 or 10 distinct rounded teeth or crenulations which are weak or in part obliterated on the plates cephalad of the sixth. Two longitudinal rows of large tubercles, there being in each row 3 tubercles on each metazonite, the most caudal of these being on a lobe or tooth of the caudal margin; tubercles increasing in size from segment to segment in in going caudad, the caudal ones of the eighteenth and nineteenth segments in particular being large and conical. Keels of the nineteenth segment produced caudad so that the posterior edge is parallel with long axis of body or nearly so; between these keels 4 stout conical teeth project caudad and nearly attain level of caudal margin of the anal tergite when viewed from above.

Anal tergite short, nearly concealed from above by the nineteenth plate. Presenting a broad, mesally notched, median lobe and on each side of this and farther proximad 2 conical teeth separated by deep incisions.

Anal scale small; on its caudal margin presenting 2 conspicuous tubercles, each of which bears a long bristle.

Sternites very narrow; longitudinally sulcate.

Trochanters of the legs relatively very long.

Ducts of testes opening through simple perforations on the ventral surface of swellings on the coxæ of the second legs, these swellings commonly contiguous at the median line.

Gonopods of male each presenting a mesally hollow subhemispherical basal division apparently capable of being closed against the corresponding lobe of the opposite gonopod. Distal division short and proportionately broad; distally presenting a short process projecting caudad and a larger subfalciform anterior process from the caudal concave surface of which bends caudad the conically pointed tip of a third process which seems to be the stylus.

Length: 9.5 to 11.5 mm.; width 2 to 2.25 mm. *Locality:* Galapagos Archipelago; Chatham Island (May 21, 1899). Probably collected by Snodgrass.) Thirteen specimens were secured.

A NEW TRICHODECTES FROM BAJA CALIFORNIA.

By V. L. Kellogg and S. Nakayama,
Stanford University, Cal.

Among some old specimens of Mallophaga in the Stanford University collection we have found a male and a female of an interesting new species of Trichodectes, which is described herewith. The specimens were collected by the well-known ornithologist, R. C. McGregor, in a bird-collecting expedition to the islands off Baja California (San Martin, Cerros, Todos Santos, San Geronimo, Guadaloupe, and others). No parasites of mammals were, as far as the records show, obtained, and the specimens referred to in this paper were credited to bird hosts, the male to a *Corvus semicinctus* from Cerros Island and the female to *Hæmatopus frazari* from San Martin Island. There is undoubtedly error in these attributions, either in the record-keeping or by abnormal straggling in game bag or on skinning table from some mammal to these birds. The host is, therefore, unknown. The specimens are typical *Trichodectes* (mammal-infesting parasites), and certainly of the same species.

The new species suggests, in general shape of head, length and character of antennæ, the semi-dentate lateral margin of abdomen, and terminal segments of the male, the wide-spread and familiar *Trichodectes limbatus* of the goat; but the specific differences are marked. Especially is the new species distinguished by the shape of the abdomen, and great length of the tarsal claws. The abdomen of the male, in the new species, is as broad as long, almost roughly circular in outline, indeed, while in *limbatus*, it is elongate ovate. Also the posterior margin of the second abdominal segment bends conspicuously forward at its middle, revealing thus a broad but deep rounding posterior emargination in this segment. Thus the abdominal characters alone conspicuously distinguish this new species from any other known Trichodectes.

Trichodectes painei sp. nov. (fig. 1, A–D).

Male: Body, length 1.21 mm.; width (across third abdominal segment), .60 mm.; general color, pale yellowish brown with darker bands and markings on head and thorax, and pronounced, although narrow, dark lateral margins of abdomen,

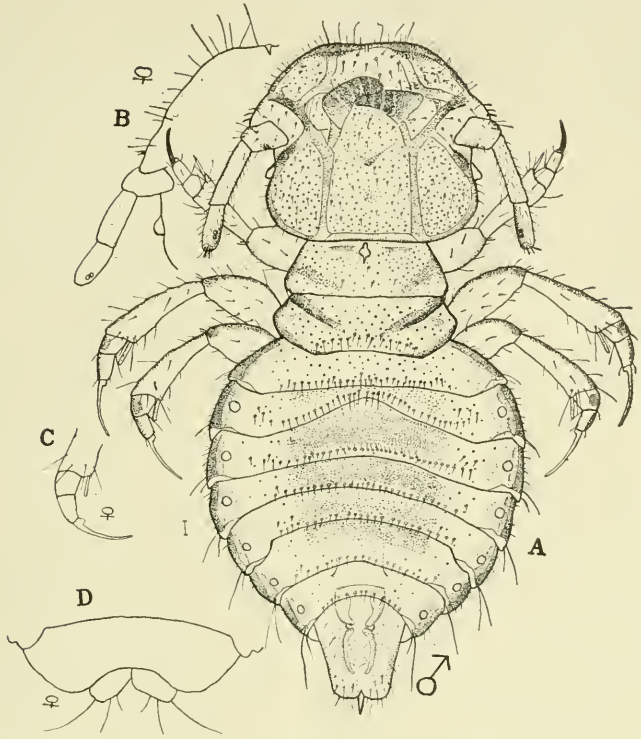

Fig. 1. *Trichodectes painei* sp. nov.

and distinct broad transverse bands, not reaching lateral margins, on segments 3 to 6, inclusive, of the abdomen.

Head, length .37 mm.; width .46 mm.; thus being wider than long; general shape quadrangular with rounding angles; clypeal front broad and straight with a slight gradual median concavity and at the middle of the concavity a very narrow, straight incision bisecting the anterior marginal marking; trabeculæ inconspicuous; ocular fossæ slight, with eyes unusually projecting and conspicuous; posterior margin straight. Antennæ very long, when projecting backwards extending slightly beyond posterior margin, second segment almost twice as long as third, two small sense pits on third segment. A pair of straight, nearly parallel occipital bands running forward to meet diagonal antennal bands, each occipital band also sending an inner branch to the base of the mandibles.

Prothorax slightly narrower than the metathorax with both segments of about the same length; lateral margins of prothorax slightly diverging so that the segment is widest between its posterior lateral angles. Metathorax widest in the middle with a projecting obtuse angle at the middle of each lateral margin; from these

obtuse angles the posterior margin runs back and inward in a flatly curving line for about one third of the width of the segment, the middle third of the posterior being straight, with a shallow concavity. A series of fine but distinct short hairs in a series roughly parallel with the slightly concave but nearly straight third of the posterior margin of the metathorax. Straight diagonal bands of darker color showing through each thoracic segment from the underside. Legs conspicuously long, largely because of the unusual length of tibiæ, tarsi and claws; tibiæ growing wider toward tip and bearing a short, strong, blunt, spineless projection at the inner angle of the tip; tarsi of middle and hind legs with claws of unusual length, each claw being longer than both tarsal segments together and more than half as long as the tibia; claws of the forelegs but a little more than half as long as those of middle and hind legs, but more strongly chitinized.

Abdomen, length .64 mm., width .60 mm.; almost roughly circular in outline, although really broader in front than behind, and with the projecting, tapering last segment and genitalia destroying the circular outline. Second segment with deeply but broadly emarginate posterior border. Lateral margins almost dentate because of the projecting postero-lateral angles of each segment. Each segment bearing a series of many fine short hairs along the median two thirds of the posterior margin; longer but inconspicuous hairs projecting from the postero-lateral angles of the segments. Strongly colored, but narrow, lateral borders on all segments; and conspicuous dark median transverse blotches covering most of the dorsum (for the middle half of its width) on segments three to six inclusive; last segment of abdomen narrow and projecting backward with the genitalia showing distinctly.

Female: Body, length 1.57 mm.; head .46 mm., width .56 mm.; length of abdomen .88, width .69 mm., the abdomen thus being considerably longer than broad, and hence not of the nearly circular shape of that of the male. The antennæ are not as long and slender as those of the male, the second segment being only slightly longer than the third. The ground color of the body and markings both paler than in the male, but the markings and blotches about the same in arrangement and character.

The species name *painei* is given for Mr. J. H. Paine, an active American student of the Mallophaga.

SCIARA CONGREGATA SP. NOV. (DIPTERA).

By O. A. Johannsen,
Cornell University, Ithaca, New York.

The following description is based on specimens reared at Fayetteville, Arkansas, by Mr. George G. Becker, whose account of the habits of this insect appears in the present number of Psyche.

Sciara congregata sp. nov.

Male: Length 2 mm. Head black, palpi and antennæ fuscous, the antennæ rather short, about two thirds as long as the wing (measured from humeral cross vein), the intermediate joints not twice as long as wide. Mesonotum subshining blackish; scutellum, metanotum, and pleura subopaque, brownish black. Abdomen and hypopygium subopaque brownish black, the latter stout, with claspers resembling those of *Sciara jucunda*, though the apical setæ are rather stouter. Coxæ and legs brownish, the tarsi dark brown; legs relatively short and stout, hind tibia about as long as the petiole of the media of the wing; apical third of tibiæ slightly broadened; hind tarsus about 0.8 as long as the tibia, hind metatarsus slightly over 0.7 as long as the following four joints. Wings smoky hyaline, veins dark brown, the radius, the forks of the media and the apical part of the forks of the cubitus beset with setæ. R_1 ends two thirds as far proximad of the fork of the media as the tip of R_s is distad of this point; basal section of R_s very faint and indistinct, though the basal section of R is evidently noticeably longer than R_1; costa produced nearly 0.6 of the distance from the tip of R_s to M_1; R_s ends slightly proximad of M_2; petiole of media very inconspicuous; cubitus forks distad of the base of the petiole of the media. Halteres dark.

Female: Length 2.5 mm. Like the male in coloring and structure differing in having slightly shorter antennæ, these being less than half as long as the wing, with intermediate joints but little longer than wide; the basal section of R_s and the petiole of the media a little more distinct. The lamellæ of the ovipositor are only slightly longer than wide.

Type in my collection; paratypes in the collection of the Arkansas Agricultural Experiment Station. This species will find a place in the key given on page 118, Fungus Gnats of North America (Bull. Maine Agr. Exp. Station, No. 200), between *S. vicina* and *S. dives*, differing from both in coloring, venation, and structure of hypopygium.

MIGRATING LARVÆ OF *SCIARA CONGREGATA* JOHANNSEN.

By George G. Becker,
Agricultural Experiment Station, Fayetteville, Arkansas.

The species of Sciara which Prof. Johannsen describes in this issue of Psyche, first came under my observation on July 6, 1912, when I noticed an army of the larvæ in a chain about five feet long and three inches wide at its greatest width. The chain of larvæ was widest at about the middle and tapered toward each end.

The general appearance of the army was that of a dead snake and I was about to pass by it when closer observation showed that it consisted of a migrating mass of larvæ. The chain was moving very slowly at a rate of probably not more than a few inches per minute.

In general the movement of the army suggested a sort of flowing motion in which the larvæ from the rear came up and traveled over their fellows in front of them. It was noticed that the larvæ on the top made much better progress than those below. This would naturally be the case since the individuals on the top depended upon those beneath them for purchase. Since the larvæ must have been piled up about eight deep in the middle of the procession it would seem that those next to the ground would be unable to make much progress, and that they would therefore have to wait until those to the rear had passed over them before they could gain any headway. It was thus noticed that the advance of the chain was made by the larvæ from above. These larvæ, naturally, made more rapid progress than those beneath them, and they no sooner gained the ground in front of the chain than they were followed and covered by the great mass of migrating larvæ coming from behind. Probably they did not emerge again until most of the chain had passed over them.

The locomotion of the individual larva was accomplished by a series of intermittent, jerky, flowing movements by which the larva glided over those beneath it. These migrating larvæ left a sort of trail in their wake somewhat similar to the track passed over by a snake.

A number of the migrating larvæ taken into the insectary and placed in a cage, containing some oak leaf mold into which they soon dispersed and fed rather actively for several days. About three days later on lifting layers of the mold, I noticed that most of the larvæ had transformed to delicate yellow pupæ. No accurate record was made of the time passed in the pupal stage but this was probably about two weeks.

On July 16, 1913, a little over a year after the first observation, a second army of the worms was noticed. This was also found in the town of Fayetteville, only a few hundred yards from the locality where the observation of the previous year was made. The army was much smaller than the one noticed last year (1912), probably not more than three feet long.

Some of these larvæ were kept and pupated about one week after they were transferred to the leaf mold. The adults emerged probably two to three weeks later, during my absence. This insect proved to be the same one observed last year. Specimens sent to Prof. O. A. Johannsen were determined by him as a new species. They are described in the present issue of Psyche under the name of *Sciara congregata*.

NATURAL ENEMIES OF SIMULIUM: NOTES.

By F. M. Webster,
Bureau of Entomology.

In the concluding paragraphs of his paper on "American Black Flies or Buffalo Gnats," Bulletin 26, Technical Series Bureau of Entomology, April, 1914, the author, Mr. J. R. Malloch, calls attention to the occurrence of parasites of the larvæ found in Illinois, and also found by Mr. E. H. Strickland near Boston, Mass.

In the last paragraph of his paper, Mr. Malloch refers to some work done by agents of the Bureau of Entomology many years ago. As this reference leaves the matter somewhat obscure, it may be stated that on May 6, 1888, while studying Simulium in the St. Francis River, near Madison, Ark., the writer found a Simulium larva about one-fourth grown, presumably belonging to what was then known as *Simulium pecuarum*, infested by some

species of Nematode worm which had every appearance of being an internal parasite.

Under the same date it was mailed to Division of Entomology, where it was duly received and given a division number 3498°. Doubtless the specimen has long ago disappeared, but it is this to which Mr. Malloch refers in his paper and may perhaps belong to the same species as was later found infesting larvæ of Simulium in the Sangamon and Illinois Rivers, and which Mr. Strickland years after has been able to carefully study.

On May 11, 1887, the writer while engaged in studying buffalo gnats and other species of Simulium in the St. Francis River at Madison, Ark., encountered a species of fly which were locally termed "black gnats." These acted very much like true buffalo gnats, although I was not able to observe them biting animals. Specimens were mailed to the Department of Agriculture and the notes of the Division of Entomology show that they were received May 14, 1887, and given the division number 4133. They were described as agreeing closely with the genus *Hilara* but differing by having mouth organs longer than the head, and by possessing a stigma-like black spot near margin of wings. A year later, or to be exact, May 6, 1888, the writer was again in the same locality engaged in the further investigation of Simulium and again encountered these flies in abundance. It would seem that, as they belong to a group known to be predaceous, they were presumably attacking the gnats, although I do not find that this was actually observed by me.

While camping on Devil's River, about fifty miles from the point where it empties in the Rio Grande, March 20 to 25, 1891, larvæ, pupæ and adults of a species of Simulium not recognizable as belonging to either *S. pecuarum* or *S. meridionale* were found in abundance. Specimens of all stages were forwarded to Washington where they appear to have been received May 9, and given the division number 5003. One of these adults, captured while in the act of attacking a horse, was infested by larvæ of a water mite, division number 5003°. This is the larva of a Hydrachnid agreeing with Limnesia.

A precisely similar observation was made by myself July 30, 1884, at Oxford, Ind., where an adult mosquito was discovered with one of the water mites attached thereto.

With reference to the discussion of *Simulium pecuarum* Riley, pp. 21–24 of Mr. Malloch's paper, and the note attached thereto, it may be stated that both males and oviparous females occurred in abundance and were sent to Washington from Somerset Landing, La., during April, 1886, and also the spring of both 1887 and 1888. As a matter of fact, the egg-laying female and the male do not usually travel far from the localities where the species breeds, the males apparently never following the biting, sterile females. The oviparous females were found to each contain 500 to 750 eggs. Oviposition was observed March 27, 1888, and hatching was witnessed the following day.

The specimen, to which Mr. Malloch refers as having been collected at College Station, Texas, was obtained in sweeping a field of wheat on the college farm, February 24, 1891, while the following day both larvæ and pupæ were found clinging to driftwood in the Brazos River, seven miles away.

An abundance of material was sent from both Somerset Landing, La., and Madison, Ark., during the years 1886 to 1891. While pupæ will not develop adults if kept in stagnant water, nevertheless eggs of this species hatched en route between these points and Washington, and pupæ, packed in Spanish moss in cigar boxes, frequently develop adults also en route.

Both this species and *S. invenustum* were observed attacking stock in the White Rock Mountains near Vineland, Ark., February of the same year. Specimens were sent to Washington, and received the division number 4094B. The other sendings to which this note refers were from Pecos Creek above Marble Falls, Texas, March 7, and Cypress Mill a few days later. Other material, belonging to *S. venustum*, was sent to the Department March 19 and 23, 1887, when the females were observed ovipositing at Somerset Landing, La.

S. meridionale was sent frequently during the years 1886 to 1891 from both Somerset Landing, and from Madison, Ark., the latter collected in the St. Francis River. Simulium were also collected and forwarded to the Department from Elk Horn Falls on White River, just below Richmond, Ind., May 14, 1892. Also, specimens of two species from the Wabash River, near New Harmony, Posey County, Ind. A number of head of stock were killed

in that vicinity in 1884, and they were again quite troublesome in 1890.

In the case of sendings from Wooster, Ohio, some years after these dates, a farmer complained of flies getting in the ears and nostrils of his horses while being worked in a particular field near a brook, originating from a spring, and running over a rocky bed. Specimens of the adults were submitted and determined as *S. pecuarum* Riley, but I find no record of this in the Bureau notes on Simulium. If I remember correctly in this Wooster, Ohio, case, the difficulty was eliminated by pouring crude petroleum into the spring, allowing it to be carried down stream by the running water.

Prior to the outbreak of the war, the levees of the Mississippi River were continuous through the alluvial country and kept in good repair. With the outbreak of the war, however, when sterner matters overshadowed everything else, the levees were neglected, and in many cases caved into the river.

Soon after this time, as cavalry and artillery officers of both armies have since assured me, there were severe losses of both horses and mules in their respective commands. From this time onward to 1886, the buffalo gnat became such a scourge, killing in many cases every horse and mule on a plantation, that their appearance came to be greatly dreaded.

It is the remembrance of those days when both domestic animals and occasionally a human fell a prey to these flies, that remains to be refreshed in the minds of the people even to this day, whenever the levees give way and overflows occur during the spring time. There is, however, practically no danger whatever from a return of such disastrous outbreaks of buffalo gnats as formerly occurred. The gnats do not breed in the Mississippi River itself, and it will require more than one season's overflow to enable them to increase in numbers sufficient to become a menace to domestic animals.

The writer has been bitten by these gnats until his face and neck were so blotched as to render shaving impossible for weeks. Civil engineers working on the St. Francis River, during excessive abundance of buffalo gnats, suffered severely from their attacks. The gnats would make their way down their necks and under their clothing, and also down their rubber boots and collect there about

the angles. I have seen such men months afterwards with the calves of the legs and the ankles discolored as though the limb had been beaten or severely bruised. It may be stated in this connection that pellagra was not at that time recognized in this country.

THE MECHANISM OF THE MOUTH PARTS OF THE SQUASH BUG, *ANASA TRISTIS* DEGEER.[1]

By Daniel G. Tower, B.S.,

In preparing a previous paper dealing with the external anatomy of the squash bug (Tower, '13) it was found necessary to work out the structure of the mouth parts and internal anatomy of the head region. The mouth parts proved to be so interesting that a study more detailed than was possible in a general consideration of the anatomy has been made, the results being incorporated in the present paper. A brief description of the external region of the head and its parts has also been included so that one may more readily orient himself as to the relation of the parts to one another.

At this point I wish to thank Dr. H. T. Fernald for his assistance and the loan of books and pamphlets from his private library; and Dr. G. C. Crampton, who has directed my work and greatly assisted me in preparing this paper for publication.

As the sclerites of the head capsule are solidly fused together the general regions are all that can be described. Of these the occiput (occ), see Pl. 1 f. 1, lies behind the ocelli (oc) and forms the posterior portion of the head surrounding the occipital foramen. It is marked off by a shallow transverse groove, from the vertex. The vertex or cranium (v) comprises the dorsal region in front of the occiput and bears the ocelli. This area is not marked off from the frons (f), which lies above and between the bases of the antennæ. The anterior margin of the frons is united with the base of the clypeus (c).

Below and on either side of the compound eyes (e) lie the genæ (g), while the ventral posterior portion of the head capsule forms

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[1] Contribution from the Entomological Laboratory, Massachusetts Agricultural College.

the gula (gu). The clypeus, as has been stated, is fused at its base with the frons, and at this point is narrow, but as it curves forward and downward it widens at its tip to form the base of attachment for the labrum (lbr) from which it is separated by a narrow membranous ring.

The labrum is an elongate triangular sclerite. Its anterior surface is convex, while its posterior surface is flat and contains a groove which lies above the groove on the basal half of the anterior surface of the labium (lab).

On either side of the clypeus is a narrow prolongation of the frons called the fulcrum (fr). The fulcra lie close to the lateral walls of the clypeus hiding them, but not united with them except at their bases, where they fuse with the head capsule.

The maxillary laminæ (lm) lie below the base of the antennæ (ant). Their bases are fused with the genæ and their ventral margins are united with the bucculæ (bu), which are chitinous plates projecting from the anterior ventral side of the head on either side of the base of the labium.

The labium articulates with the anterior ventral region of the head between the bucculæ. The labium contains, as stated above, a dorsal groove in which lie the setæ (s). The edges of the groove beyond, or distal to the overlying labrum, overlap, forming a closed tube, thus giving the enclosed setæ more support. At its basal end the groove becomes very shallow; the labium becomes filled with muscles, tracheæ and nerves, and the setæ in this portion of the labium gradually come to lie within the labrum, whose edges meet beneath and confine the setæ.

The setæ now pass back through the articulating membranes, which lies between the labrum and clypeus and between the lateral walls of the clypeus. The walls of the clypeus at its tip turn under, and their edges interlock, forming a narrow pair of supporting lobes above which the setæ pass. Upon emerging from these lobes the maxillary setæ (m) spread apart to receive the tip of the pharynx and the canal from the salivary pump, both of which enter the setæ at this point.

The setæ represent the mandibles (md) and the maxillæ (m). The maxillæ are fluted and interlocked so as to form two tubes, namely the upper or suction canal (fc), and the lower or salivary canal (sc), see Pl. 1 f. 2. The mandibles are slightly shorter than

the maxillæ and their tips are barbed. Their function is that of piercing the plant tissues and holding the setæ in place, while the tips of the maxillæ, which are acute and fluted, probe the plant tissues, take up the plant juices and eject the saliva.

At the point where the maxillary setæ diverge they are surrounded by a membranous sheath, which renders air tight their connections with the pharynx (ph) and with the salivary pump canal or efferent canal (ec). After separating, the maxillæ together with the mandibles pass back, one of each on either side of the pharynx. The above mentioned membranous sheath also extends back on either side of the pharynx and encloses the setæ, being fastened to their bases. Soon after the maxillary and mandibular setæ have separated, at their junction with the pharynx, the mandibles separate from the maxillæ and take up a position above them.

The bases of both the maxillæ and mandibles widen posteriorly, forming attachments for the muscles which operate them, especially the inner dorsal portion of the base of the maxillæ. This becomes thickened to form a prominent ridge to which the chitinous rod (h), see Pl. 1 f. 7 and Pl. 2 f. 9, which articulates with the genæ, is fastened by a short tendon. The rod runs downward between the setæ and the side of the pharynx, turning under the setæ, and here lies above the tentorial lobes, being embedded in a membrane which separates the muscles of the setæ from these lobes. Laterally the end of this crescent shaped rod is fastened to the under side of a small internal knob on the genæ (p) situated directly below the compound eye. Ventrally the rod is attached to the tentorial lobe, see Pl. 1 f. 7.

The maxillary setæ are each controlled by two powerful muscles, both of which are attached directly to the bases of the maxillæ. These are the protractor muscle (pm_1), which extends anteriorly and is attached to the inside of the maxillary lamina and the side of the tentorial structure supporting the pharynx and salivary pump; and the retractor muscle which extends posteriorly and is attached to the occiput and also by a few fibres to the dorsal surface of the tentorial lobe.

Each mandibular seta is controlled by two series of muscles. The two retractor muscles (rm), see Pl. 1 f. 3, are attached directly

to the base of the seta. A short upwardly directed one is attached behind the ocelli, a longer one extends posteriorly and is attached laterally to the walls of the occipital foramen. The protractor muscle (pm) is attached to the inside of the frons. This muscle instead of being directly attached to the base of the mandible, is attached to a small chitinous triangular plate (b) which articulates at one corner with the gena near the anterior margin of the latter just anterior to the base of the antenna. This triangular plate likewise articulates with the mandible by means of a small rod (a) which is attached at its posterior end to the base of the mandible, while its anterior end articulates with the ventral corner of the triangular plate. The muscle in contracting pulls the mandible forward by means of the small connecting rod. These protractor and retractor muscles control the piercing and probing of the maxillary setæ, and the piercing and holding of the plant tissues by the mandible.

The cavity of the pharynx (ph), which is larger in the middle than at either end, becomes continuous with that of the suction canal, in the setæ, at the point of divergence of the maxillary setæ. At this point the hypopharynx (hph), see Pl. 2 f. 12, or anterior portion of the ventral plate of the pharynx (which is a slender chitinous trough-shaped process) enters the suction canal and lies on the ventral floor of the latter, while the epipharynx, or anterior portion of the dorsal plate of the pharynx, lies above the setæ, fitting snugly over them, and extends anteriorly between the lobes of the clypeus. The membranous sheath surrounding the union of the pharynx and setæ make this union air tight.

The pharynx becomes constricted posteriorly as it passes between the circumœsophageal commissures, opening posteriorly into a membranous œsophagus. Posterior to this constriction the œsophagus is enclosed by a sheath made up of longitudinal muscles. This sheath is connected with the wall of the occipital foramen dorsally by two transversely attached muscles, given off dorso-laterally from the muscular sheath, and ventually it is connected by two ventro-lateral muscles which diverge and are attached to the walls of the occipital foramen. This sheath extends from the posterior end of the pharynx back into the prothoracic region. The four muscles support the œsophagus in this region and probably by their movements of relaxing and contracting, together

with the action of the longitudinal muscles of the sheath, play some part in passing the food down the œsophagus.

The pharynx is double U-shape in cross section. The lateral margins of the dorsal plate (dp) are attached to the dorsal edges of the rigid chitinous ventral plate. To the dorsal surface of the dorsal plate are attached the powerful pharyngeal muscles (phm), see Pl. 1 f. 6, which retracting draw up the dorsal plate creating a vacuum thereby drawing the plant juices up through the suction tube of the setæ and into the pharynx.

The pharyngeal muscles are attached dorsally to the inside of the head capsule. There are three distinct series of pharyngeal muscles attached to the dorsal plate of the pharynx. The first or anterior series is short and composed of small muscles. They are attached to the dorsal plate just posterior to the epipharynx. The second is the longest series and is attached to the widened middle portion of the pharynx. The third or posterior series is attached to the more flattened upcurved posterior portion of the pharynx.

As the dorsal plate lies on the ventral plate, when the pharyngeal muscles are relaxed it seems reasonable to suppose that this pump acts in the following manner. The middle portion of the pharynx is filled when muscle series one contracts and is followed by the contraction of series two, the third series remaining relaxed while the middle portion of the pharynx is filling. When the middle portion is full the first series of muscles relaxes, allowing the dorsal plate to drop. The third series now contracts, opening the way into the œsophagus as the second series relaxes forcing the contents of the pharynx down into the œsophagus. Series three now relaxes to complete the emptying of the pharynx. At the completion of this series of contractions and relaxations at the posterior end of the pharynx, no doubt a new series of similar contractions and relaxations begin again, or possibly they start just before the completion of the first series. As the above description describes a wave-like motion and as no distinct valves have been found as are seen in the salivary pump, the above described process is no doubt the correct one.

Anteriorly the hypopharynx is marked off from the remainder of the ventral plate of the pharynx by raised irregular thickenings situated at the base of the hypopharynx on its lateral walls. The epipharynx is similarly marked off from the remainder of the dorsal

plate by corresponding thickenings on the dorsal plate. The epipharynx is also well marked off from the remainder of the dorsal plate because at this point the flexible dorsal plate ends and the portion beyond or epipharynx lies above the union of the setæ and bears ten papillæ. These irregular thickenings on the lateral walls of the dorsal and ventral plate interlock on either side of the canal of the pharynx. Upon a superficial examination these interlocking thickenings appear to be valvular, but closer observation shows them to be lateral to the canal and that the canal is closed by the dorsal plate of the pharynx being pressed against the ventral plate. Situated on the ventral surface of the epipharynx and above the diverging setæ there is, as stated above, a series of ten minute transparent papillæ arranged in pairs. It has been stated by some writers that these papillæ or glands secrete an oily substance which lubricates the setæ, which at this point must necessarily move forward and backward and in close contact with the epipharynx and hypopharynx. Others state that these are taste organs. The balance of opinion seems to be in favor of the latter view, although this point has not been sufficiently investigated.

Just posterior to the epipharynx on the dorsal plate of the pharynx there are four pairs of glands arranged in a line, each opening into the pharyngeal cavity. The nature of the secretions which these glands empty into the pharynx is not known, but probably they are digestive fluids. Above this series of glands is attached the first series of pharyngeal muscles.

Anteriorly and dorsally the pharynx is supported by two struts (n), see Pl. 2 f. 11 and 13, situated lateral to the lateral dorsal portion of the pharynx. These struts diverge and extending upward fuse with the lateral walls of the clypeus. In addition to these the anterior portion of the ventral plate is supported by upward extending diverging lateral struts which fuse with the inner walls of the fulcra, see Pl. 2 f. 12. At the point where the setæ meet, the lateral walls of the clypeus pass down on either side of the epipharynx and setæ and meet beneath the setæ, thus forming the lobes of the clypeus (lc), see Pl. 2 f. 13. The pharynx is also supported by the tentorial structures, but this will be taken up later.

Below the anterior end of the pharynx lies the salivary pump (sp) supported by the tentorium. This very unique pump consists of a chitinous cylinder and piston. The cylinder is closed at

its anterior end except for the two openings of the salivary ducts (sd) on its ventral side and the opening into the salivary pump canal or efferent canal (ec) in its anterior dorsal surface. Within the cylinder is a valvular flap (iv) which is attached posterior to the salivary ducts. This valve covers these ducts and allows the salivary juices to enter the cylinder from the salivary ducts, but does not permit it to flow back. The dorsal opening is closed by a long valvular flap (ov), attached to the dorsal wall of the efferent canal, which extends forward. This allows the salivary fluid to pass out of the pump and into the efferent canal, but not to return again into the cylinder. Normally the cylinder is nearly filled by the piston head or plunger (pl), see Pl. 1 f. 5, to which is attached anteriorly and laterally the elastic flexible membranous posterior wall of the cylinder. Posteriorly the piston head or plunger is attached to a piston rod to which are attached two large muscles (k) which diverge posteriorly and are attached to the posterior ventral region of the head and also by few muscle fibres to the ventral surface of the lobes of the tentorium. These muscles in contracting draw the plunger back creating a vacuum in the cylinder. This closes the dorsal outlet valve and opens the ventral or inlet valves causing the pump cylinder to fill with saliva from the salivary ducts. When the muscles relax, the elasticity of the posterior wall of the cylinder draws the plunger back into place, thereupon the ventral valves are closed and the dorsal one is opened and the saliva is forced out through the efferent canal and down the salivary canal in the setæ and into the plant tissues.

It seems not unreasonable to suppose that these salivary juices act on the plant cells chemically, possibly as a poison, and cause them to yield their juices more readily, although this point has not yet been investigated.

The efferent canal after leaving the pump cylinder extends forward in a straight line (being supported by a portion of the chitinous tentorium and gradually itself becoming chitinized) until it reaches the membranous sheath about the setæ which it penetrates, and then unites with the lower of salivary canal in the setæ.

The tip of the efferent canal which is trough-like and chitinized enters the salivary canal at the separation of the maxillary setæ and lies on the ventral surface of the salivary canal. The union is made air tight by the chitinous tentorial support of the efferent canal and the membranous sheath.

As these unions of the pharynx and the efferent canal with the setæ must be more or less loose to allow for the forward and backward sliding movements of the setæ, as they are used in feeding, the membranous sheath must fit tightly in and about these parts to insure that there be no leakage at these two joints.

The tentorial structures are variously modified. The middle region of the ventral plate of the pharynx is supported by two chitinous plates which abut against and are attached to the posterior portion of the head in the gula region. These pass forward and upward as broad curved narrowing plates. They converge as they approach the pharynx and their inner edges turn up so that the ventral surfaces of the turned up portion lie along the sides of the ventral plate and are united by tendons to the ventral plate of the pharynx, see Pl. 1 f. 4 and 7. These plates continue forward along the sides of the pharynx, their ventral surfaces extend further up the side of the pharynx. In cross section they appear somewhat crescent shaped as seen in Pl. 1 f. 6 (t). Lying on either side of the pharynx, they form a trough or bed in which the pharynx lies. Anteriorly the salivary pump lies below the pharynx and between these curved tentorial structures securely held in place by the connective tissue which surrounds it. Just anterior to the pump, portions of the two inner surfaces of the plates pass upward on either side of the efferent canal supporting it and continue with it to its connection with the setæ. A portion of each plate passes forward and slightly downward, fusing medianly, with that of the other side, below the portions which support the efferent canal to form the plate to which is attached the dorsal anterior surface of the labium.

Opposite the anterior end of the salivary pump, the outer margins of the plates roll upward and over the fused central plates, and form the two black heavily chitinized horns of the tentorium (ht), each of which contains a groove, which acts as a guide to the converging setæ, which meet over the tip of these horns and pass forward together above the lobes of the clypeus.

The horns of the tentorium separate posteriorly to allow the chitinized tip of the efferent canal and its supporting structures to pass upward between them and connect with the salivary canal in the maxillary setæ at the point where the setæ come together.

The lateral margins of the horns of the tentorium and the lateral margins of the plate to which the anterior dorsal surface of the

labium is attached, are fused to the inside of the maxillary lamina and to the bucculæ along the line of union of the lamina with the bucculæ.

A very delicate chitinous rod (i) which broadens dorsally is situated internal to each compound eye. Each of these rods is attached to the dorsal surface of the same small knob-like projections of the genæ below the compound eyes, to which the chitinous rod that articulates with the base of the maxillary setæ is attached, see Pl. 1 f. 7 (p), and extending upward and slightly forward is attached just above the eye. These rods apparently act as protectors and supports of the eye structures and a few muscle fibres from the antennæ are attached to them dorsally.

There are two thick strong struts projecting inward from the head capsule, one on either side of the head, located slightly anterior to and inward from each ocellus. These form the base of attachment for most of the antennal muscles.

The labrum is a very flexible sclerite. It contains numerous muscles, tracheæ and nerves. The action of its muscular system has not been worked out.

The labium is controlled by two muscles, of these the protractor, or extensor, extends down the labium beneath the anterior surface and is attached basally to a small process of the tip of the tentorial plate to which the labium is attached. The retractor muscle extends down the labium posteriorly and basally is fastened to the ventral surface of the plate with which the labium articulates.

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LETTERING OF FIGURES.

a = chitinous rod at base of mandible.
ant = antenna.
b = chitinous triangular plate articulating with genæ.
b-ant = base of antenna.
bu = bucculæ.
c = clypeus.
dp = dorsal plate.
e = eye.
ec = efferent canal.
f = frons.
fc = food canal or suction canal.
fr = fulcrum.
g = genæ.
gu = gula.
h = chitinous rod connecting maxillary setæ and genæ.
hc = head capule.
hph = hypopharynx.
ht = horns of the tentorium.
i = chitinous rod behind eye.
iv = inlet valve.
k = retractor muscle of salivary pump.
l = struts to which some of the antenna muscles fasten.
lab = labium.
lbr = labrum.
lc = lobes of the clypeus.
m = maxilla.
md = mandible.
ml = maxillary laminæ.
n = pharyngeal struts.
oc = ocelli.
occ = occiput.
ov = outlet valve.
p = internal knob below compound eye.
ph = pharynx.
phm = pharyngeal muscles.
pl = plunger of pump.
pm = protractor muscle of mandible.
pm_1 = protractor muscle of maxillæ.
pth = prothorax.
rm = retractor muscle.
s = setæ.
sc = salivary canal.
sd = salivary duct.
sg = salivary glands.
sp = salivary pump.
t = tentorium.
v = vertex.
vp = ventral plate.

EXPLANATION OF PLATES.

Plate I.

Fig. 1. Side view of head.

Fig. 2. Cross section of setæ.

Fig. 3. Mandibular seta showing its connection with the gena.

Fig. 4. Cross section through the middle region of the pharynx.

Fig. 5. Longitudinal section of salivary pump.

Fig. 6. Cross section of the pharynx and salivary pump as seen in fig. 10.

Fig. 7. Cross section through the eyes. A diagrammatic drawing of fig. 9.

Plate II.

Figures 8–13 are microphotographs.

Fig. 8. Shows the salivary pump and efferent canal and the attachment of the labium. The horns of the tentorium are separated.

Fig. 9. Cross section of the head through the eyes.

Fig. 10. Cross section of the head through the bases of the antennæ.

Fig. 11. Longitudinal section of the head showing the pharyngeal muscles, pharynx and salivary pump, their supports, and the position of the setæ.

Fig. 12. Shows the ventral plate of the pharynx, and the hypopharynx, which are supported by the struts running to the fulcra.

Fig. 13. Shows the position of the pharynx and setæ at their junction, behind the lobes of the clypeus.

[1] The microphotographs were taken by T. W. Nicolet, from slider prepared by the author.

ADDITIONS TO THE GALL MIDGE FAUNA OF NEW ENGLAND.

By E. P. Felt,
Albany, New York.

Last year we prepared a list[1] of 137 New England species, a number being characterized as new. Additional material has been received through the courtesy of Mr. C. W. Johnson of the Boston Society of Natural History, Mrs. A. T. Slosson of New York, and Miss Cora H. Clarke of Boston. Full data as to the origin of the material accompanies each description.

Mr. Johnson captured a specimen of *Asphondylia fulvopedalis* Felt at Brattleboro, Vt., August 15, 1908, adding thereby another species to the list.

Monardia lateralis sp. nov.

Male: Length .75 mm. Antennæ half the length of the body, thickly haired, dark brown; 13- and probably 14-segmented the fifth with a stem one-half the length of the tapering basal enlargement, which latter has a length nearly twice its diameter. Palpi; the first and second segments short, the third twice the length of the second. Mesonotum dark reddish brown. Scutellum, postscutellum and abdomen reddish brown. Halteres and legs mostly fuscous yellowish, the apical portion of the fourth and the fifth tarsal segments reddish brown. Claws strongly curved, finely denticulate, the pulvilli longer than the claws. Genitalia; basal clasp segment short, very broad, truncate distally; terminal clasp segment short, stout, broadly rounded apically and not reaching the median line. Harpes broad, irregular, heavily chitinized posteriorly, with the inner posterior angles produced in slightly curved, stout, conical processes extending in a postero-lateral direction.

Type: Cecid. 1511.

This species runs in our key to *M. balsamicola* Felt, from which it is easily separated by marked differences in the genitalia. It was received from C. W. Johnson, labeled Boston, Mass., May 10, Owen Bryant.

Monardia multiarticulata sp. nov.

Female: Length 3 mm. Antennæ extending to the third abdominal segment, thickly haired, yellowish brown, with 29 and possibly more antennal segments, the fifth subsessile, disk-like, with a length about three-fourths its diameter and exceptionally large, irregular stemmed disks. The terminal segments are produced, the stem with a length nearly two-thirds that of the broadly pyriform basal en-

[1] Psyche, Vol. XX, pp. 133–47.

largement. Palpi; the first segment subquadrate, the second with a length four times its diameter, the third a little longer than the second, the fourth a little longer than the third and somewhat dilated. Mesonotum black, sparsely clothed with ferruginous hairs. Scutellum dark brown, postscutellum fuscous. Abdomen brownish yellow, the ovipositor fuscous. Halteres and legs mostly fuscous yellowish, the distal tarsal segment slightly fuscous; claws denticulate, the pulvilli rudimentary. Ovipositor short, the lobes triarticulate, the distal segments suborbicular and rather thickly clothed with long, stout setæ.

Type: Cecid. 1501.

This species is described from a very interesting midge received from Mrs. A. T. Slosson and labeled Franconia, N. H. It is remarkable because of the very large number of antennal segments. This and other characters prevent our referring it to two allied forms, namely *C. lignivora* Felt and *C. articulosa* Felt.

Monardia rugosa sp. nov.

Female: Length 2 mm. Antennæ extending to the third abdominal segment, thickly haired, light brown; 12 segments, the fifth with a stem three-fourths the length of the tapering basal enlargement, which latter has a length one-third greater than its diameter, bears conspicuous disk-like organs near the middle and is conspicuously wrinkled apically; terminal segment produced, with a length fully twice its diameter, the distal half more slender, coarsely and reticulately wrinkled, and with a short, tapering asymmetrical process apically. Palpi; first segment subquadrate, the second ovate, the third smaller, globose, the fourth more than twice the length of the third and slender. Mesonotum reddish brown. Scutellum light purplish brown, postscutellum, abdomen, coxæ and legs mostly fuscous yellowish. Claws rather stout, evenly curved, the pulvilli rudimentary. Submedian ventral glands of the sixth abdominal segment oval. Ovipositor short, triarticulate, the terminal lobes tapering to a narrowly rounded setose apex.

Type: Cecid. 1510.

This midge was received from C. W. Johnson and labeled Hanover, N. H., August 5, 1908. It is easily separated from females previously referred to this species, by the distinct stems of the antennal segments.

Porricondyla novae-angliae sp. nov.

Female: Length 1.75 mm. Antennæ extending to the third abdominal segment, sparsely haired, dark brown, probably 12 and possibly 14 segments, the fifth with a stem one-fourth the length of the cylindrical basal enlargement, which latter has a length three times its diameter; terminal segment missing. Palpi; the first segment stout, with a length three times its diameter, the second one-half longer, more slender, the third a little longer than the second, somewhat dilated, and the fourth one-half longer than the third. Mesonotum shining dark brown. Scutellum red-

dish brown, postscutellum dark brown. Abdomen dark yellowish brown. Halteres yellowish basally, fuscous apically. Coxæ and femora basally yellowish, the distal portion of femora and the tibiæ mostly dark straw. Tarsi yellowish brown, the posterior pair with the distal portion of the second and the third, fourth and fifth segments whitish. Ovipositor short, the terminal lobes biarticulate, the basal portion narrowly oval, the distal segment fusiform and sparsely setose.

Type: Cecid. 1503.

The midge was received from Mrs. A. T. Slosson and was labeled Franconia, N. H. The structure of the ovipositor serves to separate it at once from all other females referable to this genus.

Porricondyla papillata sp. nov.

Female: Length 3 mm. Antennæ extending to the fourth abdominal segment, ratherly thickly haired, yellowish, the distal segments brownish; 14 segments, the fifth with a short stem, the cylindrical basal enlargement with a length about three times its diameter. Palpi; the first segment long, with a length four times its diameter, the second short, irregular, the third nearly twice the length of the second, the fourth slender and fully twice the length of the third. Mesonotum reddish brown. Scutellum brownish yellow, postscutellum a little darker. Abdomen sparsely haired, yellowish brown. Halteres brownish yellow. Coxæ and femora mostly pale straw. Tibiæ a little darker, the tarsi yellowish brown. Claws stout, strongly curved, unidentate, the pulvilli longer than the claws. Ovipositor short, indistinct in the preparation, apparently being covered by two rounded lateral plates, each with a large, thick group of papillæ sublaterally; each papilla subconical, hirsute and apically with a falcate process.

Type: Cecid. 1502.

The midge characterized above was received from Mrs. A. T. Slosson and labeled Mount Washington. It is a large form easily separated from all other midges known to us, by the two large sublateral groups of papillæ at the posterior extremity.

Lasiopteryx crispata sp. nov.

Larva: Length 2.5 mm., moderately stout, yellowish orange. Head rather narrowly triangular, apex narrowly rounded. Antennæ biarticulate, tapering, with a length about three times the diameter; breastbone well chitinized, bidentate, the shaft tapering posteriorly and somewhat expanded at its extremity. Skin coarsely shagreened, posterior extremity broadly rounded, slightly bilobed.

Female: Length 1 mm. Antennæ one-half the length of the body, sparsely haired, fuscous, the two basal segments yellowish; 13 and probably 14 subsessile segments, the fifth cylindric, with a length about $2\frac{1}{2}$ times its diameter and with a moderately thick subapical group of long, curved setæ near the ventral third. Palpi; first segment irregular, the second with a length three times its diameter, the third and

fourth, each as long as the second and successively more slender. Face pale yellowish; eyes black. Body yellowish. Mesonotum fuscous, the submedian lines with broad, rather coarse scalelike hairs. Abdomen clothed with fuscous scales and a few long hairs, the incisures yellowish. Wings hyaline, the membrane with numerous narrow, curved scales; costa dark brown. Halteres black. Coxæ yellowish; femora basally pale yellowish, the tibiæ and tarsi gradually darker to dark brown. Claws slender, strongly curved, unidentate, the pulvilli about half the length of the claws. Ovipositor short, the lobes narrowly oval and thickly setose.

Type: Cecid. a2341.

A single female was reared August 22, 1912, from a jar containing oval, yellowish blister galls on *Oakesia sessilifolia* collected by Miss Cora H. Clarke at Magnolia, Mass. It is possible that this insect was not an inhabitant of this gall. The generic reference is also provisional.

Schizomyia speciosa sp. nov.

Female: Length 2 mm. Antennæ as long as the body, thickly haired, reddish brown, the segments distally with yellowish hairs, these producing an indistinct yellowish annulation; 14 segments, the fifth with a length about five times its diameter, the 12th with a length one-half greater than its diameter, the 13th with a length equal its diameter, the 14th disk-like. Palpi; first segment irregular, the second with a length about three times its diameter, the third with a length four times its diameter, somewhat dilated, the fourth one-half longer than the third and dilated. Mesonotum yellowish brown, the submedian lines thickly clothed with long, yellowish hairs. Scutellum and postscutellum yellowish. Abdomen sparsely haired, dark brown. Wing membrane thickly clothed with dark scales, almost subhyaline, there being a distinct spot near the tip of the third vein, one at the apex of the fifth and another along its posterior fork. Halteres dark brown, the distal portion of the stem yellowish, the apical half of the club white. Coxæ yellowish brown. Legs mostly dark brown, the anterior and middle femora narrowly annulate in the middle with yellowish, the posterior femora with the basal half white; the bases of the tibiæ, the first tarsal segment and the distal half of the second, third and fourth and the basal portion of the fifth white. The bands on the posterior tarsi yellowish and broader, there being on the third and fourth tarsal segments only a narrow, brown annulation near the basal third. Claws moderately stout, evenly curved, simple, the pulvilli rudimentary. Ovipositor when extended probably as long as the body, the aciculate part narrowly chitinized ventrally and approaching the condition found in Asphondylia; the ventral plate well developed.

Type: Cecid. 1507.

The striking midge described above was received from Mrs. A. T. Slosson and labeled Franconia, N. H. It is allied to *S. rivinæ* Felt from which it may be easily separated by its somewhat larger

size, the darker color of the abdomen, the more distinctly and broadly white-banded posterior tarsi and the relatively longer antennal segments.

Hormomyia proteana sp. nov.

Male: Length 5 mm. Antennæ extending to the third abdominal segment, sparsely haired, fuscous yellowish; 14 segments, the fifth subsessile, subcylindric, with a broad constriction at the basal third; the eighth and following rather plainly binodose, with stems about three-fourths and one-half their diameters, respectively. The three circumfili irregular and apparently forming double or nearly double bands. Terminal segment with a narrow constriction dividing the globose basal enlargement and the fusiform distal swelling. Palpi probably small (indistinct in the preparation) and presumably uni- or biarticulate. Mesonotum shining black. Scutellum and the lateral and posterior margins of the thorax yellowish, the postscutellum dark brown. Abdomen mostly yellowish brown. Halteres yellowish. Coxæ and legs fuscous yellowish; claws simple, the pulvilli rudimentary. Genitalia; basal clasp segment long, moderately stout; terminal clasp segment long, stout; dorsal plate broadly, deeply and triangularly emarginate, the lobes moderately slender and narrowly rounded apically; ventral plate moderately long, broad, broadly rounded.

Type: Cecid. 1521.

The large midge described above was collected by Mr. C. W Johnson at Auburndale, Mass., May 28. It is easily distinguished from other large Hormomyias by the antennal segments and particularly by the cylindric character of the basal ones of the flagellum.

Parallelodiplosis cinctipes sp. nov.

Male: Length 1 mm. Antennæ one-half longer than the body, thickly haired, pale straw; 14 segments, the fifth with stems 2 and $2\frac{1}{2}$ times their diameters, respectively. Circumfili moderately long. Palpi; first segment short, broadly oval, the second quadrate, with a length more than twice its width, the third a little shorter and more slender than the second, the fourth one-half longer than the third, dilated. Mesonotum yellowish brown. Scutellum yellowish, postscutellum and abdomen yellowish brown. Wings subhyaline, with indistinct fuscous areas near the distal fourth, before and behind the third vein, near the middle, on the margin between the third and fifth veins, and on the fork of the fifth and at the basal third an indistinct diffused area extending nearly across the wing. Halteres yellowish transparent. Legs dark brown, broadly banded with white as follows: Femora, the apical half; tibiæ, a broad band near the basal third and the apical half; tarsi, the apex of the first segment and the basal two thirds of the second, the basal two thirds of the third and most of the fourth and fifth, the banding being more striking on the posterior than on the anterior or mid legs. Genitalia; basal clasp segment moderately long, stout, with a distinct tooth at the internal basal

angle; terminal clasp segment long, rather stout; dorsal plate broad, deeply and roundly emarginate, the lobes narrowly rounded; ventral plate moderately long, broad, narrowly rounded apically; style long, the basal two thirds swollen, the apex dilated.

Type: Cecid. 1522.

The well marked midge described above was reared in May, 1908, by Mr. C. A. Frost, Framingham, Mass., from dead twigs of *Rhus vernix*. The specimens were placed at our disposal through the courtesy of Mr. C. W. Johnson.

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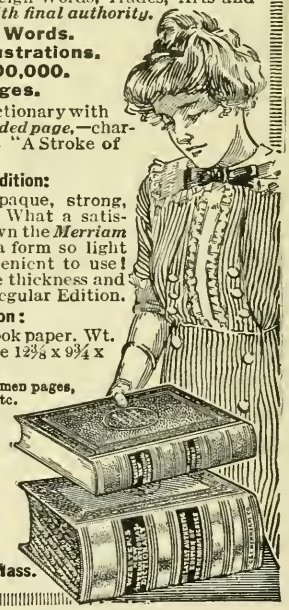

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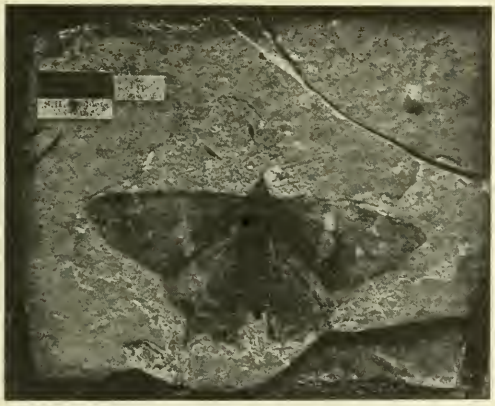

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Wellesley College.

J. H. Emerton,
Boston, Mass.

J. G. Needham,
Cornell University.

W. M. Wheeler,
Harvard University.

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HYBRID BUTTERFLIES OF THE GENUS BASILARCHIA.

By W. L. W. Field,
Milton, Massachusetts.

On August 19, 1910, at Alstead Center, New Hampshire, several females of *Basilarchia archippus*, reared in captivity, were placed in a breeding-cage with males of *B. arthemis* captured in the neighborhood. The butterflies were fed with dilute honey applied to heads of *Prunella* and clover.

On August 20, a pair was found in copulation, remaining in that state for about half an hour. Afterward the female was removed from the cage and placed on willow shoots out-of-doors, under a cheese-cloth covering. Every leaf of the willow had been inspected; a wooden baseboard was provided, and all crevices were tightly packed with cotton. The butterfly was a crippled one, and found difficulty in balancing herself upon the leaves. Some of her eggs were laid upon leaves in the normal way, a few on stems, and many on the cheese-cloth in the vicinity of the foliage. In seven days she laid sixty-two eggs, and then died.

The larvæ began hatching nine days after the beginning of oviposition, but in all only nineteen appeared; and it was noted that none of these came from eggs laid toward the end of the period of oviposition.

The larvæ grew slowly, but were favored by unusually mild weather, and began to construct hibernacula early in October. On October 21, sixteen were found hibernating; the others had disappeared. The hibernating larvæ were transferred to a small outdoor shelter near my laboratory in Milton, Mass.

On April 27, 1911, they were placed on willow shoots under a cheese-cloth shelter. The willow shoots had been started indoors and kept under close scrutiny, and were known to be free from other larvæ.

On May 7, the larvæ began to issue from their hibernacula. In all ten appeared, but one was very belated and weak, and soon

died. One other was injured by a fall after pupating, and died. Eight, all males, reached the imago stage successfully. The small size of the pupa which died warranted the surmise that it, also, was a male.

The butterflies were all closely like the type specimen of *arthechippus* in the Museum of Comparative Zoölogy, described by Scudder (1889), and the two specimens captured on the wing in Alstead, N. H., and deposited in the same collection. The older specimens are likewise all males.

Diligent efforts were made to mate these butterflies with females of allied species. *Arthemis*, *archippus*, *astyanax* and *proserpina* were all tried, in different breeding ages and in various numbers and groupings, but no mating occurred. Both sexes, however, in several instances showed marked sexual excitement, and their failure to copulate is probably to be ascribed to some unfavorable element in the illumination of the cages at critical moments.

On August 30, 1910, at Alstead Center, a female *Basilarchia astyanax*, reared in captivity from a larva obtained near Brooklyn, N. Y., mated with a male *arthemis* captured in Alstead. The duration of copulation was fifty-five minutes. The female was afterward imprisoned over carefully-inspected wild cherry shoots, on the leaves of which she deposited eighty-two eggs. Oviposition was begun on September 5, and extended over nine days.

The eggs were extremely slow in hatching, and no exact count of the young larvæ was obtained. Forty-one survived the early frosts, and the construction of hibernacula began on October 21. The hibernating larvæ were kept through the winter in an outdoor shelter in Milton, Mass., and bagged out on inspected shoots of wild cherry April 27, 1911. On May 7 they began to emerge from their nests, but their number had dwindled to ten when the count was made. All of the ten pupated successfully, but only eight reached the imago state: five males and three females, all rather dark examples of *proserpina*.

Efforts to breed these butterflies with one another were unsuccessful. Attempts were then made to mate them with *arthemis* and *astyanax*, the two parent species; and the females were introduced into the boxes containing the males of *arthechippus*, already described; but no copulation occurred.

The accompanying plate shows a male and a female of *proserpina*, and two males of *arthechippus*, chosen from the two series just described. These specimens, with others more worn and disfigured by their prolonged detention in the breeding cages, are in the Museum of Comparative Zoölogy at Harvard University. The tattered remains of the parents of both broods will be found in the same case.

Publication of this record has been delayed in the hope of obtaining new hybrids and breeding them to further generations; but though success seemed very close in the experiments of 1912 and 1913, no progress has been made. The work has been resumed with abundant material, and the present summer may witness some definite results. At all events, the hybrid character of *arthechippus* and *proserpina* is now established; and observations already published (Field, 1910) make it clear that *proserpina* will at least breed with one of the parent species. Increased interest thus attaches to the butterflies of this always interesting genus.

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Note on *Linognathus forficula* Kellogg and Paine.

Through recent correspondence with H. Fahrenholz of Hannover, Germany, an active worker with the Anoplura, the writer has received information which concerns the nomenclature of *Linognathus forficula*, described by Kellogg and Paine from *Cervicapra arundinum*.[1] The generic position of Rudow's *Hæmatopinus forficulus*[2] has, on account of an insufficient description, been considered doubtful. However, Fahrenholz has come into possession of a series of specimens of Rudow's species which reveals the fact that it must be placed in the genus *Linognathus*. The name *L. forficula*, therefore, as applied to Kellogg and Paine's species, must give way, on account of priority, and is herewith substituted by the name *Linognathus fahrenholzi*. J. H. Paine.

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[1] Kellogg, V. L. and Paine, J. H. Anoplura and Mallophaga from African Hosts; Bull. Ent. Research, Vol. II, p. 147, July, 1911.

[2] Rudow, Zeitschr. f. gew. Naturw. Vol. 34, p. 169 (1869).

THE AMERICAN SPECIES OF MYRMICA ALLIED TO *M. RUBIDA* LATREILLE.[1]

By William Morton Wheeler.

The large and handsome *Myrmica rubida* Latreille remained for many years the only species of an aberrant group within its genus. In 1894 Emery described the first American species of this group, *M. mutica*, from Denver, Colo., and five years ago I added a species from California, *M. bradleyi*. Two additional species, *M. aldrichi* and *hunteri*, from Idaho and Montana respectively, have since come to light and are described in the following pages. Thus all of the American forms are known only from the mountainous regions of the Western States. The single Old World species occurs in similar localities in Central and Southern Europe and as far east as the Caucasus in Asia Minor and Eastern Siberia. I have had abundant opportunity to study *M. rubida* in the Rhone valley and other localities in Switzerland and *M. mutica* at Colorado Springs and in neighboring localities in Colorado. Both species have very similar habits. They usually nest in sandy creek bottoms under stones or in small crater nests. The workers of both species sting severely, especially the Eurasian *M. rubida*, but neither is very aggressive. The pupæ have a peculiar canary yellow color, unlike that of any other species of the genus.

As all five of the species now recognized are closely related to one another and constitute a sharply defined group, I propose to separate them from *Myrmica sens. str.* as a subgenus, *Oreomyrma, subgen. nov.*, with *M. rubida* Latr. as the type (Fig. 1a). The workers and females in this subgenus are distinguished by having the epinotum unarmed, the antennal club 5-jointed and the mandibles with two large apical and 12–14 minute basal teeth. The male has no club to the antennal funiculi and the mandibles are like those of the worker. In *Myrmica sens. str.*, with the type *M. rubra* L., the antennal club of the worker and female is 3-or 4-jointed, the mandibles have only 7–12 teeth and the epinotum is armed with a pair of spines. The males have a distinct 4- or 5-jointed antennal club, and their mandibles are only 4–8-toothed.

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[1]Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 79.

The males and females of only two of the species (*M. rubida* and *mutica*) are known. The workers of the five species may be readily separated by means of the following key:

1. Anteroventral surface of postpetiole with a pointed or rounded tubercle or protuberance 2
   Anteroventral surface of postpetiole flat or at any rate without a tubercle or protuberance 3
2. Large species (worker, 7–8.5 mm.; female, 9.5–12 mm., male, 8.5–10 mm.) epinotum subdentate; postpetiole with a small, pointed, anteroventral tubercle; deep red, posterior portion of first gastric segment blackish *rubida* Latreille.
   Smaller species (worker, 4–6 mm.), anterior border of clypeus entire, epinotum not subdentate, rounded in profile; anteroventral portion of postpetiole much more protuberant 4
3. Deep red; petiole subopaque ..... *mutica* Emery.
   Black, with red thorax, petiole and postpetiole; both petiole and postpetiole shining, more slender ..... *bradleyi* Wheeler.
4. Yellow; anteroventral tubercle of postpetiole conical or pointed. *aldrichi* sp. nov.
   Deep red; spot on vertex and posterior portion of first gastric segment black; anteroventral tubercle of postpetiole more rounded ..... *hunteri* sp. nov.

Myrmica (Oreomyrma) mutica Emery (Fig. 1 d).

Myrmica mutica Emery, Zoöl. Jahrb. Abth. f. Syst. VIII, 1894, p. 311 ♀.

Worker: Length, 4–6 mm.

Head subrectangular, as broad as long, with straight lateral borders and rounded posterior corners. Eyes at the middle of the sides. Clypeus convex, its anterior border very feebly sinuate in the middle. Mandibles with two large apical and about a dozen minute basal teeth. Antennal scapes, rather strongly curved and slightly flattened at the base, scarcely reaching beyond the posterior corners of the head. Funicular club 5-jointed. Thorax in profile with rounded pronotum and the mesonotum gently sloping to a rather deep constriction in front of the epinotum, which has a subequal base and declivity, the former feebly convex, the latter sloping and nearly straight. Petiole in profile longer than high, its node bluntly rounded, with concave anterior and convex posterior slopes; ventral surface of peduncle in front with a small, acute tooth. Postpetiole scarcely longer than broad, a little broader behind than in front, somewhat broader than the petiole; its ventral surface in profile straight. Gaster a little larger than the head. Legs long, tibiæ and femora feebly clavate.

Subopaque; dental border of mandibles, postpetiole, gaster and legs shining. Mandibles, frontal area and front longitudinally rugose; remainder of the head longitudinally and rather indistinctly punctate-rugulose. Thorax finely rugose, longitudinally on the pleuræ, pro- and mesonotum, transversely and more coarsely on the epinotum. Petiole and ventral portion of postpetiole finely and densely punctate. Gaster and legs with small, scattered, piligerous punctures.

Hairs white, erect or suberect, coarse, rather short, abundant on all parts of the body, legs and scapes.

Ferruginous red; gaster slightly paler; frontal area, and in some specimens also the antennal clubs, infuscated; mandibular teeth black.

Female: Length, 6.5–7.5 mm.

Closely resembling the worker. Postpetiole in some specimens opaque rugulose, or with only the node smooth and shining. Mesonotum and scutellum sharply and regularly longitudinally rugose, the former with an anteromedian and a pair of parapsidal blackish streaks. Wings grayish hyaline; veins pale brown, stigma dark brown.

Male: Length, 6–7 mm.

Head, including the eyes and excluding the mandibles, distinctly broader than long, rounded behind. Mandibles similar to those of the worker, with two large apical and numerous minute basal teeth. Clypeus very convex, with entire anterior border. Antennæ slender; scapes very short, not longer than the second funicular joint; which is three times as long as the first and of the same length as the succeeding joints. There is no differentiated club. Thorax rather small, narrower than the head through the eyes, with very distinct Mayrian furrows. Scutellum convex, epinotum, petiole and postpetiole much as in the worker. Gaster more slender, with the genital appendages proportionally larger and more exserted than in *M. rubida.*

Shining; head opaque, indistinctly punctate and longitudinally rugulose; thorax subopaque, more shining above, longitudinally rugose-punctate even on the epinotum. Sides and ventral portions of petiole finely and densely punctate.

Hairs much as in the worker but more delicate and flexuous.

Black; dental borders of mandibles, tibiæ and tarsi brown or sordid yellowish; gaster red, often brownish in the middle above; base of first segment sometimes black or all of the gaster, except the base of the first segment, black. In other specimens the postpetiole is red. Wings colored as in the female.

Colorado: Denver; type locality (Theo. Pergande); Colorado Springs, Salida, Buena Vista and Wild Horse, 6000-7000 ft. (Wheeler); Canyon City (Rev. P. J. Schmitt).

New Mexico: (Ern. André.).

Utah: Salt Lake County (R. V. Chamberlin), as the host of the peculiar xenobiotic ant, *Symmyrmica chamberlini* Wheeler.

Washington: Olympia (T. Kincaid); Ellensburg and Pullman (W. M. Mann).

Alberta: McLeod (C. G. Hewitt).

British Columbia: Dog Lake, Penticton (C. G. Hewitt).

Myrmica (Oreomyrma) bradleyi Wheeler. (Fig. 1 c.)

Myrmica bradleyi Wheeler, Journ. N. Y. Ent. Soc. XVII, 1909, p. 77, ☿ .

Myrmica (Oreomyrma) aldrichi sp. nov. (Fig. 1 b.)

Worker: Length 5–6 mm.

Head subrectangular, a little longer than broad, with nearly straight sides and posterior border and rounded posterior corners. Mandibles and antennæ as in

M. mutica. Clypeus convex, its anterior border very feebly sinuate in the middle. Frontal area indistinct. Thorax similar to that of *mutica*, but the epinotum with its base feebly and evenly convex and fully twice as long as the distinctly concave declivity. Petiole laterally compressed ventrally, with a small, acute tooth near the anterior end of the peduncle, its node from above subelliptical, longer than broad, in profile with concave anterior and slightly convex posterior slopes. Postpetiole from above but little broader than the petiole, slightly longer than broad, a little broader behind than in front; in profile convex above, especially behind, below with a prominent conical or pointed protuberance near its anterior end.

Mandibles opaque, finely longitudinally striated, their dental border smooth and shining. Head and thorax opaque, longitudinally rugulose-punctate, posterior portion of clypeus, vertex, occiput and pronotum above smooth and shining. Epinotum transversely rugulose. Gaster, legs, petiolar and postpetiolar nodes smooth and shining, with sparse, minute, piligerous punctures; petiole and postpetiole on the sides and below subopaque; finely and densely punctate.

Hairs white, erect, rather short; covering the body, legs and scapes as in *M. mutica*.

Brownish yellow; dental borders of mandibles and antennal clubs pale brown.

Described from sixteen specimens taken by Prof. J. M. Aldrich at Moscow, Idaho.

At first sight this species may be readily mistaken for an immature *M. mutica* on account of its yellow color, but on closer inspection it is easily distinguished by the shape of the epinotum and postpetiole and the smooth front, occiput, pronotum and petiolar mode.

Myrmica (Oreomyrma) hunteri sp. nov. (Fig. 1 c).

Worker: Length 4–6 mm.

Closely related to *M. aldrichi* but differing in the following characters: Body and appendages brownish red or ferruginous, with a large, black, subtriangular spot on the vertex and a band of the same color across the posterior portion of the first gastric segment. Frontal area, posterior clypeal suture, antennal clubs and dental border of mandibles more or less infuscated. Sculpture sharper and coarser than in *aldrichi*. Upper surface of head with coarse, scattered punctures in addition to the rugæ. Smooth areas on the head, thorax and pedicel much as in that species. Hairs pale yellow instead of white. Anterior clypeal border entire. Base of epinotum somewhat flattened, anteroventral protuberance of postpetiole broadly rounded and not conical or pointed.

Described from a dozen specimens taken by Dr. S. J. Hunter from a couple of nests on the slopes of two mountains on the Madison River, nearly opposite the mouth of Beaver Creek, Montana, at an altitude of about 7,500 feet. The nests were in shaley earth and apparently of the crater type.

Of all the American species of *Oreomryma*, *hunteri* is most closely related to the palearctic *rubida* in coloration and sculpture. Per-

haps it should be regarded merely as a subspecies of *aldrichi*, but its exact status can be determined only with the aid of additional material and with specimens of the males and females of both forms.

Further researches in the mountains of the northwest will probably bring to light additional species of *Oreomyrma*. The number and distribution of those at present known indicate that the Rocky Mountains are the center of distribution of the subgenus and that *M. rubida* may have reached the Old World during the Tertiary by way of the Behring Strait land-bridge.

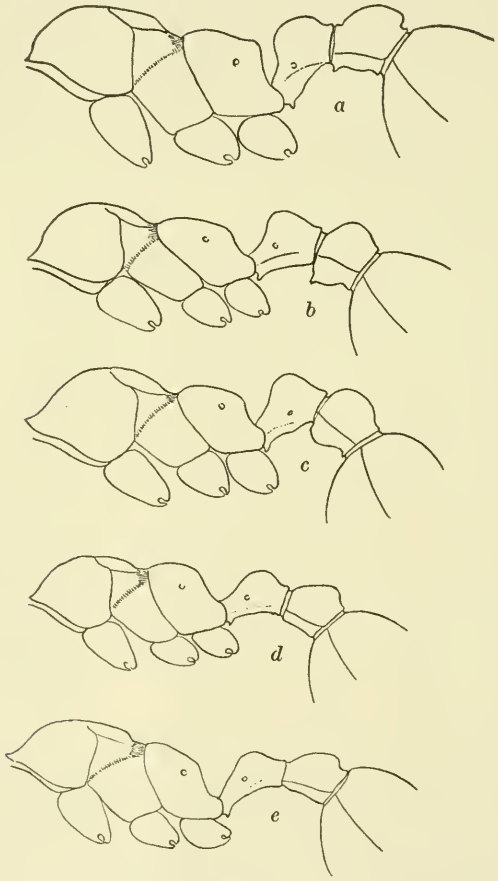

Fig. 1. *a*, Thorax and pedicel of *Myrmica* (*Oreomyrma*) *rubida* Latr. in profile; *b*, of *M.* (*O.*) *aldrichi* sp. nov.; *c*, of *M.* (*O.*) *hunteri* sp. nov.; *d*, of *M.* (*O.*) *mutica* Emery; *e*, of *M.* (*O.*) *bradleyi* Wheeler.

THE DISCOVERY OF ECLIMUS HARRISI IN THE WHITE MOUNTAINS, N. H.

By Charles W. Johnson,
Boston Society of Natural History.

This interesting species has long been known only by the type, a male, in the Harris collection, in the Boston Society of Natural History. It bears the label, "H. Gray," without date or locality. It was described by Osten Sacken as *Epibates harrisi* in his Western Diptera (Bull. U. S. Geol. Survey, Vol. 3, p. 273, 1877). In the note following the description he says: "It is probably from the Northern United States as are nearly all the specimens in the collection." On page 271 in the table of species it is referred doubtfully to the "Atlantic States (?)," but in the table of contents where all the species are arranged systematically with localities, "Massachusetts" is given without a question. I am unable to find any authority for this and doubt if Osten Sacken made the table of contents.

During the meeting of the New England Federation of Natural History Societies at the Glen House the first week in July, frequent collecting trips were made to various parts of the mountains. On July 8, I captured a male of *Eclimus harrisi* on the flowers of the blackberry on the Mount Washington Road near the Raymond trail, just below the two-mile post, at an elevation of about 2,600 feet. This resembles the type in every respect except that its length is 12 mm. while the type measures 14 mm. A female of this species was taken by Mr. C. A. Frost, July 6, along the railway, above Base Station.

A REVIEW OF OUR SPECIES OF TRIGONOMETOPUS (DIPTERA; LAUXANIIDÆ).

By Frederick Knab,
Bureau of Entomology, Washington, D. C.

The Lauxaniid genus *Trigonometopus* is easily recognizable by the peculiar shape of the elongate head, triangular in profile, with the frons horizontal and the face strongly receding, the antennæ inserted at the apex of the triangle. Four species have been

described from America, three of which are represented in the national collection by single specimens. Four other specimens in the collection belong to two species hitherto undescribed and are now characterized. The European species, *Trigonometopus frontalis* Meigen, frequently has the last section of the fourth vein appendiculate; none of the specimens before me show this peculiarity. The American species may be separated as follows:

1. Wings subhyaline, two round dots on outer section of third vein *punctipennis* Coq.
   Wings not so marked 2
2. Wing pale along the costa, a dark streak medially 3
   Wings not so marked 5
3. Abdomen mostly pale ..... *vittatus* Loew
   Abdomen dorsally black, marked medially with yellow 4
4. Wings with a dark spot on the anterior cross-vein, median stripe of abdomen to tip ..... *albifrons* sp. nov.
   Wings without spot on anterior cross-vein, median stripe of abdomen abbreviated ..... *angustipennis* sp. nov.
5. Wings whitish hyaline, reticulated with fine bars of black between the veins *reticulatus* Johns.
   Wings not reticulate, a dark shade along costa involving second vein *rotundicornis* Will.

Trigonometopus angustipennis sp. nov.

Male: Frons pale brownish, moderately broad, narrowing very slightly anteriorly, the part in front of the eyes not broadened; a dark patch clothed with dense black hairs laterally from eyes to antennæ; occiput dark brown along posterior margins of eyes, a black streak from eyes along lower margin of cheek. Antennæ ferruginous, the third joint compressed, in lateral view broad and rounded; arista long, pale at base, black beyond. Mesonotum and scutellum black, with three narrow, well-defined, longitudinal yellowish stripes, confluent on anterior margin, posteriorly continued over the scutellum. Pleuræ ocher yellow. Abdomen dorsally black, a median yellowish stripe extending to the apex of the fourth segment; sides and venter yellowish. Legs yellowish, the tarsi slightly infuscated. Wings rather narrow, the costal region to the middle of the submarginal cell pale yellowish, subhyaline, the involved veins pale; the rest of the wing smoky, a distinctly darker median streak involving the third and fourth veins and near the tip of the wing extending forward to the costa and involving the tip of marginal cell; all the veins within the smoky zone black, a dark shade along the fifth vein and posterior cross-vein. Length: Body about 4.5 mm., wing 4 mm.

Guadeloupe, West Indies, 3000 feet altitude, 30 July, 1905, one specimen (Aug. Busck).

Type: Cat. No. 18482, U. S. Nat. Mus.

In this species the ocular margins converge slightly anteriorly while in the two species which follow they are distinctly divergent; beyond the bulging eyes the frons is not markedly broadened, as is the case in the other species. The head is also slightly shorter in the portion beyond the eyes. In the single specimen the head is somewhat distorted, nevertheless the differences from *T. albifrons*, the species it most resembles, are obvious and abundant.

Trigonometopus albifrons sp. nov.

Male and female: Frons creamy white, very broad, widening anteriorly, a large dark brown spot densely clothed with black hairs laterally before eyes, scattered black hairs anteriorly diminishing to behind the middle; occiput dark brown along posterior margins of eyes to the cheeks, a dark streak from the eye along the lower margin of the cheek, face white, nearly flat. Antennæ whitish, the third joint tinged with ferruginous, compressed beyond its base, in profile broad and rounded; arista very long, pale near base, black beyond. Thorax narrow; mesonotum broadly blackish brown at the sides, a median yellowish zone occupying nearly half its width and divided by two ill-defined dark stripes into three pale longitudinal stripes. Scutellum blackish brown, with a narrow median and less distinct lateral yellowish stripes. Pleuræ pale yellowish, infuscated on the mesosternum. Abdomen dorsally black, with pale lateral incisions and a median yellowish stripe extending its entire length; venter pale. Legs pale yellowish, the bristles black; tarsi very slightly infuscated. Wings rather broad, the costal region to the middle of the submarginal cell pale yellow, semi-opaque and with the veins pale; posterior portion of wing tinged with grey and with all the veins behind the second black, a darker shade about the cross-veins and broadly along the third vein, particularly distally where it is abruptly produced to the anterior margin at the tip of the second vein. Halteres pale, with infuscated knobs. Length: Body about 4.2 mm., wing 3.5 mm.

San Marcos, Nicaragua, 2 specimens (C. F. Baker); Cacao, Trece Aguas, Alta Vera Paz, Guatemala, 30 March, 1906, one specimen (Schwarz and Barber).

Type: Cat. No 18481, U. S. Nat. Mus.

The specimen from Guatemala differs in some respects. On the wings the anterior expansion of the dark shade reaches the costa before the end of the second vein, thus involving the tip of the marginal cell; the portion of the second vein within the dark shade is black. I attribute no significance to this difference, as the two specimens from Nicaragua, which are surely conspecific, show variation in this respect. In one the dark shade reaches the costa at the tip of the second vein, in the other the pale costal zone extends a short distance beyond the end of the second vein.

Trigonometopus vittatus Loew.

A single specimen before me, taken by Mrs. A. T. Slosson at Biscayne Bay, Florida, agrees with Loew's description in most particulars. The wing coloration indicated by Loew is like that of the species just described. In the present specimen the difference between the yellowish anterior portion of the wing and the smoky posterior portion is but weakly indicated; the dark shade appears to begin behind the third vein, instead of in front of it, thus leaving a pale streak along the anterior margin of the first posterior cell. No trace of the distal extension of the dark shade to the costa at the tip of the second vein, as indicated by Loew, is perceptible, nor is there any strong contrast in the coloration of the veins in the two regions. Another difference occurs in the coloration of the abdomen; this may, however, be due largely to the condition of the specimens, since the insect is said to have an entirely pale abdomen in life. In Loew's specimen the abdominal segments are said to have basal dark bands, while in the specimen before me these bands are apical. It is possible that the Florida specimen represents a distinct species, but the variability shown by the three specimens of *T. albifrons*, and the paucity of material, indicate a conservative course.

PROTHETELY IN THE LARVA OF *PHOTURIS PENNSYLVANICA* DE GEER.

By Francis X. Williams,
Bussey Institution, Harvard University.

The term prothetely (προθεῖν, to run before, and τέλος, completion) was proposed by Kolbe in 1903, who applied it to that condition found in insect larvæ in which the imaginal discs have developed with abnormal rapidity resulting in the production of larvæ with pupal or imaginal characters.

Prothetely, though not of common occurrence, has been noted chiefly in coleopterous larvæ, being there represented by external wing-pads, adult legs, additional antennal joints, modified mouth-parts, abdominal tergites, etc., one or several of these peculiarities occurring in a single larva.

In the fall of 1913, the writer collected upwards of one hundred larvæ of our common large firefly, *Photuris pennsylvanica* DeG., in the Arnold Arboretum, adjoining the grounds of the Bussey Institution. These larvæ, ranging from about 13 to 18 mm. long, were in the second and last year of their growth. Under natural conditions they should have pupated in May or June of 1914, and produced adults a few days later, but, owing to the fact that they were kept under artificial conditions, adults emerged in late winter as well as in summer.

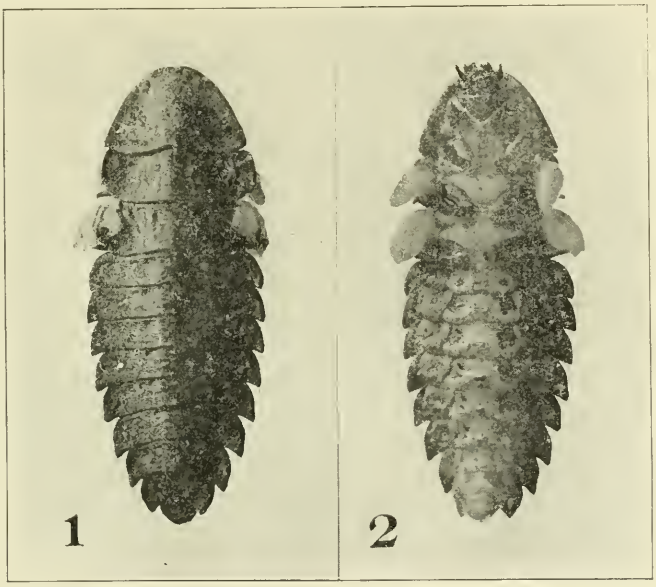

Fig. 1. Prothetelous larva of *Photuris pennsylvanica* De Geer. 1, dorsal view; 2, ventral view.

As secured in the field, these larvæ appeared to be perfectly normal. They were examined from time to time in the laboratory, and on May 27, 1914, an individual was found with a pair of well developed wing-pads on the meso- and metathorax. Two days later another such larva was discovered. Photographs were taken showing the dorsal and ventral view of one of these larvæ anæsthetized with chloroform, and are reproduced above. It will be seen that the wing-buds are here much smaller than the wing-cases of

a pupa, but similarly situated; they are quite symmetrical and are developed just under the heavily-chitinized tergites which they reflex a little. The buds of the metathorax representing the wings are slightly larger than the elytral buds; in one specimen they are almost entirely covered with brown chitin, in the other the buds of the metathorax are largely of a whitish color and their bases show through the tergite as white subcircular areas.

Prothetely has been noted by a number of observers: Heymons (1896)[1] found it in the larva of *Tenebrio molitor;* Busck (1897)[2] observed it in six larvæ of *Anthrenus varius;* Riley (1908)[3] speaks of a prothetelous larva of a pyrochroid beetle, *Dendroides canadensis.* In lepidopterous larvæ Hagen (1872)[4] and others mention the silkworm, *Bombyx mori*, and Kolbe (1903)[5] the Lasiocampid, *Dendrolimus pini.*

As aforesaid, prothetely appears to occur most frequently in the Coleoptera, and Riley[3] offers as an explanation of this, the fact that the wing rudiment in most coleopterous larvæ is according to Tower 'not sharply marked off from the body hypodermis and is usually directly evaginated to form the imaginal organ.' The step from this condition to an external wing-pad would be comparatively simple, which would not be the case in the Lepidoptera and the Diptera for example, for here the wing rudiment is well differentiated from the body hypodermis, for the former is invaginated and thus lies in the body cavity, a condition designated by Tower as the "enclosed type" of wing development.

Inasmuch as all the cases of prothetely noted occur only in larvæ kept under artificial conditions, this accelerated development is probably due in some way to these unnatural conditions. Strickland (1911)[6], is of the opinion that prothetely "is usually caused by keeping larvæ at an abnormally high temperature. This probably results in an increased supply of the enzymes which cause these histoblasts to develop."

Neither larva of *Photuris pennsylvanica* pupated; they lagged behind the other larvæ, being, so to speak, already partly in the

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[1] Heymons, R., 1896, Sitzungber. d. Ges. nat. Fr. Berlin, pp. 142-144.
[2] Busck, Aug., 1897, Proc. Ent. Soc. Wash., IV, p. 123.
[3] Riley, Wm. A., 1908, Ent. News, XIX, pp. 136-139.
[4] Hagen, H. A., 1872, Stettin. ent. Ztg., pp. 392-393.
[5] Kolbe, H. J., 1903, Allgem. Zeitsch. für Ent., Bull. 8, No. 1, p. 28.
[6] Strickland, E. H., 1911, Biol. Bull., XXI, pp. 313-327.

pupal stage. One did not attempt to pupate but sickened and died, the second formed a cell in late June and remained therein in an arched position for several days; it approached the form of a pupa, the larval skin softening considerably, and the imaginal eyes could be seen through this integument, but it perished without any ecdysis.

A NEW ANOPHELINE.

By C. S. Ludlow,

Army Medical Museum, Washington, D. C.

The Anopheline to be described is an unusually brilliantly marked one, the very marked spotting of the legs and wings being at once noticeable. It probably lies nearest *ludlowii* but the wing markings are quite different, the palpal bands are all narrow, and the legs are very much more spotted than even the most distinctly marked specimen of *ludlowii* which I have seen.

Myzomyia parangensis sp. nov.

♀. Head brown covered with white and dark brown forked scales, the white ones on the vertex and spreading laterad about one-half the width of the eyes, the brown fork scales on the rest of the head except a long tuft of slender white scales projecting forward between the eyes; antennæ brown, verticels and pubescence white, a few white scales on the proximal joints, basal joint brown with "frosty tomentum"; palpi fairly heavily scaled, the scales outstanding, brown except a small white tip and narrow white bands at the base of the penultimate and at the base of the antipenultimate, the apical joint is very short; proboscis brown, labella light; clypeus brown; eyes brown.

Thorax; prothoracic lobes dark brown with long, yellow bristles; mesothorax a soft yellow, covered with "frosty tomentum" and sparsely by light yellow to white fine hair-like scales, more apparent in a median line of them, and long white scales projecting over the nape, but not confined to the very middle portion. A brown median line widening at the caudal margin, and continued still more broadly on the scutellum; scutellum much as mesonotum; pleura very dark brown with lines of white "frosty tomentum"; metanotum brown.

Abdomen dark brown covered with golden brown hairs, and a few long, light spatulate scales on the apex of the eighth segment; the genitalia are also covered with long spatulate scales.

Legs: coxæ and trochanters white; femora very markedly spotted or ringed in brown and white, there being no marked predominance of either color, the spots

rather large, the very apices light, but sometimes only faintly so; tibiæ like femora, but the apices more distinctly white; the first tarsal joints are also markedly spotted and have an apical white band; the second tarsal joints are both apically and basally banded, more broadly in the fore legs, in the fore and mid legs usually with one intermediate spot, on the hind legs there are several intermediate spots; the third tarsals all have apical and basal light bands and at least one intermediate spot on the hind legs; the fourth tarsals have apical and basal bands, broader on the fore and mid legs, and the hind legs have the intermediate spot; the fifth tarsals are all basally light banded, and in some specimens at least a suggestion of an apical band. Ungues simple and equal. The bandings and spots on the hind tarsals, especially where there are only a few or one spot, divide the legs so they seem quite evenly marked brown and white.

Wings light yellowish much mottled with dark brown. The costa has six brown spots and a mere dot, the last practically at the junction of the first longitudinal vein with the costa; proximad is a small white spot followed by a larger dark one extending on to the first longitudinal and the upper fork of the second long vein, then comes a light spot about three times as long as this second dark spot followed by a small dark spot, about half as long as the preceding dark spot and extending on to the first long vein, then a long light spot followed by the third dark spot which is the largest of all the dark spots, the distal third extending on the sub-costa, the first long vein, on the stem of the second long vein and on the third long vein, the last two veins being less heavily marked than those celphalad of them, there is then on all these veins but the costa a light portion running under the remainder of the costal dark spot until the very proximal end where the dark again extends as a tiny spot on the sub-costa and first long vein. The fourth dark spot is not so long and extends on the sub-costa and first long vein; the fifth dark spot is small, and on the costa only, and the sixth spot is longer but also only on the costa. The wing field is much spotted. A small spot besides the "dot" spoken of on the upper fork of the second long vein near the base of the cell and two on the lower fork, the one near the apex small, and there is one on the stem near the junction of the sub-costa with the costa. The third long vein is mostly light, there being besides the dark spot connected with the large costal spot another dark spot just exterior to it and one near the apex of the vein; the fourth long vein has two spots on the stem and two on each fork; the fifth long vein is mostly light, but has one dark spot on the stem towards the base, and three on its upper fork; the sixth long vein has three dark spots, one near the base, one about the middle, and one near the apex. The fringe is much mottled and is light at the junction of all the veins except the upper fork of the second long vein and at the junction of the sixth, and has also light mid spots between the upper and lower forks of the fifth, between the fifth and the sixth and beyond the sixth it is light save for two dark spots just interior to this vein. The apices of all the veins are light. Halteres with dark knobs and light stems.

Length: about 7 mm.

Habitat: Parang, Mindanao, Philippine Islands.

Taken: October and November.

NOTES ON ASILIDÆ, WITH TWO NEW SPECIES.

By Nathan Banks,

East Falls Church, Virginia.

In the genus *Asilus* Hine has used as diagnostic characters the bristles on hind border of the scutellum and on front side of the hind tibiæ. There are cases where these seem to help very much, but there are so many cases where they mislead that I think a division of the genus on a color character (whether hind femora entirely black or not) is much more useful for our Eastern species. For *A. notatus* but two scutellar bristles have been described, yet in many cases there are four or five, and often three. The tibial bristles are apt to confuse *A lecythus* with *A. paropus*, if one is not familiar with the species.

Asilus autumnalis sp. nov.

Face yellowish, white on the tuberosity, mystax black above and yellowish or yellowish-white below, beard white; antennæ black, third joint with sides more parallel than in *A. novæscotiæ*, bristle full as long as third joint. Thorax with dull black median stripe, indistinctly divided in front, and two spots each side behind, rest with yellowish dust, black hair in front and black bristles behind; scutellum with two bristles on the hind margin; abdomen brown, mostly clothed with yellowish pollen on sides and behind, and yellow hairs all over. Legs with black femora, the tibiæ and metatarsi pale yellowish, with black tips. Wings as in *A. novæscotiæ*. The male forceps are more narrowed at tip than in *A. novæscotiæ*, and the tip more bent downward, so that the lower side is plainly concave. Length, 14–15 mm.

From Falls Church, Va., in August and September.

Our local species of *Asilus* which have the hind femora entirely black may be distinguished as follows:

1. Front and middle femora largely yellow; ovipositor very long. . . *flavifemoratus.*
   Front and middle femora black 2
2. All tibiæ pale only at extreme base; metatarsi black; mystax black and white . . . . . *notatus.*
   Tibiæ with more pale 3
3. Mystax mostly golden, tibia I wholly clear yellow; abdomen black, with white hair, no yellow pile; male forceps furcate at tip . . . . . *orphne.*
   Male forceps not furcate, tibia I not all clear yellow 4
4. Mystax mostly black; hind tibiæ mostly dark; abdomen dark, with pale gray apical margins to segments . . . . . *sadytes.*
   Mystax largely pale 5

5. Mystax mostly white; male appendages not much narrowed nor bent down at tip ..... *novæscotiæ.*
Mystax whitish or yellowish below, black above; male appendages more curved and narrowed at tip ..... *autumnalis.*

Of *Leptogaster* I have taken most of the Eastern species, and in going over these I am inclined to keep *flavipes* and *favillaceus* as separate, at least as varieties, and would describe a new species. As in *Asilus* I think the color characters are here more valuable than some structural ones, at least more useful than venation.

1. No empodia; hind femora with band before broadest part; hind tibæ with banP at base and at middle dark; thorax pale; antennæ yellow ..... *annulatus.*
Empodia present 2
2. Hind tibiæ dark only at extreme tip; hind femur usually not plainly banded. . 7
Hind tibiæ dark for a considerable distance; hind femur dark or dark-banded 3
3. Legs mostly black; antennæ dark; hind legs very slender ..... *tenuipes.*
Legs mostly pale 4
4. Dorsum of thorax wholly shining black; hind femora with apical dark band, and another over the beginning of the swelling ..... *atridorsalis.*
Dorsum not wholly shining black 5
5. Thorax with three black stripes; hind femora with band over thickened part; antennæ pale ..... *virgatus.*
Thorax without such stripes 6
6. Antennæ dark; hind legs short, and the swelling greater than usual, and covered by broad band, the dark of hind tibiæ undivided ..... *pictipes.*
Antennæ yellow; hind legs longer, the dark band on hind femora not so broad; the dark of hind tibiæ divided by pale ..... *brevicornis.*
7. Thoracic notum polished reddish, often a black spot behind on each side; hind femora with a small dark band 8
Thoracic notum not polished reddish 9
8. Body mostly reddish ..... *testaceus.*
Body mostly dark, and with pale marks ..... *badius.*
9. Abdomen yellow on basal part, only dark over the incisures ..... *incisuralis.*
Abdomen with much more dark 10
10. Abdominal segments dark, pale only near apex; hind femora show a faint dark mark, bristles of thorax black ..... *loewi.*
Abdominal segments with pale before middle on third, fourth and fifth segments 11
11. Lower anterior bristle of the two thoracic ones pale, larger species with duller marks ..... *favillaceus.*
Both thoracic bristles dark, marks on abdomen strongly contrasting. . . . *flavipes.*

L. virgatus Coq. probably is *L. carolinensis.* *L. incisuralis* Loew probably is *L. ochraceus.*

Leptogaster loewi sp. nov.

Similar to *L. favillaceus* and *L. flavipes*. Legs pale; hind femora with traces of a dark band over swollen part, tip of hind tibiæ dark. Antennæ yellow; thorax grayish brown above, with traces of median stripes, the two bristles each side black; abdomen grayish brown, tips of third, fourth, and fifth segments yellowish; venation yellowish-brown, as in *L. flavipes*.

Differs from *L. flavipes* (and *favillaceus*) in lacking pale on abdomen before middle of segments, and the more distinct band on hind femora. Length, 10–12 mm.

From Paeonian Springs, Va., 28 June, and Ithaca, N. Y., 7 July.

NOTES ON AULACOPHORA OLIVIER AND OIDES WEBER.

By F. C. Bowditch,
Brookline, Massachusetts.

In the arrangement of my Austral-Malayan species of Aulacophora the following notes occur which may aid in the study of this group.

In Mr. Baly's table of males, Linn. Soc. Journ. vol. xx, p. 2, No. 14 *postica* Chap. is placed in § A_{-B}: it should be in § A_A having the middle anal segment sulcate longitudinally, as stated by him in the description, p. 12, and verified by examination.

Unicolor Jac. cited by Baly l. c., p. 23, states that the ♂ is unknown; the description by Mr. Jacoby, Notes Leyden Mus. vol. v, p. 201, speaks of five specimens, all ♀'s; one of these five examples in the first Jacoby collection is now before me and is a ♂: the middle lobe of the anal segment is slightly concave, placing it in § A_{-B} of Baly's table of ♂'s. Mr. Baly speaks of its resemblance to *Boisduvali* but the anal sulcation seems to me to differ somewhat and needs further comparison. If the two are identical it seems that intermediate forms must occur and I have seen none.

Semilimbata Baly described l. c., p. 74, has no characters given for the ♂; the type specimen apparently came from "New Guinea, (Wallace)"; in the first Jacoby collection among the unnamed material is a ♂ with the same label; the middle anal segment is deeply concave placing the species in Baly's A_A.

Denticornis Blackb. seems to me to be the same as *fraudulenta Jac.* The peculiarities of the two first joints of the ♂ antennæ described by Mr. Blackburn seem to me to be present in the ♂ type of *fraudulenta* (in my collection) and to have been overlooked

by Jacoby in his description; unless the specimen is held at a certain angle the points spoken of are easily overlooked.

Frontalis, Baly, l. c., p. 182, describes the third joint of the antennæ "twice as broad as long." Comparison with a specimen in my collection labeled "type ex Baly" seems to show the words to be accidentally transposed so they should read "twice as long as broad."

Borrei Baly (pectoralis Jac) is described as having the thorax impunctate (Ann. Mus. Gen. 1886, p. 50); the types now in my collection all have the surface near the anterior angles punctured, so the description should read, "impunctate except the anterior angles." Mr. Blackburn in describing his *A. Richmondensis* Proc. Zoöl. Soc. N. S. W. vol. v, 1890, p. 360, relies upon Mr. Jacoby's description to separate the two forms, which seem identical; in Mr. Jacoby's second collection he has under the name *pectoralis* specimens from N. S. W. (square purple label) which exactly agree with the description of Mr. Blackburn's species.

A. celebensis Jac. l. c., p. 52, typically has basal and ante-apical spots, what seems an extreme variety, has the elytra entirely black, except for a small flavous spot at the apex, or a slight margin in the middle of the side, the latter very like (flavo-marginata Duv.). All come from Toli-Toli, No. Celebes (Fruhstorfer).

Aulacophora blackburni sp. nov.

Reddish, castaneous, labrum, face and antennæ flavous, mandibles, eyes, tibiæ and tarsi blackish, femora fuscous at apex, the joints 3, 4, 5 of the antennæ dilated in the male like *denticornis Jac.*

Type: 1 ♂ Manila (coll. Bowditch). Length, 5 mm.

Head impunctate with two almost circular, deep foveæ, one on either side of the vertex above the eye, antennæ a little more than half the length of the body, first joint clavate, second joint very small, rounded, with a minute point externally in the middle, third joint in the shape of a long pointed perpendicular tooth, the following two joints broadly dilated acutely pointed at their anterior angles, the following joints elongate nearly equal, thorax twice as broad as long, finely punctured, very sparsely and finely on the disk, sulcation nearly straight, abbreviated on either side, elytra strongly depressed below the base, showing very lightly punctulate, last abdominal segment longitudinally lightly concave or sulcate.

The above specimen was in the second Jacoby collection mixed with examples of *similis* Oliv. *Denticornis* Jac. is the only other species known to me with the peculiar dentate antennal third joint, and this form should be placed next it.

In Nov. Zoölog. vol. i, pp. 299–300, Mr. Jacoby described *Oides unifasciata* and *suturalis*, calling attention to the produced metasternum, imitating to some extent the genus Doryphora, four nearly allied additional forms have occurred and are here made known. Mr. Jacoby further intimates a new genus for his forms, but I have allowed all to remain in Oides for the present: the two Jacoby species and also the new ones are rather more chunky and robust than the other species of Oides and may be almost picked out by the shape alone.

Oides confusus sp. nov.

Convex ovate, shining; head, antennæ and below, mostly black, thorax flavous, elytra reddish fulvous, with a common broad basal black band, not attaining the lateral edge and a large round subapical spot on each elytron black.

♀ with metasternum produced into a well marked obtuse process, last ventral segment obtuse, impressed on either side.

Type ♀ Milne Bay, Br. N. Guinea (coll. Bowditch). Length, 12 mm.

Imitates *O. rubra Blanch.* in size and color, but more convex and wider, antennæ attaining the rear edge of basal black band with the two or three basal joints more or less fulvous, third and fourth equal and longer than the others, head with a few fine punctures and an impressed line on the front, thorax very finely punctulate over its entire surface and all the angles rounded, scutellum smooth, truncate behind, elytra finely punctulate over the entire surface, abdomen edged with rufous spots, the coxæ and base of the femora are also more or less tinged with rufous, probably mixed with *rubra* in many collections.

Oides binotata sp. nov.

Convex, elongate, shining rufous, mouth, eyes, thorax and a large median lateral spot on each elytron black. ♂ and ♀ with metasternum produced into a well-marked obtuse process.

Type: ♂ ♀ Kapour Holl, N. Guinea (Frühstorfer) coll. Bowditch. Length, 11 mm.

Head with a few faint punctures on the front, which is smooth and shining with a faint median line, antennæ reaching the middle of the elytra, thorax shining, faintly impressed on either side, rather strongly, evenly punctured, sides strongly margined, the angles obtuse, the anterior ones slightly reflexed, scutellum with apex obtusely rounded, elytra smooth, shining, oblong, rather strongly and evenly punctate, the sutural margin somewhat thickened posteriorly, the black spot on each elytron is transversely rounded and a trifle nearer the lateral edge than the suture; the metasternum process, with the color easily separate this form.

Oides gahani sp. nov.

Ovate flavous, eyes, antennæ except base, elytra except anterior third, black, the flavous part of the elytra being narrowest at the scutel and from there curved back to meet the lateral margin at about the middle, ♂ and ♀ with metasternum produced into a well marked obtuse process.

2 ♂ 1 ♀ Stephansort, 1 ♂ Milne Bay, Br. N. Guinea. Length, 11 mm.

Type: ♀ Stephansort (coll. Bowditch).

Head faintly and sparingly punctulate with a dark median line, antennæ reaching the middle of the body the scape wholly and second joint partly flavous, thorax shining, impressed on either side of the disk, moderately and unevenly punctulate, obsolete at the sides, which are rounded and slightly reflexed, anterior angles rounded, posterior obtuse, scutel obtusely pointed behind, elytra shining, rather more strongly punctulate, near the base, punctures becoming obsolete and fine as they enter the black space, sutural margin thickened near the apex, entire underside dirty flavous; two of the specimens were in the 2d Jacoby coll. under the name *dimidiatum* Blanch. but the size, shape and metasternal process separate it at once.

Oides femoratus sp. nov.

Smooth, convex, flavous, antennæ, most of the head, under side of the body largely and legs, except the basal two thirds of the femora black, scutellum and margin of the suture fuscous, ♂ with metasternum produced into a well marked obtuse process.

Type: ♂ Cooktown (Austral.) (square dark blue paper label) 2 spec. (unnamed in 2d Jacoby coll.) (coll. Bowditch). Length, 9 mm.

Head with a few fine punctures and impressed line on the front like *confusus* (*ride supra*), mouth yellow, antennæ reaching the middle of body, the scape more or less rufous, thorax smooth, shining, faintly impressed on the disk, very faintly punctulate, anterior angles rounded, posterior obtuse, sides margined and faintly explanate, scutellum large very obtusely rounded at apex, elytra convex, everywhere faintly and evenly punctulate, the extreme sutural edge thickened, under side mostly shining black, with the pro and mesothorax somewhat flavous, and coxæ and trochanters more or less yellow, legs black except the basal two thirds of the femora; the color of the legs and the metosternal process (which is black) easily distinguish this form, the upper color makes the species resemble *suturalis* Jac. from New Guinea.

SOME COMMENTS ON THE VALUE OF WARNING COLORS AND MIMICRY IN INSECTS.

By C. H. Richardson,
New Jersey Agricultural Experiment Station, New Brunswick, N. J.

During the course of an extended field trip through Nevada and eastern California several years ago, I had an opportunity to make some observations on the feeding habits of certain amphibians and reptiles. As several of these observations throw light upon the protective value of warning colors and mimicry in insects, they are given in the hope that they will be a real contribution, even though a meager one, to these disputed questions.

In the region about Pyramid Lake, Nev., the fleet-footed grid-iron-tailed lizard (*Callisaurus ventralis* Hallowell) was very abun-

dant. Examination of the stomach contents of a number of these lizards showed that their normal food was composed of various insects and bits of tender plant foliage. I was however, quite surprised to find in the stomach of one adult male, shot at Derby, Nev., two wasps so conspicuously banded as to place them unmistakably in the category of insects possessing warning colors. One had black and yellow bands on the thorax and abdomen, the other black and gray-white bands on the abdomen. Another wasp in a partially disintegrated condition, one insect larva, other insect fragments, a number of green leaves and a few pebbles furnished the bulk of the stomach ingredients. The whole mass of food had begun to decompose and the colors of the insects were considerably dimmed. It is evident here that a mature lizard (with full adult colors and testes enlarged) did not discriminate between conspicuously banded stinging insects and a harmless white larva. As further evidence that *Callisaurus* shows no aversion to bright colors, I may add that small, vivid purple flowers were found in the stomach of one individual. Merriam [1] states that blossoms form a considerable part of the food of this species and although he does not give the colors of the blossoms, it is fair to assume that a comparatively large number are brilliantly colored, as brilliantly colored flowers grow abundantly throughout the habitat of *Callisaurus*.

At Tallac, Lake Tahoe, Cal., I watched a large adult leopard frog (*Rana pipiens*), on one occasion for a considerable length of time. I was concealed so that I could observe the actions of the frog, yet it could not see me. In the course of its wanderings over a grassy meadow, the frog captured an insect which was taken into its mouth, ejected, taken into its mouth again and finally discarded. The insect proved to be a drone fly, closely resembling certain species in the Syrphid genus, *Eristalis*. The first abdominal segment of the fly bore two conspicuous yellow triangular-shaped markings, the apices of which did not quite meet mediodorsally. Here, then, we have a mimicking insect whose form and vivid color pattern combined were not of sufficient warning significance to ward off an insectivorous enemy. Just why the frog refused to eat the fly is not quite clear, possibly it was distasteful, but it is certain that the fly was mutilated beyond recovery.

[1] N. A. Fauna No. 7, 1893, p. 172.

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Will exchange insects of various orders for Parasitic Hymenoptera from any part of the world.—C. T. Brues, Bussey Institution, Forest Hills, Mass.

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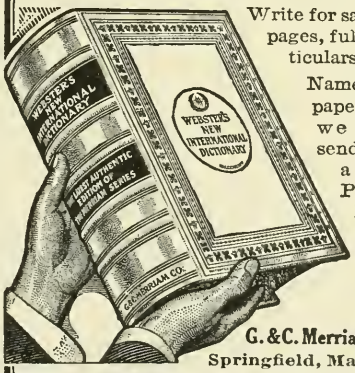

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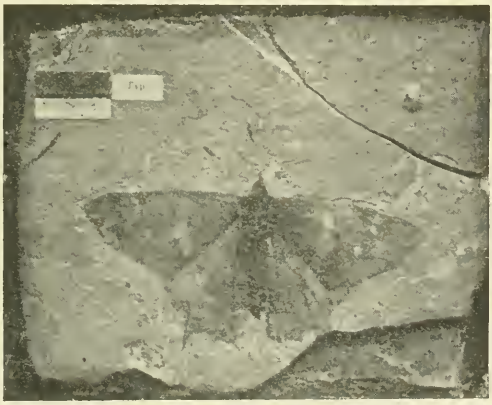

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PSYCHE

VOL. XXI. OCTOBER, 1914. No. 5

LIST OF THE HEMIPTERA-HETEROPTERA OF MAINE.[1]

By H. M. Parshley,
Bussey Institution, Harvard University.

The present list is the first of a series of papers in preparation by me on the Heteroptera of New England and is offered as a record of the species definitely known to inhabit Maine. In view of the great extent of almost inaccessible territory in the state and the relatively small amount of collecting which has been done, it is to be expected that additional species will be found, but I hope that the list is complete enough to be a useful basis for subsequent work, as it includes records of 175 species.

The records have been compiled chiefly from the following sources: An unpublished list of Maine Hemiptera by Mr. O. O. Stover, whose material was determined in part by Uhler, in part by Professor Osborn; the collection of the Maine Agricultural Experiment Station, determined largely by Mr. E. P. Van Duzee; the collection of Mr. F. A. Eddy of Bangor; the collection of the Boston Society of Natural History; and my own collection. The dates given are the earliest and latest which I have found on record for the several species.

My thanks are due the following, who have lent me their assistance: Dr. Edith M. Patch, who has put the collections and records of the Experiment Station at my disposal; Mr. J. R. de la Torre Bueno, who has determined a number of specimens and given valuable suggestions; Mr. F. A. Eddy, the veteran collector of Maine, who has permitted the free use of his valuable collection; Mr. C. W. Johnson, who has given me access to the collection of the Boston Society of Natural History; Mr. O. O. Stover, who has generously allowed me to make use of his unpublished records; and Mr. C. A. Frost, who has given me specimens of several species which otherwise would not have been recorded.

[1] Papers from the Maine Agricultural Experiment Station: Entomology No. 74.

The arrangement of the families followed is that of the new system of Reuter,[1] with certain modifications in accordance with the views of Kirkaldy and Bueno.

Family CORIXIDÆ.

Arctocorixa Wallengren.

A. interrupta Say. 8 May. Orono.
A. nitida Fieb. 24 April–1 May. Orono.

Corixa Geoffroy.

C. alternata Say. 15 April–13 Oct. Orono.
C. harrisii Uhl. Orono.
C. kennicotti Uhl. 21 April.

Family NOTONECTIDÆ.

Notonecta Linné.

N. insulata Kirby. 27 April. Orono.
N. irrorata Uhl. 22 May–19 Sept. Orono, Machias.
N. undulata Say. 8 May–17 Oct. Orono.
N. variabilis Fieb. 20 April–15 Sept. Orono.

Buenoa Kirkaldy.
(= *Anisops*, American species.)

B. elegans Fieb. Orono.

Family BELOSTOMATIDÆ.

Belostoma Latreille.
(= *Zaitha* Auct.)

B. flumineum Say. 20 June (with eggs)—17 Oct. Orono.

Lethocerus Mayr.
(= *Belostoma* Auct.)

L. americanus Leidy. 8 May–12 Sept. Orono, Oldtown.

Family ACANTHIIDÆ.
(= *Saldidæ* Auct.)

Pentacora Reuter.

P. ligata Say. Norway, Magalloway River.

Acanthia Fabricius.

A. coriacea Uhl. 4–11 July. Orono, Brewer.
A. major Prov. (= *deplanata* Uhl.) Reported from the State by Uhler.

Family MIRIDÆ.
(= *Capsidæ* Auct.)

Stenodema Laporte.

S. trispinosum Reut. 16 June. The Forks.

[1] Oefv. Fin. Vet. Förh., vol. 54, p. 5 (1911-12).

Miris Fabricius.

M. dolobratus Linn. 31 May–14 July. Throughout the state.
M. vicinus Prov. 22–31 May. Orono.

Resthenia Spinola.

R. insignis Say. 10 July–26 Sept. Paris, Mt. Kineo.

Lopidea Uhler.

L. confluens Say. 28 July–8 Aug. Orono, Camden.
L. media Say. 12 July. Princeton.

Phytocoris Fallen.

P. eximius Reut. 30 June—11 July. Orono, Waldoboro.
P. pallidicornis Reut. 16 Sept. Westbrook, Waldoboro, West Beach.
P. annulicornis Reut. 17 Aug. Ft. Kent, Durham.
P. lasiomerus Reut. 30 July. Orono.
Reported predaceous on aphids.

Neurocolpus Reuter.

N. nubilus Say. Orono.

Calocoris Fieber.

C. norvegicus Gmel. 15 July. Eastport.

Adelphocoris Reuter.

A. rapidus Say. 20 July–15 Aug. Orono, Brunswick, Pownal, etc.

Lygus Hahn.

L. pabulinus Linn. Orono.
L. pratensis Linn. 7 May–12 Sept. Found everywhere.
L. pratensis var. Red form so determined by Van Duzee. Orono.
L. convexicollis Reut. 6 July–17 Sept. Orono.
L. invitus Say. 5–27 July. Orono, Waldoboro, West Beach, Capens.
L. flavonotatus Prov. Orono.

Lygidea Reuter.

L. mendax Reut. 30 June. Orono.
L. rubecula Uhl. 18 July. Moosehead.

Coccobaphes Uhler.

C. sanguinarius Uhl. 27 June–3 Aug. Monmouth, Manchester.

Tropidosteptes Uhler.

T. ? pettiti Reut. Rangeley.

Horcias Distant.

H. limbatellus Walk. 15 Aug.

Pœciloscytus Fieber.

P. basalis Reut. 13 Oct. Westbrook.
P. divergens Reut. 11 July. Capens.

Pœcilocapsus Reuter.

P. dislocatus var. goniphorus Say. 15 Aug. Orono.
P. lineatus Fab. 14 July–17 Aug. Orono, Machias, Eastport.

Camptobrochis Fieber.

C. nitens Reut. 11 July–15 Aug. Orono.

Capsus Fabricius.

C. ater Linn. 19 June–18 July. Capens, Orono, Eastport.

Monalocoris Dahlbom.

M. filicis Linn. 31 May–17 Aug. Bethel, Orono, Ft. Kent, Pownal.

Diaphnidia Uhler.

D. pellucida Uhl. 22 July. Orono.
On potato plants.

Hyaliodes Reuter.

H. vitripennis Say. 17 Aug. Ft. Kent.

Cyrtorrhinus Fieber

C. marginatus Uhl. 18–28 July. Moosehead, Orono.

Pilophorus Westwood.

P. amœnus Uhl. Collected in Maine by Packard.

Orthotylus Fieber.

O. flavosparsus Sahlb. 22–30 July. Orono.
On potato plants.

O. congrex Uhl. 10 July. Calais.

Collaria Provancher.

C. meilleurii Prov. 17 Aug. Ft. Kent, Orono.
C. oculata Reut. Durham.

Halticus Hahn.

H. citri Ashmead. Pownal.

Stiphrosoma Fieber.

S. stygica say. 17 Aug. Ft. Kent.

Idolocoris Douglas and Scott.

I. agilis Uhl. Pownal.

Orectoderus Uhler.

O. obliquus Uhl. 26 July. Machias.

Lopus Hahn.

L. decolor Fall. 15 July. Pownal.

Megalocoleus Reuter.

M. coagulatus Uhl. Pownal.

Plagiognathus Fieber.

P. fraternus Uhl. 13 Sept. Westbrook.
P. fuscosus Prov. 11 July–3 Aug. Orono, Waldoboro, Pownal.
P. politus Uhl. 14 July–13 Sept. Orono, Westbrook.
P. obscurus Uhl. 10 July–17 Aug. Calais, Ft. Kent.
So recorded probably = *fuscosus*.

This family has been little collected, and doubtless many more species inhabit the state. I intend to pay special attention to the group, and give this arrangement as merely tentative.

Family ANTHOCORIDÆ.

Anthocoris Fallen.

A. musculus Say. 30 April–19 Aug. Orono, Ft. Kent.

Lyctocoris Hahn.

L. fitchii Reut. 28 June. Orono.

Triphleps Fieber,

T. insidiosus Say. 22 June. Orono, Pownal.

Family CLINOCORIDÆ.

(= *Cimicidæ* Auct.)

Clinocoris Fallen.

C. lectularius Linn.
Seasons and distribution no more restricted than in other regions.

C. ? hirundinis Jenyns.
There is a specimen in the Station collection taken from a swallow's nest and so labelled, but probably this species is strictly European.

Family NABIDÆ.

Pagasa Stal.

P. fusca Stein. Orono.

Reduviolus Kirby.

R. subcoleoptratus Kirby. 7 July–27 Aug. Orono, Belfast, Ft. Kent.
R. rufusculus Reut. 8 May–5 Oct. Orono, West Beach, Waldoboro.
R. ferus Linn. 17 April–5 Oct. Generally distributed, Orono, etc.

Family NEPIDÆ.

Ranatra Fabricius.

R. americana Mont. 4 Oct. Orono.
This species has been confused with both *fusca* Beauv. and *quadridentata* Stal. *Nepa apiculata* Harr. should be found in the state, as its known range includes this region.

Family HYDROMETRIDÆ.

Hydrometra Latreille.

H. martini Kirk. 6 May–17 July. Orono, Monmouth.

FAMILY REDUVIIDÆ.

Pygolampis Germar.

P. pectoralis Say. Manchester.

Reduvius Lamarck.

R. personatus Linn. 19 June–24 Aug. Orono, Pownal, Brunswick.

Apiomerus Hahn.

A. ventralis Say. 26 June. Monmouth.

Zelus Fabricius.

Z. exsanguis Stal. (= *luridus* Stal.) Manchester.
Z. socius Uhl. 18 July. Monmouth.

Fitchia Stal.

F. aptera Stal. 31 May–29 June. Manchester, Orono, Monmouth.
Records of the winged form have not come to my notice.

Acholla Stal.

A. multispinosa De Geer.

Sinea Amyot et Serville.

S. diadema Fab. 4 July–8 Aug. Orono.

(SUBFAMILY EMESINÆ.)

Ploiariodes White.

P. tuberculata Banks. 27 June. Monmouth.

FAMILY MACROCEPHALIDÆ.

(= *Phymatidæ* Auct.)

Phymata fasciata Gray should be found in the state, but definite records have not come to my notice.

FAMILY GERRIDÆ.

Gerris Fabricius.

G. remigis Say. 20 April–17 May. Orono.
G. conformis Uhl. 22 Sept. Orono.
G. marginatus Say. 10 May–19 July. Orono, Westbrook, Norway, Durham.
G. buenoi Kirk. 1 May–15 Sept. Orono.

Limnoporus Stal.

L. rufoscutellatus Latr. 6 May–19 July. Orono, Brunswick, Norway.

Trepobates Uhler.

T. pictus Her.-Schfr. 15 Sept. Orono.

Metrobates Uhler.

M. hesperius Uhl. 22 Sept. Orono.

Family VELIIDÆ.

Microvelia Westwood.

M. americana Uhl. 17 May–19 Sept. Orono, Pownal, Paris.

M. borealis Bueno MSS. 3 May. Orono.

I took specimens of this species in a temporary puddle in a wagon road through a field.

Rhagovelia Mayr.

R. obesa Uhl. 15 July. Paris.

Family TINGITIDÆ.

Corythuca Stal.

C. ciliata Say. Collected in Maine by Packard.

C. juglandis Fitch. 4–6 June. Orono.

C. arcuata Say. May–17 June. Ft. Kent, Brunswick, Bethel.

C. pergandei Heid. 22 May–17 Sept. Orono.

Leptobyrsa Stal.

L. explanata Heid. Bar Harbor.

Physatochila Fieber.

P. plexa Say. Westbrook.

Tingis Fabricius.

T. (*Melanorhopala*) clavata Stal.

The occurrence of this species is reported in the Station records, but I have been unable to locate an actual specimen.

Family MYODOCHIDÆ.

(= *Lygæidæ* olim)

Ischnorhynchus Fieber.

I. geminatus Say. 22 May–11 Sept. Orono.

Records of *I. resedæ* Panz. probably refer to this species.

Cymus Hahn.

C. luridus Stal. 24 May. Orono.

C. angustatus Stal. 10–26 June. Westbrook, Orono, Holden.

C. discors Horv. 20 June. Orono.

Blissus Burmeister.

B. leucopterus Say. 13 April–3 May. Jackman, Orono.

B. hirtus Mont. 7 April–12 May. Orono.

These two species are very closely allied, and may not be distinct. I found them together under stones in early spring.

Phlegyas Stal.

P. annulicrus Stal. 23 June. Holden.

Œdancala Amyot et Serville.

Œ. dorsalis Say.

Reported from the state by Stover, but I have not been able to find definite data.

Nysius Dallas.

N. ericæ Schill. 28 Sept. Orono, Westbrook, Pownal.
N. longiceps Stal. 28 July. Orono.

Belonochilus Uhler.

B. numenius Say. 10 Sept. Orono.

Orsillus Dallas.

O. scolopax Say. Portland.

Uhler recorded this species as abundant on dry sedges near Portland.

Lygæus Fabricius.

L. kalmii Stal. 27 July–11 Aug. Orono, Green Lake.
L. turcicus Fab. Orono, Waldoboro.

Cligenes Distant.

C. pallidus Uhl. 22 April. Orono.

Ligyrocoris Stal.

L. contractus Say. 2–12 Sept. Orono.
L. diffusus Uhl. 2–15 Sept. Orono.

Myodocha Latreille.

M. serripes Oliv. 24–30 May. Orono.

Sphærobius Uhler.

S. insignis Uhl. 25 Sept. Westbrook.

Cnemodus Herrich-Schaeffer.

C. mavortius Say. 19 June. Skowhegan.

Sphragisticus Stal.

S. nebulosus Fallen. 13 Sept. Pownal.

Eremocoris Fieber.

E. ferus Say. 27 April–13 Sept. Holden, Orono, Pownal, Capens.

Drymus Fieber.

D. unus Say. Orono.

Scolopostethus Fieber.

S. ? atlanticus Horv. 29 March. Orono.
S. diffidens Horv. 30 April. Orono.

Xestocoris Van Duzee.

X. nitens V. D. 22 April. Orono.

Geocoris Fallen.

G. bullatus Say. 15 June–20 July. Orono, Pownal.

Family NEIDIDÆ.

(= *Berytidæ* olim)

Neides Latreille.

N. muticus Say. 10 June–14 Aug. Orono.

Jalysus Stal.

J. spinosus Say. 6 June. Bangor.

Family ARADIDÆ.

Aradus Fabricius.

A. æqualis Say.
A. robustus Uhl. 24 April–27 June. Orono, Monmouth, Manchester.
A. similis Say. 29 April–4 June. Orono.
A. acutus Say. Norway.
A. niger Stal. 29 March–11 May. Orono.
A. quadrilineatus Say. 17 June–19 July. Holden, Paris, Monmouth.
A. hubbardi Heid. 4 June. Orono.
A. lugubris Fall. 7 June. Orono, Norway.
A. abbas Bergr. 17 July–17 Aug. Ft. Kent, Machias.

Aneurus Curtis.

A. inconstans Uhl. 24 Sept. Orono.

Family CORIZIDÆ.

Corizus Fallen.

C. crassicornis Linn. (= *punctiventris* Auct.) 31 May–7 Sept. Ft. Kent, Orono.
C. lateralis Say. Orono.

Harmostes reflexulus Say doubtless occurs, but no definite record has come to my notice.

Family COREIDÆ.

Anasa Amyot et Serville.

A. tristis De Geer. 22 June–17 Oct. Orono and numerous other localities.

Corynocoris Mayr.

C. typhæus Fab. 10 May. Orono.

I took twelve specimens of this species as they flew up, one by one, to the dried body of a long dead fowl. Some alighted nearby and others disappeared within the carcass. I was unable to determine whether they came to feed on the juices of the carrion or to prey on other insects, and they may have been attracted merely by the odor. I believe that there are few if any so positive records of the frequenting of carrion by Heteroptera.

Family ALYDIDÆ.

Alydus Fabricius.

A. eurinus Say. 19 June. Orono.
A. pilosulus Her.-Schfr. 8 Sept. Orono.
A. conspersus Mont. June–10 Aug. Orono, Ashland.

Megalotomus Fieber.

M. quinquespinosus Say. 5 Aug.–28 Sept. Orono, S. Orrington.

Protenor Stal.

P. belfragei Hagl. 15 July–11 Sept. Orono, Pushaw Lake, Norway.

Family PENTATOMIDÆ.

(*Cimicidæ* Kirk.)

Elasmostethus Fieber.

E. cruciatus Say. 12 June–31 Aug. Orono, Paris, Ft. Kent, N. E. Harbor, Chamberlain Lake.

Elasmucha Stal.

E. lateralis Say. 4 July–30 Sept. Mt. Katahdin, Kineo, Capens, Mercer, N. E. Harbor.

Pentatoma Olivier.

P. persimilis Horv. 15 May–26 Sept. Orono, Caribou, Monmouth, Cherryfield.

Mormidea Amyot et Serville.

M. lugens Fab. 25 July–2 Sept. Orono, near Portland.

Euschistus Dallas.

E. euschistoides Voll. (= fissilis Uhl.) 18 June–11 Sept. Orono, Pownal, etc.
E. tristigmus Say. 27 May–17 Sept. Orono, Houlton, Wales, Pownal.
E. variolarius Pal. Beauv. Orono.

No doubt *E. ictericus* Linn. will be found, as its known range seems to include the state.

Cœnus Dallas.

C. delius Say. 5 May–17 Sept. Orono, Bar Harbor.

Neottiglossa Kirby.

N. undata Say. 19 May–31 Aug. Orono, Bar Harbor.

Cosmopepla Stal.

C. carnifex Fab. (*lintneriana* Kirk.) 31 May–17 Sept. Capens, Orono, Ft. Fairfield, Eastport.

Banasa Stal.

B. calva Say. Orono, Manchester.
B. dimidiata Say. 16 June–28 Sept. Orono, S. Orrington, Bangor, Sherman.

Perilloides Schouteden.
(*Perillus* Stal., in part.)

P. exaptus Say. 19 May–30 Aug. Orono, Wales, Monmouth.
P. circumcinctus Stal. 17 May. Pownal.

Zicrona Amyot et Serville.

Z. cærulea Linn. 22 to 24 June. Newbury Neck, near Surrey.

I have one specimen of this species taken by Mr. F. A. Eddy on the coast. As far as I know it has hitherto been reported only from the West and from Mt. Washington, N. H.

Apateticus Dallas.
(= *Podisus* Herrich-Schaeffer.)

A. cynicus Say. 25 Aug.–2 Sept. Orono. Pittsfield.
A. bracteatus Fitch. 6–24 Aug. Long Island in Penobscot Bay, Houlton.
A. maculiventris Say. 11 June–13 Sept. Orono, Norway, Pownal.
A. sereiventris Uhler. 29 May–3 Aug. Orono.
A. modestus Dallas. 24 June–17 Aug. Orono, Bangor, Pownal, Monmouth.

Family THYREOCORIDÆ.
(incl. *Cydnidæ*)

Sehirus Amyot et Serville.

S. cinctus Pal.-Beauv. 30 April–31 Aug. The Forks, Orono, Bangor, Chamberlain Lake.

Thyreocoris Schrank.

T. nitiduloides Wolff. 14 June–21 Aug. Orono, Deering, Norway.
T. pulicaria Germ. 8 May. Orono.
T. unicolor Pal.-Beauv. 30 April–15 Sept. Orono, Pownal, Norway.

Family SCUTELLERIDÆ.

Homœmus Dallas.

H. æneifrons Say. 22 July–12 Sept. Orono, Machias, Ft. Kent, Ashland.

Eurygaster Laporte.

E. alternata Say. 8 May–21 Aug. Orono, Houlton, Pownal, W. Beach.

NEW AND LITTLE KNOWN HARVESTING ANTS OF THE GENUS POGONOMYRMEX.[1]

By William Morton Wheeler.

1. Pogonomyrmex guatemaltecus sp. nov.

Worker. Length 5–5.5 mm.

Head subrectangular, excluding the mandibles a little longer than broad, with nearly straight sides, feebly excised posterior margin and prominent anterior cor-

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 80.

ners. Eyes rather small and flat, elliptical, just in front of the median transverse diameter of the head. Mandibles convex, with five subequal teeth. Clypeus short, feebly convex, its anterior border strongly bidentate, arcuately excised between the teeth, sinuate laterally. Frontal area distinct, with a median carinula. Antennal scapes reaching less than half the distance between the eyes and posterior corners of the head; funicular joints 2–10 scarcely longer than broad. Thorax short, but little longer than the head without the mandibles, broadest through the pronotum, somewhat compressed behind; in profile the dorsal outline is usually convex and evenly rounded as far back as the boundary between the epinotal base and declivity. These meet at an obtuse angle, the declivity being shorter than the base, descending perpendicularly and forming a right angle on each side with the metasternal angle which is sharp and rectangular in profile. There are no traces of spines or teeth on the epinotum. Petiole with a slender, laterally compressed peduncle which is nearly as long as the node and armed with a distinct anteroventral tooth; node compressed anteroposteriorly and rounded in front, slightly overarching the peduncle, with which its straight or slightly concave anterior surface forms at least a right angle and in some specimens even an acute angle in profile; seen from above the posterior surface is subelliptical, nearly twice as long as broad, and with rounded and not acute anterior border. Postpetiole campanulate, a little broader than the petiole, broader behind than in front, in profile very convex both dorsally and ventrally. Gaster elliptical, smaller than the head. Legs well developed.

Body, but especially the mandibles and gaster, shining. Mandibles very coarsely longitudinally striated. Clypeus and head covered with coarse longitudinal rugæ, subparallel on the head and diverging only very slightly from the median line and not till they reach the occiput. Interrugal spaces reticulate and feebly punctate. Anterior depressed portion of pronotum transversely rugulose; remainder of pronotum, the mesonotum and pleuræ coarsely and longitudinally reticulate-rugose. Rugæ on the epinotum finer and transverse. Petiolar peduncle smooth and shining, posterior surface of node coarsely longitudinally reticulate-rugose. Postpetiole subopaque, finely and densely reticulate-punctate. Upper surface of gaster with sparse piligerous foveolæ, which are somewhat more closely aggregated near the anterior margin of the first segment. Legs very finely shagreened with small, sparse, piligerous punctures. Antennal scapes longitudinally rugulose.

Hairs pale yellow, stiff, pointed, erect, varying in length, generally distributed over the body and appendages. Ammochætæ on clypeus, ventral surfaces of mandibles and gula long, but on the gula forming only a small psammophore, *i.e.*, the long hairs surround only the anterior portion of the gula and do not enclose the whole of it as in most species of *Pogonomyrmex sens. str.*

Color deep red, legs and base of first gastric segment slightly paler; teeth of mandibles black; anterior border of clypeus, posterior border of first gastric segment and a transverse band on each of the remaining segments dark brown or blackish.

Female (deälated). Length nearly 7 mm.

Very similar to the worker. Rugosity of thorax finer and more regular. Gaster larger, with the black banding of the segments more distinct, but the punctures on the dorsal surface smaller and less foveolate.

Described from a large number of workers and a single female, which I took December 12–14, 1911, from many nests at Zacapa, Guatemala, in the extremely arid plains known as "La Fragua," a region with pronounced xerophytic vegetation (giant cacti, etc). The ants were nesting in the fields, the grass of which, at the time of my visit, was parched and had been eaten down to the roots by the cattle. The nests were regular, flattened craters from 3–8 inches in diameter, not surrounded by clearings, and much like the nests of the other small North American species of *Pogonomyrmex*. A pile of grass-seed or chaff, often found to one side of the crater, showed that the species is granivorous like other members of the genus. Many nests were also found in the sand-ballast of the railroad near the town of Zacapa. The worker is readily distinguished from that of most of the described species of *Pogonomyrmex* by the peculiar shape of the thorax, clypeus and petiole and by the 5-toothed mandibles.

2. **Pogonomyrmex huachucanus** sp. nov.

Worker. Length 4.5–5 mm.

Head subrectangular, excluding the mandibles as broad as long, with nearly straight lateral and feebly excised posterior margin. Eyes elliptical, rather convex, at the middle of the sides of the head. Mandibles with convex external and rather oblique apical borders, the latter 6-toothed. Clypeus moderately convex, its anterior border marginate, distinctly bidentate and arcuately excised between the teeth. Frontal area distinct, with median carinula. Antennæ not reaching halfway between the eyes and the posterior corners of the head; first and second funicular joints distinctly longer than broad, remaining joints, except the last, as long as broad. Thorax slightly longer than the head without the mandibles, from above broadest through the pronotum, but with the transverse diameters of the meso- and epinotum equal; in profile the dorsal outline is convex in the pronotal region but the mesonotum and base of the epinotum form a straight line gently sloping to the two spines, which are shorter than the base of the epinotum, rather slender but blunt, closely approximated at their bases and directed upward, outward and slightly backward. The epinotal declivity is short, abrupt and much as in *P. guatemaltecus*, forming in profile a right angle with the metasternal angles, which are in turn rectangular. Petiole with slender, laterally much compressed peduncle, half as long as the node and with a distinct but rather blunt anteroventral tooth. Node from above subelliptical, pointed or acuminate in front, less than twice as long as broad, its posterior surface rather sharply marked off from the anterior, so that the summit appears pointed also in profile. The anterior surface is slightly convex in profile and rises abruptly and perpendicularly from the peduncle, the posterior surface, also slightly convex, is about one and one half times as long as the anterior and constricted near its posterior end. Postpetiole from above sub-

globular, a little broader behind than in front, a little broader than long and somewhat broader than the petiolar node. In profile the dorsal surface is very convex, the ventral bears a rounded boss in its middle. Gaster elliptical, proportionally larger than in *P. guatemaltecus*

Mandibles, gaster and legs shining, remainder of body appearing more subopaque, owing to their sculpture. Mandibles longitudinally striated; clypeus and head longitudinally rugose, the rugæ being moderately strong and numerous and distinctly and gradually diverging from the median line towards the posterior corners; the interrugal spaces densely punctate. Thorax throughout reticulately rugose, the rugæ being somewhat coarser and further apart than on the head, longitudinal on the pronotum and pleuræ and arcuately transverse on the mesonotum and base of the epinotum. Peduncle and anterior surface of petiolar node shining, finely shagreened, posterior surface coarsely and irregularly rugose and punctate. Postpetiole finely and densely punctate. Gaster very smooth and shining even at the base, with minute and sparse piligerous punctures. Legs finely shagreened and sparsely punctate, antennal scapes longitudinally rugulose.

Hairs pale yellow, erect, of unequal length, covering all parts of the body, longest on the dorsal surface. Ammochætæ well-developed on the clypeus, ventral surfaces of mandibles and gula, but the psammophore is restricted as in *P. guatemaltecus* and does not extend to the posterior and lateral borders of the head.

Deep red, lower surface of head, the legs, coxæ and gaster paler and more yellowish; dorsal surface of first gastric segment with a dark brown cloud on each side and usually with a median longitudinal streak of the same color. Mandibular teeth and anterior border of clypeus black.

Described from twenty-two specimens taken by myself November 11, 1910, from a single nest on the rocky southern wall of Miller Canyon in the Huachuca Mountains, Arizona, at an altitude of about 5,600 feet. This nest was under a small, flat stone and resembled the nests of *P.* (*Ephebomyrmex*) *imberbiculus* Wheeler, which I have seen in the mountains of Texas.

At first sight *P. huachucanus* resembles *guatemaltecus*, but closer comparison reveals many differences, especially in the shape of the thorax and petiole, not the least being the presence of epinotal spines in the former species. This is, indeed, unlike any of the known North American species but singularly close to *P. bispinosus* Spinola of Chili, as I find by comparison with cotypes of the variety *semistriatus* Emery received from Professor Silvestri. The thorax in *bispinosus*, however, is more flattened dorsally in front than in *huachucanus*, the metasternal angles are rounder, the petiolar node is lower and the postpetiole is as long as broad and less globular. The gaster of the typical *bispinosus* is said to be smooth and shining as in *huachucanus*, but in the variety *semistriatus* its

base is opaque and finely punctate-striolate. These differences are all so slight that *huachucanus* may eventually prove to be merely a subspecies of *bispinosus*. The resemblances between the two forms, separated by such a wide territory, is very suggestive in connection with the origin of the genus *Pogonomyrmex*. Owing to the fact that this genus is represented by the greatest number of species in North America, and that it is most closely related to the boreal genus *Myrmica*, it has been assumed that the species of *Pogonomyrmex* originated in the western United States and migrated thence along the arid plains and mountain ranges through Mexico, Central and South America as far as Patagonia. On this assumption, *P. huachucanus* might be regarded as a rare relict of a group of species which once ranged over a large portion of western America, but now survive only in Chili and the Huachuca Mountains of Arizona.

P. huachucanus and *guatemalteeus*, together with *bispinosus* and two other South American species, *brevibarbis* Emery and *silvestrii* Emery, are also of considerable interest, because in the restricted area of the gula enclosed by the long hairs of the psammophore and in sculpture they are transitional between the species of *Pogonomyrmex sens. str.* and the subgenus *Ephebomyrmex* Wheeler. The acute, spinose character of the metasternal angles in *brevibarbis* and *silvestrii* reveals a still closer relationship to the latter subgenus. All of these species may, therefore, represent today the most primitive and ancestral forms from which both subgenera have been evolved.

3. Pogonomyrmex californicus Buckley.

The worker of the typical form of this species measures 5.5–6 mm. and is characterized by the shape of the petiole and the sculpture. The anterior surface of the petiolar node forms very nearly a right angle with the upper surface of the peduncle, and the ventral surface of the latter bears no tooth. The surface of the body is shining, the rugæ of the head and thorax being sharp and pronounced, the spaces between them impunctate or with punctures so small and shallow as to be barely visible under a magnification of 20 diameters. The petiolar and post-petiolar nodes are very finely and densely punctate and indistinctly rugulose. The body is light ferruginous red, the mandibles, clypeus and legs more yellowish.

The female measures about 8 mm. and resembles the worker very closely in form, sculpture and color. The head is somewhat broader than long. Wings hyaline, with their basal portions distinctly yellowish, the veins and stigma brown.

The male measures 7.5 mm. and has rather broad mandibles, with oblique 4-toothed blades. Head, thorax, nodes of petiole and postpetiole, coxæ and femora,

except their bases and tips, and base of first gastric segment, black; remainder of body red, the mandibles and antennæ being more brownish, the gaster more yellowish in tint. Wings colored as in the female.

No type-locality in California is mentioned in Buckley's original description. I have seen numerous specimens from the following places:

California: Lakeside, Pasadena and Claremont (Wheeler); Point Loma, near San Diego (P. Leonard); San Pedro (T. D. A. Cockerell); Lompoc and Upland (J. C. Bradley); San Jacinto; Sierra Valley.

Arizona: Yuma (Wheeler).

Nevada: Las Vegas (J. C. Bradley)

This ant is very common in the sandy canyon bottoms of southern California. Its nests are flat craters 4–10 inches in diameter, with sloping, central or eccentric entrances. The workers are agile hunters of insects when these are to be found, but at certain seasons of the year large numbers of seeds are collected and stored in the nests. The nests in the Arroyo Seco, at Pasadena, Cal., were often found covered with the seeds of a common canyon shrub (*Eriogonum fasciculatum*) during the month of December.

4. Pogonomyrmex californicus Buckley subsp. estebanius Pergande.

This form, which should be regarded as a subspecies and not as a variety, averages a little smaller in all three phases than the typical *californicus*. In the worker the rugæ of the head and thorax are decidedly more delicate, but the interrugal punctures are quite as indistinct. The anterior surface of the petiolar node is more sloping and therefore forms a larger obtuse angle with the upper surface of the peduncle, and the node is lower than in the typical form of the species. There is also a tendency to develop a tooth on the anteroventral surface of the petiole. Typically the gaster is black, with the base of the first segment yellowish red; but specimens are sometimes found with only the tip of the gaster black or with a few black spots on the first segment, usually near its lateral or posterior borders. The nodes are sometimes infuscated; more rarely the whole gaster is black.

The female varies considerably in size, from 7–9 mm; and the gaster varies greatly in color. In most of my specimens it is entirely black, except for a large, bilobed, yellowish red spot at the base of the first segment. In others only the lateral and posterior margins of this segment are black and often the markings are interrupted in the middorsal line. The veins of the wings are pale yellow, but the stigma is brown.

The male measures 6.5–8.5 mm. Its mandibles are narrow, with transverse, bidentate, apical borders. Its color resembles that of the typical *californicus*, except that the gaster is in some specimens entirely red, in others entirely black. In some specimens, too, more or less of the anterior portion of the head may be red.

Lower California: Calmalli Mines, San Esteban, type locality; San Borgia and Margarita Island (Eisen and Haines).

California: Needles (Wheeler); Otis (J. C. Bradley).

Arizona: Yuma, Yucca, Tucson and Phoenix (Wheeler); Nogales (Oslar); Florence.

This subspecies is very abundant in the hot deserts of California and Arizona, but according to my observations it nests only in pure sand.

5. Pogonomyrmex californicus Buckley subsp. longinodis Emery.

I fail to find this form among the large amount of material I have collected, and am inclined to believe that it must be either very rare or local. It was described by Emery as follows from specimens taken in the Colorado Desert of California and received from Pergande: "The worker differs from that of *P. californicus* in its more slender pedicel, the second joint of which [*i.e.* the postpetiole] is not as high as long; the peduncle of the first joint [petiole] is shorter than the very long and anteriorly pointed node. Sculpture feebler than in *californicus;* pedicel merely finely punctate, without rugæ. Color rather light red, abdomen, with the exception of the pedicel and its base, brown."

6. Pogonomyrmex californicus Buckley subsp. maricopa subsp. nov.

The worker of this form measures 6–7.5 mm. and therefore averages larger than the typical *californicus* from which it differs in the shape of the petiole and in sculpture. The node of the petiole is less pointed above, its anterior surface is straight and forms an obtuse angle with the upper surface of the peduncle, and there is often a distinct anteroventral tooth. The petiole is fully as long as high. The rugæ of the head and thorax are much less prominent and the spaces between them are filled densely with very distinct punctures, clearly visible under a magnification of 20 diameters. The surface of the head and thorax are decidedly subopaque and not shining as in the typical *californicus.* The nodes of the petiole and postpetiole are also more coarsely shagreened and less shining. The color is the same.

A single dealated female from Rincon, New Mexico, measures 8 mm. and closely resembles the female of the typical form in sculpture, the rugæ of the head and thorax being sharp, the interrugal punctures rather indistinct.

New Mexico: Alamogordo, type locality (G. von Krockow); Prescott and Albuquerque (Wheeler); Roswell, Deming and El Rincon (T. D. A. Cockerell); Las Trueles (Miss Lillie Gerhardt); Engle (Miss Nora Newberry.)

Arizona: Yuma, Tucson, Benson and Grand Canyon (Wheeler).

California: Needles (Wheeler).

Texas: Marfa (Wheeler); Barton (J. C. Crawford); Victoria (J. D. Mitchell); Chisos Mts., 4600 ft. (W. B. Phillips).

Mexico: Ojos del Diablo and Ojos de San Dijuela in Chihuahua (C. H. T. Townsend).

As shown by this list of localities, *maricopa* ranges much further

to the east, through the deserts of New Mexico and Texas, than the other subspecies of *californicus*, and usually occurs at greater elevations. Its nests are very similar, being flat craters in sand, with sloping central or eccentric entrances.

7. Pogonomyrmex subnitidus Emery.

If I am correct in my identification, this form is not a subspecies of *P. occidentalis* Cresson, as Emery supposed, but a distinct species. Emery's description is unfortunately very brief, but I believe that it refers to a form which I found nesting in the vicinity of Pasadena, California, both in the higher portions of the Arroyo Seco and on the summit of Mt. Lowe (6400 ft.). I have also received a series of workers of the same form from Mr. J. C. Bradley, who took them in Los Gatos Canyon of the Diablo Range in the same state. The nests are like those of *californicus* and therefore entirely unlike the nests of *occidentalis*. The sculpture of the head, thorax and pedicel of the worker, moreover, is very much like that of the true *californicus*, but the epinotum is armed with two slender, pointed spines, which are longer than in *occidentalis*.

8. Pogonomyrmex comanche Wheeler.

This form, which was also originally described as a subspecies of *occidentalis*, must now be regarded as an independent species. In the worker *comanche* the thoracic dorsum is distinctly more rounded and arched in profile than in the worker *occidentalis* and the epinotal spines are longer both in the worker and female, but especially in the latter. There is also a great difference in the mandibles of the males of the two species, the blade in the male *occidentalis* being moderately broad with oblique apical border bearing 5 or 6 teeth, whereas in *comanche* it is narrow and more curved and its apical border is transverse and only 3–4-toothed. The epinotum of the male *comanche* bears a pair of small teeth, which are represented by tubercles in *occidentalis*. The greatest difference between the two species, however, is seen in the habits and distribution, *comanche* living at low levels in pure sand, where it makes rather small, flat crater nests very much like those of *californicus*, whereas *occidentalis* lives at elevations over 6,000 feet, and constructs large gravel cones with basal entrance and surrounded by a clearing. The colonies of the latter species are also much more populous. The types of *comanche* were taken in the

sandy post oak woods at Montopolis, near Austin, Texas. I have taken the species also at Milano in the same state.

A study of *comanche, subnitidus, californicus* and its subspecies *maricopa* shows that these forms have essentially the same habits and are all very closely and peculiarly related. Without its spines the worker *subnitidus* would be indistinguishable from the worker *californicus*, and the same relation obtains between *comanche* and *maricopa*. As it seems evident that the spined species of *Pogonomyrmex* must be more primitive that the spineless forms, it is not improbable that *subnitidus* is really the parent species of *californicus* and *comanche* the parent species of *maricopa*. If further study supports this conclusion, *maricopa* will have to be regarded as a distinct species.

FORFICULA AURICULARIA IN RHODE ISLAND.

By R. W. Glaser,
Bussey Institution, Harvard University.

Since all previous records of *Forficula auricularia* in America are very dubious, a report of the occurrence of large numbers of this species of earwig in Newport, Rhode Island, seems advisable.

While in Newport in July, 1914, I heard that the estate of Mr. T. Suppern Tailer was infested with earwigs and that they were making themselves extremely disagreeable by entering the house and crawling over people at night. I went to the estate and found literally hundreds of what I then supposed to be the European earwig. Mr. James A. G. Rehn of the academy of natural sciences in Philadelphia and Mr. A. P. Morse of Wellesley, Mass., have since kindly identified the species as *F. auricularia* Linn.

I found the insects hiding in all possible places during the day. They were abundant in the cracks of stone walls, under porches and behind vines. They were also taken from the inside of flowers in large numbers.

According to Mr. Tailer and his gardener, the earwigs were first noticed in 1912. In 1913 they increased to such an extent that suppression work by spraying was begun and at the time of writing this note (July, 1914), they seemed to have passed beyond control and have spread to adjoining estates. No one seems to be able

to account for the introduction of *F. auricularia* into this estate in any other way than through the agency of imported plants. Their prodigious increase can also be explained with no less difficulty, for refuse or anything which one might expect to be favorable food is not permitted to accumulate. Not having the time to devote to the subject, I was unable to determine upon what the earwigs were feeding.

It seems quite important that the matter be investigated by economic entomologists, otherwise, *F. auricularia* might soon rival the familiar and unwelcome *Blattella germanica* as a household pest.

A NEW STRATIOMYID

By Charles W. Johnson,
Boston Society of Natural History.

This interesting fly was taken on one of my many collecting trips to the Berkshire Hills in western Massachusetts. I have delayed recording it, hoping that additional material would be obtained. In the table of genera this would go in the genus Zabrachia Coquillett, but the form of the antennæ would at once exclude it from that genus, while both venation and antennæ bar it from the other genera of the group. Although lacking the anterior branch of the third vein, the position of the second and third veins is nearer that of *Pachygaster* than of *Zabrachia*.

Berkshiria gen. nov.

Third joint of the antennæ oblong, about double the length of the first and second taken together; third joint with five annuli, the basal one broader than the others; arista terminal, style-like, about as long as the entire antenna; front with two longitudinal ridges; transverse suture deeply impressed; scutellum large, rounded, with a broad depressed margin; third longitudinal vein without the anterior branch; ends of the terminal joints of the tarsi with bristle-like hairs. Type *B. albistylum* sp. nov.

Berkshiria albistylum sp. nov.

Black; front shining, the two ridges forming deep central and orbital grooves, ocelligerous tubercle prominent; face receding, the orbits white; antenna yellow, arista white with its basal fourth black. Thorax sparsely covered with a whitish pubescence; humeri angulate with a small yellow spot at each point, a raised collar extending between the humeri, and a blunt spine on each side before the base of the

wing. Abdomen broad, about double the width of the thorax, the five segments shining, sparsely covered with whitish hairs. Halteres white, base of the knobs and stems brown. Legs black, knees, tips of the tibiæ and the tarsi yellow, the last two joints of the latter brownish. Wings hyaline, veins yellowish, three veins extending from the discal cell. Length, 4 mm.

One specimen, collected along Austen's Brook, Chester, Mass., May 28, 1912. Type in the collection of the Boston Society of Natural History.

Other interesting Stratiomyidæ collected at Chester, Mass., are *Scoliopelta luteipes* Will. (*Entom. Amer.*, I, 154, 1885) which was quite common August 5 and 6, 1914, and a specimen of *Chrysochroma nigricornis* Loew, July 25, 1913.

A NEW AËDINE.

By C. S. Ludlow,
Army Medical Museum, Washington, D. C.

A long while ago, before it was known that *Skusea multiplex* Theob. had long palpi in the male, and therefore was not a *Skusea*, I received and named a lot of mosquitoes, which seemed to be of this species. Nothing had called my attention to the change of position of *multiplex*, so the specimens were not re-examined, but lately I sent specimens to Mr. Edwards, who has called my attention to this point and, as the species was undescribed, kindly returned the specimens for description. In general appearance the female probably more nearly resembles *multiplex* than any other species but it is described below as

Aëdes panayensis sp. nov.

Head dark brown, covered with flat brown scales, which appear grey in some lights, and small curved scales around the eyes; antennæ brown, white-banded, verticels brown, pubescence white; palpi brown and very short in both male and female; proboscis brown; clypeus brown; eyes dark brown.

Prothoracic lobes brown; mesothorax brown, sometimes very dark, and covered with slender golden brown curved scales; scutellum as mesothorax, with six long marginal brown bristles on the mid, and three marginal bristles on the lateral lobes; pleura dark, with bunches of white scales; metanotum dark brown.

Abdomen with brown scales and large white basal lateral spots on all but the eighth segment.

Legs: coxæ and trochanters light; femora dorsally brown, and ventrally white nearly to the apex, and a light knee spot; tibiæ dorsally brown, darker than the

femora, but ventrally white scaled to the apex; tarsal joints all brown. With the exception of the femora, all the parts of the legs show a decided variation as to color, dependent on the angle of light. Ungues of female serrate, those of the male fore legs have both the ungues serrate.

Wing clear, covered with brown rather heavy *Tæniorhynchus*-like scales. The first sub-marginal cell is about three times as long as its stem, and nearly a third longer and as wide as the second posterior cell, which is about the same length as its stem. The mid cross-vein meets the root of the third long vein and they are of about equal length, while the posterior cross-vein is much shorter, and three times its length interior to them. Halteres have light stems and dark knobs.

Length: (female) 3 mm. (male) 2.5 mm.

Habitat: Rather widespread, but the first specimens were taken at Iloilo, Panay, P. I.

Taken at various times in the various places.

THE STANFORD EXPEDITION TO BRAZIL, 1911.

J. C BRANNER, *Director.*

ACARIANS FROM BRAZIL.

By Nathan Banks,
East Falls Church, Va.

The mites collected by Messrs. Mann and Baker belong to two families, Ixodidæ and Parasitidæ (Gamasidæ). Several are the same as those described from Paraguay by Berlese; the ticks are species common in Brazil; of the six species described as new, the *Trachuropoda* is the most remarkable. Besides these there are some immature specimens, mostly of the Parasitidæ, that cannot be named.

Ixodidæ.

Amblyomma striatum Koch. Two from Porto Velho, Rio Madeira (Mann and Baker).

Amblyomma geayi Neum. One from Abuná, Rio Madeira, Brazil (Mann and Baker).

Margaropus annulatus Say. Several from Porto Velho, Rio Madeira, Brazil, (Mann and Baker).

Parasitidæ.

Megalolælaps hœros Berl. Several from Independencia, Parahyba, on *Copris* (Mann).

Macrocheles cordiger Berl. Specimens, which are probably this species have the dorsal shield less narrowed behind than Berlese figures. They are from Porto Velho, Rio Madeira, on *Phanæus* (Mann).

Hypoaspis scutalis sp. nov.

Body about once and a half longer than broad, nearly truncate behind, sides nearly parallel. Dorsum without hairs, two stout ones on margin near tip, and short bristles on ventral edge near margin; palpi long and prominent; legs I and IV fully as long as body, last joint of leg I very much longer than the preceding joint; leg II rather stout in the middle; all with short hairs or spine-like bristles. Sternal plate with three hairs each side, not near margin, one on a small plate at base of coxa III. Vulva shows a triangular opening. Ventri-anal plate extremely broad in front, concavely narrowed on posterior sides, nearly twice as broad in front as long, a few stout bristles each side; anus with a hair each side. Length .7 mm.

From Abuná, Rio Madeira, Brazil (Mann coll.), on Scarabæidæ.

Hypoaspis invertus sp. nov.

Yellowish brown. Body nearly one and a half times as long as broad, narrowed in front, dorsum without hairs, except on margin, four each side behind, and two each side in front of coxæ III. Legs moderately slender, but short, and with few hairs. Sternal plate with three bristles on each side, one behind at base of coxa III, and another at base of coxa IV. Peritreme long, rather remote from the coxæ. Ventri-anal plate large, inverted pyriform, much broader in front, concavely narrowed behind, about three bristles each side in front, and one each side of the anus. Length, .6 mm.

From Abuná, Rio Madeira, Brazil, on Scarabæidæ (Mann coll.).

Megisthamus armiger Berl. One from Itacoatiara, Amazon, on large Passalus (Mann).

Euzercon balzani Berl. Several from Manaos, from Itacoatiara, Amazon, on large *Passalus*, and Porto Velho, Rio Madeira, Brazil, on Scarabæidæ. (Mann and Baker.)

Celænopsis subincisa Berl. One from Abuná, Rio Madeira, Brazil, on Scarabæidæ (Mann and Baker).

Celænopsis brevis sp. nov.

Body as broad as long, almost pointed at each end, dorsum with a transverse furrow over coxæ II, no hairs, except four rather long ones near margin beginning at middle, and smaller ones around hind margin. Beak and palpi prominent, leg I very long and slender, longer than body, last joint a little longer than the preceding; other legs moderately stout, all shorter than body; all legs with fine hairs and a stouter one on patellæ of legs III and IV; sternal plate (of ♀) only between coxæ II, two bristles each side; the vulva large, much narrowed behind; anus small, fully its length before end of ventral plate; peritreme long, angulate near coxæ III. Length, .65 mm.

From Abuná, Rio Madeira, Brazil (Mann coll.), on Scarabæidæ.

Celænopsis nitida sp. nov.

Red brown. Body plainly a little longer than broad, almost truncate behind; dorsum smooth, but each side near tip is a large curved spine, and the posterior margin bears a series of moderately long hairs. Venter with very small hairs on sternum; vulva between coxæ II and III, not very large; a large long spine each side on the beak. Leg I very long and slender, with few fine hairs; others legs short and stout, not as long as the width of body, fourth pair of legs stoutest, all with few hairs; peritreme long, close to the outer margin of coxæ; palpi long, first joint with several very long hairs on inner side. Length, 1.7 mm.

From Abuná, Rio Madeira, Brazil (Mann and Baker).

Uropoda frontalis sp. nov.

Red brown. Body nearly one and a half times as long as broad, in front produced in a slight median process, with a little hair at each side; the oral plate shows a median and slight lateral projection in front. Above and below without distinct hairs; legs very short, with few fine hairs, except at tip; the male genital aperture is small, and situate between the hind coxæ, a little nearer to the posterior than the anterior end of the body. Length, .6 mm.

From Natal, Brazil, on *Diploderus* (Mann coll.).

Discopoma ? modesta Berl. One from Independencia, Brazil, on large Scarabæidæ, probably this species (Mann).

Trachyuropoda tricuspis sp. nov.

Body about once and a fourth longer than broad, broadest rather in front of the middle. Dorsum rough, behind near tip with three ridges which project slightly as three blunt cusps. All around the body is a thin membrane which is supported by many bristles, the outer third of each bristle is jointed and much finer than the basal part. The rostrum is bilobed at base, and with a curved spine each side, palpi short, with many hairs at tip. Legs short and stout, with few hairs, femora I and II with a plate-like process behind. Sternal shield with three hairs each side; male aperture twice as broad as long, situate between coxæ III; vulva large, sides straight, narrowed behind, in front with a U mark, and three hairs each side. Venter shows a few short hairs, and is crossed by a curved furrow beyond middle, anus has a hair each side. Length, .9 mm.

From Itacoatiara, Amazon, Brazil (Mann), on large *Passalus*.

EXPLANATION OF PLATE 8.

Fig. 1. *Celænopsis brevis.*
2. *Trachyuropoda tricuspis;* vulva, and tip of body from above.
3. *Celænopsis nitida.*
4. *Trachyuropoda tricuspis.*
5. *Uropoda frontalis.*
6. *Hypoaspis invertus.*
7. *Hypoaspis scutalis.*

MR. CRAWFORD'S RECENT WORK ON THE DELPHACINÆ[1]

By E. P. Van Duzee,
University of California, Berkeley, Cala.

Mr. Crawford has given us a considerable contribution to our knowledge of the Delphacinæ of America north of Mexico in which he has described one genus and twenty species as new to our fauna and in addition has given us a fair insight into the Delphacid fauna of Central and South America. There is a carefully prepared key to the genera, in part founded on characters not before used for this purpose. Chief among these is the use of the post-tibial spur. The author has disregarded the pronotal carinæ in his classification of the genera, as a character difficult to appreciate, but uses those of the vertex and frons which are often still more obscure. In spite of all the objections that have been raised against the use of these pronotal carinæ in the classification of this group it still seems to me that they form a character of prime importance in discriminating the genera. There certainly are very few species in which their form cannot readily be made out, much more easily in fact than the form of the tibial spurs, and it seems hardly likely that they would ever separate otherwise closely related species. His discarding of this and other equally useful characters has led to his lumping several readily separable genera: three under *Dicranotropis* and six under *Megamelus*. These will be referred to later. A hasty glance over the paper shows that three genera and over forty described species were unknown to him in nature out of a total of fifteen genera and about one hundred species recorded from north of Mexico, a relatively large number which leads one to fear there may be some duplication among his twenty new species.

For one I cannot follow Kirkaldy, as Crawford has done, in giving the Delphacinæ family rank. It seems much better to continue the divisions of the old family Fulgoridæ as subfamilies, at least until some competent student has worked out the classi-

[1] A contribution toward a monograph of the Homopterous insects of the family Delphacidæ of North and South America. From Proc. U. S. Nat. Mus., Vol. 46, pp. 557-640, 1914.

fication of the Homoptera in the same masterly way in which the later Dr. Renter has the Heteroptera. I add the following notes:

Genus **Stobaera** Stal.

Crawford unites *concinna*, *minuta* and *affinis* with *tricarinata* but I am by no means convinced. While closely related I still believe them distinct as pointed out by me in my report on the Florida Hemiptera.

Genus **Cochise** Kirk.

In a letter from Mr. Muir he has suggested to me that *Cochise apacheanus* Kirk. is a synonym of *Bostæra nasuta* of Ball and I am inclined to think him right in this. Kirkaldy writes his descriptions in such a vague way it is impossible to form any mental picture of the object he is describing. For instance what does he mean when he says "lateral keels (of the pronotum) distant apically and basally, arising anteriorly at the inner margin of the eye, curving at an acute angle near the hind margin to meet the eye again"? If one tries to draw such a carina on a Delphacid pronotum he finds himself wandering aimlessly about, with two entirely different sets of carinæ as the final result. Probably the genus can only be located by a restudy of the type.

Genus **Achorotile** Dahlb.

It is likely that this genus does not occur in America. The specimens I formerly located as albosignata Dahlb., I now find to be the young of *Megamelus notatus* Germ. *Achorotile foveata* Spooner is a redescription of my *Stobæra 4-pustulata* from Florida.

Genus **Jassideus** Fieber.

In *Macrotomella* the lateral pronotal keels are distinct and run to the hind margin and the form of the head is entirely different. *Stiroma* I also believe to be sufficiently distinct. Both of these genera have the keels of the head continued over the apex while in *Jassideus* they are obsolete there, a character Crawford accepts in *Kormus*.

Genus **Phyllodinus** Van Duzee.

Mr. Crawford names Jamaica as the locality for my *nitens*. It was from Florida and was described in my paper of 1909, not 1907.

Genus **Liburniella** Crawford.

This is a good genus sufficiently distinct from *Liburnia* Stal. *L. ornata* Stal. is the only species known to me.

Genus **Stenocranus** Fieber.

S. saccharivorus Westw. is a light green insect, not "yellowish-orange" as described by Crawford. His specimens may have been in spirits. It was common about sugar cane in Jamaica and I took it at Tampa, Florida.

Stenocranus croceus Van Duzee. This species is here wrongly credited to Osborn and Ball, who merely listed the species but did not describe it. Their paper was published in 1897, not 1896. This is a true *Kelisia* as described by me, and has the front distinctly wider than in *Stenocranus* with the sides arcuated.

Stenocranus vittatus Stal is undoubtedly the same as my *lautus* and both are probably mere color varieties of *dorsalis* Fitch.

Genus **Dicranotropis** Fieber.

The genera *Peregrinus* and *Pissonotus* are entirely distinct from *Dicranotropis* and may at once be distinguished by the characters of the pronotal carinæ: In *Perigrinus* they run straight to the hind margin, while in *Pissonotus* they are more divergent and rarely attain the hind margin. In *Dicranotropis* these carinæ follow the contour of the eye. The general aspect of *Pissonotus* is very distinct, approaching only *Megamelus*. Mr. Crawford sinks my *basalis* as a synonym of *delicatus* but it is absolutely distinct. The Columbus, Texas, specimen which he examined was not typical of the species as I stated in my description. I do not think I labeled that specimen as a "type." If I did it was done inadvertently.

Genus **Megamelus** Crawford

This genus as outlined in the work before us contains at least six undoubtedly valid genera: *Megamelus*, *Kelisia* and *Prokelisia* with the lateral pronotal keels running straight to the hind margin, and *Euidella*, *Chloriona* and *Liburnia* in which they curve outward behind the eyes. In his key the author divides his unwieldy genus into these two sections and under each uses color characters first and ultimately structural features for locating the species. I have not tried to run down any of the species by his key but it would,

I believe, have been just as simple and useful had it been divided into the six genera formerly recognized. The preparation of a key for the large genus *Liburnia* was no small task and if Mr. Crawford has done this successfully it is something for which we will all feel grateful.

I must call attention to a statement made by Kirkaldy some years ago and now repeated by Crawford: that Stal used *Embolophora monoceros* as the type of his new genus *Liburnia*. There is absolutely not one iota of foundation for this statement except the fact that Stal placed it as the first species of his new genus. As a matter of fact *monoceros* is the type of the entirely distinct genus, *Embolophora*, and can never be used as the type of *Liburnia* Stal. I have already shown (Bull. Buf. Soc. Nat Sci. X, p. 504, 1912) that *Liburnia* Stal was simply a new name for *Delphax* Auct. (not of Fabr.) of which *pellucida* Fabr. should be the type. *Delphax striata* Fabr. is the type of *Delphax* Latr. but Stal does not quote *Delphax* Latr. but *Delphax* Auct. and as *striata* seems to be an unrecognized species it is probably better to use *pellucida*, which is a well known form.

TWO NEW SPECIES OF PLATYPEZA FOUND AT STANFORD UNIVERSITY.

By Frankie Willard,
Stanford University.

While making a study of the insect larvæ living in mushrooms, I found an old cluster of *Agaricus californicus* which was infested with hundreds of small oblong larvæ that were feeding on the soft fleshy portions of the plant at the base of the gills. Many other specimens were taken during the months of April and May, the dark gills of the mushrooms showing that the material was rather old. When these were placed in jars containing damp soil the larvæ fed for several days in the mushrooms. Some then bored into the soil to pupate, others pupated on the surface under the fungus or in exposed places. The length of the larval period was not determined. Most of the insects remained in the pupal stage from seven to nine days, but some did not issue until the following

September, or about the time of the early rains. These larvæ, which proved to be the immature stages of an undescribed species of Platypezidæ, are cylindrical, soft, and cream colored. The body tapers anteriorly and the first segment is rounded. The surface of the body is rough, covered with many small spines. Each segment, except the first, second and last, is provided with two large, lateral, and two smaller, dorsal, segmented, spiniferous appendages. The second segment has only dorsal setæ; the last segment has two pairs of lateral setæ and one posterior pair. The anterior margins of the first, third and twelve segments are each provided with a pair of short tube-like processes. The ventral side of segments five to eleven have a pair of papilla near each lateral margin. The slit-like anal opening is on the ventral side of the twelfth segment.

The pupa is dark brown in color; oval, flat, hard and wrinkled. The appendages are the same as in the larva.

Some of the adult flies were sent to Professor J. M. Aldrich, who kindly examined them and said they belonged to an undescribed species. He sent several specimens of still another undescribed *Platypeza*, which he reared from the shelf-fungus, Polyporus, while at Stanford in 1906. The descriptions of the two species follow.

Platypeza agarici sp. nov.

Male: Velvety-black. Head black; antennæ black; face grayish in middle; cheeks black, with black hairs. Eyes contiguous, divided, upper half reddish-brown, with large ommatidia, lower half black, with small ommatidia. Thorax black with black hairs. Abdomen velvety black; last segment and a narrow margin on the incisures, grayish. Sides and back with black hair. Legs black; tarsus brown with fuscous pile; hind tarsal joints flattened; the third joint is the longest and broadest; halteres black. Wings hyaline; subcostal cell of a yellowish tinge; veins brown; anterior branch of 4th vein well arcuated; the posterior branch reaches to the border of the wing; 2nd posterior cell short; posterior cross vein removed from border of wing on 5th vein by twice its own length. An interesting variation occurs in the cross vein between the first and second basal cell. Always faint, it is entirely lacking in some specimens.

Female: Eyes separated and not divided. Abdomen velvety black. Length, $2\frac{1}{2}$–$3\frac{1}{2}$ mm.

Platypeza polypori sp. nov.

Male: Velvety black. Head black; face black, grayish toward ventral margin; cheeks black with black pile; antennæ black; eyes contiguous, divided; the upper half reddish with large ommatidia; the lower half dark brown with small ommatidia.

Thorax black with black hairs. Abdomen velvety black; last segment and incisures dark gray; sides and back covered with fine, soft, black hairs. Legs fuscous or blackish; hind tarsal joints flattened, the basal segment broadest, the third segment longest; halteres fuscous; knobs black. Wings hyaline, subcostal cell with a very faint yellowish tinge; veins brown; anterior branch of 4th vein rises at almost a right angle from the fourth vein; posterior branch does not reach the margin of the wing; second posterior cell very short. The distance from the posterior cross vein to the tip of the 5th vein is about one-third the length of the posterior cross vein.

Female: Eyes not contiguous or divided. Face grayish. The first, third, fourth, and fifth segments of abdomen grayish.

These studies were made in the Entomological Laboratories at Stanford University where the types of the new species are deposited.

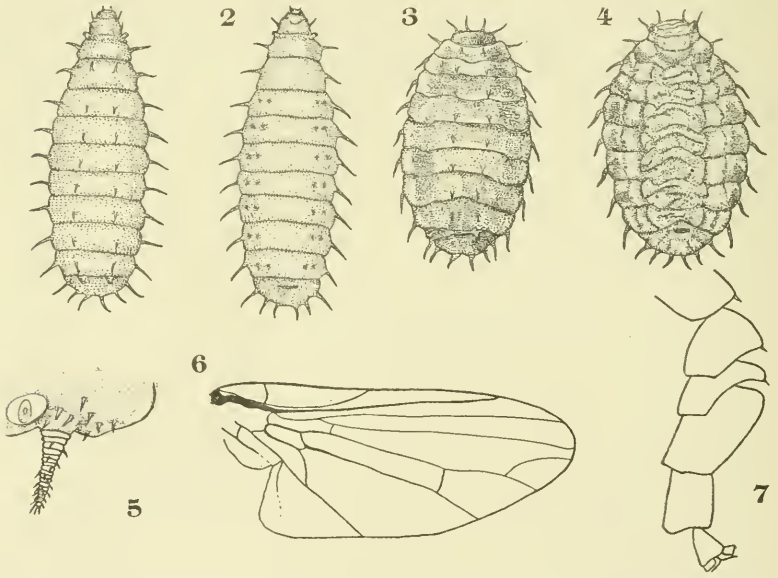

Fig. 1. *Platypeza agarici* sp. nov. 1, dorsal view of larva; 2, ventral view of larva; 3, dorsal view of pupa; 4, ventral view of pupa; 5, one of the spines of larva; 6, wing; 7, hind leg, showing flattened tarsus.

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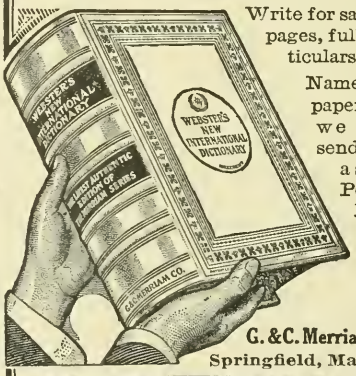

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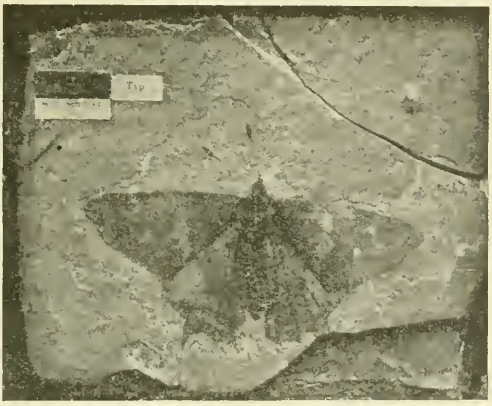

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PSYCHE

VOL. XXI. DECEMBER, 1914. No. 6

SOME MYRMECOPHILOUS INSECTS FROM MEXICO.[1]

By W. M. Mann.

The following notes are based on a small collection made during the months of May, June and July, 1913, in the State of Hildalgo, Mexico. Most of this time was spent at the Guerrero Mill, located below Real del Monte, and at the Hacienda de Velasco, where I was the guest of Mr. and Mrs. C. W. Van Law. They, together with the other Americans and English in charge of the mines and mills, showed me every hospitality and it is largely due to them that I was able to reside and collect in this interesting locality. I am much indebted to Miss Helen L. Locke, Mr. and Mrs. J. H. Skews and Messrs. Broiderick, Benton, Funston and Calland, not only for assistance of various kinds, but for many desirable specimens which they collected. The material collected has been placed in the collections of the Museum of Comparative Zoölogy at Cambridge and of Mr. B. Preston Clark of Boston, through the kindness of whom the excursion was possible.

Although this region is easily accessible, and unusually interesting and rich in insect life because of its ecologically varied nature, it has been largely neglected by collectors. Only a few things have been collected at Pachuca and at Guerrero Mill. Prof. W. M. Wheeler, in looking over the literature on Mexican ants, failed to find Hidalgo cited as the locality for a single species, and I have found no records of other insects from that state.

Among the thirty-nine species and varieties of ants collected (an account of these has been published by Wheeler in the *Journal of the New York Entomological Society*, Vol. XXII, 1914, pp. 37–61) nine were found to harbor guests or parasites. Three of these belong to the genus Formica, one each to Camponotus, Prenolepis,

[1] Contribution from the Entomological Laboratory of the Bussey Institution of Harvard University, No. 84.

Liometopum and Tapinoma, and two to Pheidole, all of which genera are commonly the hosts of inquilines, Prenolepis less frequently than the others. The inquilines found are mostly undescribed species of genera known to be of myrmecophilous habits, but a new Diaprid, *Hemilexis jessei*, and a new genus of Bethylidæ, *Bruesiella formicaria*, both of which are probably parasitic on the host ant, are described. There is also an interesting new genus of cockroach, *Myrmecoblatta rehni*, which inhabits nests of various species of ants, where it no doubt officiates as scavenger. The occurrence of the weevil *Liometophilus manni* Fall at Pachuca, with the same species of host with which it has been found in Arizona shows that it is definitely associated with this ant.

I have included in this paper a few remarks on the synonomy of some species from north of the Mexican boundary, and erected a new subgenus to contain certain of our species of Cremastocheilus.

ORTHOPTERA.

Family Blattidæ.

Subfamily BLATTINÆ.

Myrmecoblatta gen. nov.

Female: Body elongate oval, not greatly flattened, the abdomen about as broad as the thorax. Head almost concealed by the pronotum, only a narrow strip of the vertex showing. Head small, triangular, the vertex somewhat swollen. Eyes well developed, elongate, emarginate on inner border. Antennæ long and slender, the first joint thickened, the second small, the third longer than the second and twice the length of the fourth. Thorax longer than broad, convex above, tegmina and wings absent. Abdomen convex above, beneath gradually elevated to the middle, which is therefore broadly carinate. Supra-anal plate semi-orbicular, evenly rounded in outline. Cerci large, with eight distinct joints. Sub-genital plate apparently provided with valves. Last ventral segment completely divided by a V-shaped slit. Legs short and robust, with abundant fine, short hairs. Femora weakly armed beneath, and with a strong spine at apex; tibiæ spined at apex and on outer margin.

Male: Form broad. Pronotum entirely concealing the head. Tegmina more than half as broad as long; short, not reaching apex of abdomen, with poorly developed veins. Wings short and broad, less than half the length of tegmina, with poorly developed veins. Supra-anal plate more than twice as long as broad, the sides concave in outline, posterior border notched at middle, rounded on either side. Sub-genital plate broader than long, straight at sides, rounded behind, slightly concave at middle, bearing two equal stylets.

Type: Myrmecoblatta rehni sp. nov.

Myrmecoblatta rehni sp. nov.

Female: (Fig. 1). Length 5 mm. Width 3 mm. Color reddish-brown, the legs lighter, above regularly punctate and finely setose. Thorax longer than broad. Pronotum broader than long, with concave posterior border and extended, narrowly rounded angles. Meso-and epinota subequal, with nearly straight sides and concave posterior border. Abdominal segments 1–7 subequal, with straight posterior borders, the eighth considerably narrower than the seventh, rounded behind. Cerci 8-jointed, a third as broad as long, acuminate for apical half their length; nearly as long as the sub-genital plate. Head about as broad as long, the front with an indistinct Y-shaped suture. Labium obtusely pointed, concealing the mandibles. Eyes occupying the sides of the head, faintly emarginate on the inner border. Antennæ slender, shorter than the body, about 37-jointed; the third joint twice as long as the fourth, joints 4–13 transverse, the rest distinctly longer than broad, and sub equal; all the joints finely setose. Legs short, rather flat, the femora armed at apex with a slender curved spine; tibiæ bearing on the outer border three slender subequal spines, at the apex two long and two shorter spines.

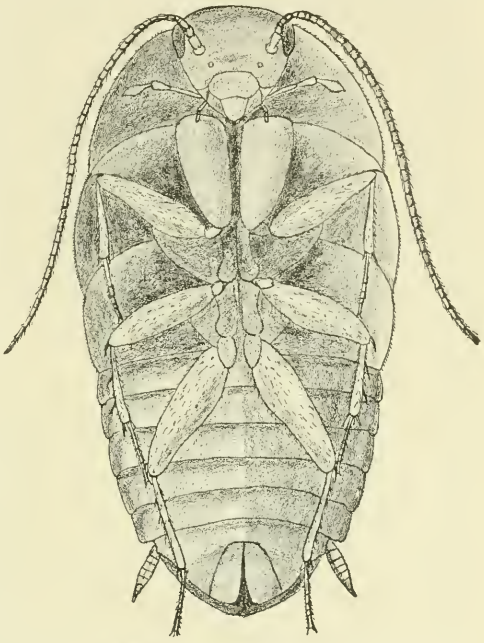

Fig. 1. *Myrmecoblatta rehni* gen. & sp. nov. Ventral surface of female.

Male: (Fig. 2). Length 4.5 mm. Width 2 mm. Color and setosity similar to that of female. Pronotum proportionally slightly broader than in the female, the angles broadly rounded, posterior border concave. Tegmina extending a little more than two-thirds the length of abdomen, broadly oval in outline, the apex narrowly rounded; venation not very distinct. Wings less than half the length of tegmina. Cerci

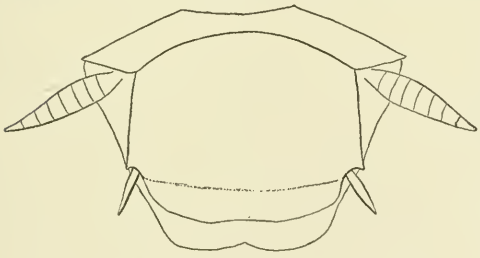

Fig. 2. *Myrmecoblatta rehni* gen. & sp. nov. Ventral surface of last gastric segments of male.

more slender than in the female, longer than the supra-anal plate at middle. Legs and antennæ longer than in the female, the latter as long as the body.

Nymph: Similar to female, lighter in color. The suture on the front of head is more distinct than in the adult.

Described from one male and numerous females and nymphs taken at Guerrero Mill in nests of *Formica subcyanea* Wheeler, *F. rufibarbis* Fab. var. *gnava* Buckley, and *Camponotus maculatus* Fab. subsp. *picipes* Olivier. Some of the females had oöthecæ attached. They were abundant, several occurring in almost every nest, where they are no doubt very efficient scavengers. The genus has no systematic affinities with *Attaphila*, the only other known Blattid of Myrmecophilous habits, but is more closely related to Blatta, to which it runs in Caudell's key to the genera of this family (*Proc. U. S. Nat. Mus.* Vol. 44, 1913, p. 601–602).

COLEOPTERA.

Family Staphylinidæ.

Pseudolomechusa subgen. nov.

Type: *Xenodusa sharpi* Wasmann.

This beetle was described by Wasmann from a series which were taken at Cuernavaca, in company with *Camponotus auricomus* Roger. In one canyon near the Guerrero Mill I found a number of adults, some of them in copula, with colonies of *Camponotus maculatus* var. *picipes*, Olivier which was here very abundant. In the immediate vicinity were many nests of *Formica microgyna rasilis* var. *nahua* Wheeler and several of *T. rufibarbis* var. *gnava*. Buckley. With the former ant three adults of *sharpi* were taken and with *gnava* several more, and three larvæ, the latter close to the ant brood. As most of the beetles were found with *C. picipes* (nineteen were taken from one nest) it appears that this is the secondary or winter host and *F. gnava* the primary or definitive. This heterocious habit is common to all of our species of *Xenodusa* as far as known. The adult *sharpi* is very different from the other American species on account of its greatly thickened pronotal margins and shorter antennal joints. Seen in profile the anterior border is drawn out beneath into a distinct angle similar to the structure in the species of the European genus Lomechusa.

The larva is very different from that of *X. cava*, the only one known in that stage, which has been described and figured by Wheeler (*Jour. N. Y. Ent. Soc.*, Vol. XIX, 1911, p. 165–166) and closely resembles that of Lomechusa. Those which I found are 5.5 mm. in length, yellowish-white in color, with short, feeble legs, no eyes, papillose antennæ and shallowly impressed vertex. The body is slender and cylindrical, not at all depressed as it is in *cava*, with an even covering of fine erect hairs.

The movements in life were very slow. Considering the pronotal structure and the larval characters *sharpi* should not be included in Xenodusa sens. strict., but more properly belongs to a distinct subgenus for which I propose the name *Pseudolomechusa*.

Apteronina wasmanni sp. nov.

Length 3 mm. Head broader than long, rounded at sides, occipital margin straight; clypeus projecting, the anterior border rounded; front broadly depressed, the surface concave, with a longitudinal impression extending to occiput. Eyes rather large, located at sides of the anterior third of head. Antennæ long, the first joint about twice the length of the second, which is two-thirds as long as the third; the second joint is sharply constricted near base; fourth joint about half as long as third; joints 4–10 subequal in length, becoming thicker anteriorly; apical joint cylindrical, nearly twice the length of penultimate. Thorax not as broad as head, very slightly longer than broad, rounded in front and at anterior third of sides, posterior to which the sides are straight; posterior border straight; surface slightly concave, with a narrow longitudinal impression at middle. Elytra transverse, each as long as broad, together broader than thorax; sides nearly straight; posterior border rounded. Abdomen at base as broad as elytra, broadest behind. Legs long and slender.

Body and legs subopaque, finely punctate, the punctures coarser on the elytra and abdomen; everywhere with fine, recumbant, silky hairs; thorax and sides of abdomen with longer coarse hairs.

Color black, the antennæ and legs brownish.

Described from several specimens taken with *Liometopum apiculatum* Mayr at Pachuca and Guerrero Mill.

A. schmitti Wasmann, which lives in company with the same host ant from Colorado to Southern Arizona, has the head longer than broad, the thorax is longer in proportion to the width, the general form is more slender; the color is light ferruginous, except the gaster, which is dark fuscous. The color of the Mexican form of the host ant is considerably darker than that of the Arizona variety with which I have taken *schmitti*, so the beetle in each

case resembles the ant in that respect. Besides color the beetle is similar to the host in pilosity and, superficially, in form, and in life it carries its abdomen erect in a manner similar to the way in which the ant holds its gaster. Nothing is known regarding the biological relation of the beetle to the ant.

Dinardella mexicana sp. nov.

Length 2.75 mm. Head slightly broader than long, rounded at sides and in front, posterior border straight; front with a flattened disc. Eyes medium in size, flat. Antennæ short, extending to apex of elytra; joints in front of the middle thickest; first joint as long as the two succeeding together; joints 2–3 longer than broad; joints 4–10 transverse; apical joint a little less than twice the length of penultimate. Prothorax as long as broad, broadest at posterior fourth, posterior to which the sides are straight; anterior and posterior borders straight; disc with a faint longitudinal impression. Elytra transverse at base, together considerably broader than thorax; sides slightly rounded; the posterior border of each straight. Abdomen broad and flat; at base as broad as elytra, the greatest width at the third and fourth segments. Legs short and slender.

Body subshining, finely punctate throughout and covered with a fine mat of yellow pubescence; the thorax and elytra bear scattered, erect, black hairs.

Color dark fuscous to piceous, legs and antennæ lighter.

Described from a small series taken at Pachuca and Guerrero Mill with *Liometopum apiculatum* Mayr.

Besides being much darker in color *D. mexicana* differs from *D. liometopi* Wasmann in the shape of the head, which in the latter species is distinctly triangular and much broader than long; in the thorax not being broader than long, and in having proportionately longer elytra.

Zyras (*Myrmœcia*) **tapinomatis** sp. nov.

Length 3 mm. Thorax broad; abdomen narrow. Color piceous, except the antennæ, mandibles, palpi and tarsi, which are fuscous; shining throughout; the antennæ less so than the body. Head not as wide as prothorax, about as long as broad; finely but distinctly punctate. Antennæ not extending to apex of elytra, thick; first and third joints longer than broad, second joint small; joints 4–10 as long as broad, each slightly longer than the preceding; apical joint a little shorter than the next two together. Pronotum a little broader than long, with rounded sides, the disc at middle very broadly and deeply impressed, the impression about one and a half times as long as broad; finely punctate. Elytra together broader than long, the sides straight and parallel, punctured similar to pronotum. Abdomen long and slender; about two-thirds as broad as elytra; very shining; the third and fourth segments each having on the dorsum a prominent tubercle, the anterior of which is the smallest, conical, and bears at the sides a fine mat of re-

cumbent yellow hairs; the posterior from above is round, with flat surface and without hairs. The median portion of the abdominal dorsum is glabrous; the rest of the body, legs and antennæ are thickly though microscopically pilose, the antennæ more densely than the other parts.

Described from three specimens taken at San Miguel in nests of *Tapinoma sessile* Say.

This species is very similar to *M. lugubris* Casey which I took some years ago in Orcus Island (Puget Sound) with colonies of the same host ant, but differs in the fine punctation of the head and thorax, which in *lugubris* are reticulate. The thoracic depression in *tapinomatis* is deeper and narrower than in *lugubris* and the abdomen is proportionally much more slender.

Family Pselaphidæ.

Pilopius major sp. nov.

Female: Length 3.25 mm. Color throughout brown. Head narrower than thorax; from the front twice as long as broad, the sides in front of eyes sub-parallel; vertex foveolately impressed at sides, a thin median carina extending to between the antennal tubercles. Eyes large and convex, located at the posterior third of head. Antennæ thick, the first joint slightly bent at base, as long as the two succeeding joints together; third joint smaller than the fourth, which is larger than the fifth; joints 5–11 sub-globose, equal in size; apical joint one and three-fourths times as long as penultimate, thickened. Prothorax a little longer than broad, narrowed in front, with rounded sides; base compressed above, with median and lateral foveæ; the former is elongate, extending one-third the distance to apex. Elytra together longer than broad, the sides rounded; humeri elevated into thick ridges; discal striæ broad, slightly arcuate, extending three-fourths the length of elytra. Abdomen narrower than elytra and about the same length.

Body shining everywhere, finely punctate, with a thin covering of short, scale-like hairs which are more dense in the pronatal foveæ and on the occiput and posterior elytral margins.

Described from specimens taken at San Miguel with *Prenolepis* (*Nylanderia*) *mexicana* Forel., one from each of three colonies. The maxillary palpi are short and proportionally smaller than in the other species of the genus that I have seen. This species belongs to the group which includes *pulvereus* Lec., *ocularis* Csy. and *abruptus* Csy., in the latter two of which only the males have been described, but is considerably larger than any of these. The pubescence is much sparser than in *pulverius*. The other species whose hosts are known are guests of different species of Aphæno-

gaster. Like most other Pselaphids of myrmecophilous habits, few are found in a single ant colony, but they are generally common, there being one or two in almost every nest of the host ant in the localities where they occur.

Family Histeridæ.

Hetærius helenæ sp. nov.

Length 2 mm. Color reddish-brown, in some specimens the side margins of the head, the margin of mandible and apex of femur piceous; shining. Form robust, about two-thirds as broad as long. Head above sparsely, coarsely punctate, less so between the eyes and beneath; clypeus about twice as broad as long, finely punctate; front with short yellow hairs. Thorax transverse, its breadth nearly twice the length; broadest at base; front border concave, narrowly margined; sides straight to the constriction, which is located about five-eighths the distance from the anterior angle to base; median portion of disc finely, regularly punctate, with sparse yellow hairs; marginal portion in front of constriction very finely rugose longitudinally and less shining than the remainder of thorax; the anterior border feebly rounded, posterior portion slightly elevated; margin of sides with a rather dense brush of long stiff yellow hairs. Elytra at base distinctly broader than thorax, the width of both together about equal to length; abundantly pilose; apical margin punctate; marginal and humeral striæ entire; third and fourth striæ extending for five-sixths the length of elytra, carinated for entire length. Propygidium and pygidium finely rugulose, the former with sparse long hairs. Posternum narrowly margined for half its length; transversely impressed at half the distance from end of margination to anterior border; distinctly excised at anterior border; margined portion shining, smooth behind and finely punctate in front. Anterior tibiæ nearly a third as broad as long, the front margin posterior to the angle straight, with about eleven elongate denticles. Middle and posterior tibiæ one-third as broad as long, the outer edge rounded.

There is considerable variation in the shade of color and a little in size. The hairs are rather long, curved, and moderately abundant. In some specimens they are almost entirely absent, probably having been scraped off by the ants.

Described from a number of specimens taken in nests of *Formica subcyanea* Wheeler and *F. microgyna* subsp. *rasilis* var. *nahua* Wheeler. The former ant is the favorite host, as nearly every nest in some localities contained the beetles, while they were found in only one nest of the latter species out of dozens examined.

This species, the first known from Mexico, is more closely related to some undescribed forms from our southwestern states than to any of the described species. It is more pilose than any of the species which I have seen, except *californicus* and an undescribed species (*hirsutus mss.*) from Arizona.

Terapus mnizechi Mars.

Two specimens were taken at San Miguel in nests of *Pheidole vasleti* var. *acolhua* Wheeler. In the place where these were found was a stone fence extending for about a half mile, along which were literally hundreds of nests of *acolhua*. Although I made several visits here and searched many nests in other localities for the beetles no more were found. It is evidently exceedingly rare locally but has a wide distribution in Mexico.

Terapus infernalis Fall.

Melanetœrius infernalis Fall.

An account of this species has been given by Wheeler (Psyche XVIII, 1911, p. 112–114) who found a number of specimens at Pasadena in company with *Pheidole hyatti* Emery. One of these was studied by Bickhardt (Psyche XIX, p. 97, 1912) who found that the beetle and most of the details of Wheeler's figure agreed with Marseul's description and figure of *mnizechi*, to which species he referred it. Recently, through the kindness of Mr. J. H. Arrow, I was able to examine in the British Museum a specimen of *mnizechi* from the Federal District of Mexico. This was undoubtedly the same as the San Miguel specimens, and these are specifically quite distinct from the Southern California form. In *infernalis* the propygidium is feebly punctate above and more coarsely beneath, with the upper, smoother portion much smaller than the lower, and there is no sharp line between the two parts. In *mnizechi* the upper portion is smooth and shining, the lower punctured and opaque, and each part is in strong contrast to the

Correction: For Myrmecotonus read "Myrmeceicon," page 179 and 180.

mentum angulate behind. This character is correlated with the geographical distribution of the species, all of the species in this group inhabiting the middle and far West. *C. wheeleri* Lec.

gaster. Like most other Pselaphids of myrmecophilous habits, few are found in a single ant colony, but they are generally common, there being one or two in almost every nest of the host ant in the localities where they occur.

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There is considerable variation in the shade of color and a little in size. The hairs are rather long, curved, and moderately abundant. In some specimens they are almost entirely absent, probably having been scraped off [illegible]

[illegible] than any [illegible] I have seen, except *californicus* and an undescribed species (*hirsutus mss.*) from Arizona.

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Family Scarabæidæ.

Cremastocheilus, *subgenus* Myrmecotonus nov.

Type: *Cremastocheilus knochii* Lec.

I propose this subgenus to contain those species which have the mentum angulate behind. This character is correlated with the geographical distribution of the species, all of the species in this group inhabiting the middle and far West. *C. wheeleri* Lec.

should be included with these, though in some specimens the mentum is very feebly notched.

The species which belong to *Cremastocheilus* subgenus *Cremastocheilus* have the mentum distinctly incised behind and are all native of the Atlantic states. The type of the genus *Cremastocheilus* is C. *castaneæ* Knoch.

Cremastocheilus (Myrmecotonus) mexicanus West.

Several specimens, found with *Formica subcyanea* Wheeler at Guerrero Mill agree closely with others identified as this species from nests of *Formica gnava* Buckley in the Huachuca Mts. (Schaeffer) and from the Santa Rita Mts., Arizona (Snow). There is in this series, as in other species in the genus, considerable variation in sculpture and pilosity as well as in size.

Cremastocheilus (Myrmecotonus) armatus Walker.

C. pilisicollis Horn.

Recently I examined the type and several paratypes of *C. armatus* in the British Museum, and compared with specimens of the form which is identified in collections as *pilisicollis* Horn. The two are identical, so the latter name must fall into synonomy, as was considered probable by Horn. (Monographic Revision of the species of Cremastocheilus and Synopsis of the Euphoriæ of the United States. *Proc. Amer. Phil. Soc.* XVIII, 1879, p. 390).

Family Curculionidæ.

Liometophilus manni Fall.

A single specimen of this curious weevil was taken at Pachuca in the galleries of a colony of *Liometopum apiculatum* Mayr. The species was first found in Southern Arizona, where it lives with a variety of the same ant. The oily-red color, so characteristic of the chitin in many beetles of myrmecophilous habits, is evident at the middle of the anterior elytral margin, where the scales are absent, probably having been gnawed off by the ants. This is, so far as is known, the only truly myrmecophilous weevil found in North America.

The Mexican specimen (length 4 mm.) is considerably larger than a paratype from Arizona in my collection, and the light-

colored transverse bands on the elytra are in stronger contrast to the rest of the body, but otherwise the two agree closely.

HYMENOPTERA.

Family Diapridæ.

Hemilexis jessei sp. nov.

Female: (Fig. 3). Length 3 mm. Color jet black, except the mandibles, front of the propleuræ, petiole, antennæ and legs, which are rufous. Head subglobose, as broad as long and about as thick as long, sparsely punctulate, with scattered white pilosity; occipital border rounded, sides in front of eyes very slightly concave. Mandibles thick and short; bifid at tip. Eyes large, orbicular, little convex, black, located at sides of head posterior to middle. Ocelli small, arranged in a triangle. Antennæ inserted at bases of flattened tubercles; contiguous at base; the scape clavate, about as long as head; apex of scape shortly excavated beneath, unarmed. Pedicel thickened toward apex, as long as the first funicular joint; first funicular joint a little longer than the second, joints 2–6 subequal; the last four subequal, forming a club. Prothorax above very short; in profile triangular; the pronotum thickly covered with white pubescence. Parapsidal furrows shallow, but distinct, extending the length of mesonotum. Mesonotum feebly, very sparsely punctate. Scutellum sparsely rugulose longitudinally, transversely

Fig. 3. *Hemilexis jessei* sp. nov. ♀

depressed posteriorly. Metanotum longitudinally carinate at middle, the surface rugulose. Petiole cylindrical, twice as long as broad, smooth and shining. Abdomen smooth and very shining; somewhat depressed. Legs rather short, the femora narrow basally, and clavate at apex. Wings extending past tip of abdomen, the tips rounded; pilose; slightly infuscated; veins yellowish.

Described from a series found in several colonies of *Formica subcyanea* Wheeler about Velasco and near Guerrero Mill. This is the second American species of Hemilexis as defined by Kieffer (*Gen. Ins. Fasc.* 124, p. 20, 1911), and differs widely from the other, *H. californica* Ashmead. Nothing is known regarding the habits of the other species, but *jessei* and the following variety are undoubtedly closely associated with the ants, probably as parasites on the immature phases. Only one or two individuals were found in each nest. They moved about rather slowly among the ants, which paid no attention to them.

This species is dedicated to my small collecting companion, Master Jesse Van Law.

Hemilexis jessei var. **minor** var. nov.

Three females which were taken in the same locality and with the same host ant as the preceding form seem to belong to a distinct variety. The size is much smaller (length 1.75 mm.) than in the typical form, and the coloration is lighter. The prothoracic pleuræ, scutellum and petiole being light fuscus. Otherwise the two forms are identical.

Family Bethylidæ.

Bruesiella gen. nov.

Female. Apterous. Head transverse, broader than thorax; face evenly rounded, smooth except small foveæ at apex. Antennæ 12-jointed, the basal joint much enlarged; inserted at base of clypeus; narrowly separated at base. Mandibles stout, thickened at tips. Eyes well developed, oval, flat. Ocelli absent. Prothorax transverse, smooth, with a single large puncture near a feeble longitudinal impression at margin. Mesothorax transverse, the pleuræ extended into a thick, nearly perpendicular lamina. Metanotum from above subquadrate, broadest behind, sides feebly, irregularly margined; the posterior border with an acute, interrupted carina. Scutellum absent. Abdomen slender, somewhat depressed. Legs short, stout, the middle and posterior femora swollen, flattened; tibiæ spinose, the middle more strongly than the others.

This genus runs out at Sclerochroa in Kieffer's table in the Genera Insectorum. (Fascicle 76, p. 10, 1908). The peculiar structure of the mesothorax is quite different from that in any other of the described allied genera. In general appearance it bears considerable resemblance to some of the Thynnidæ.

Type: Bruesiella formicaria sp. nov.

Bruesiella formicaria sp. nov.

Female: (Fig. 4). Length 3.5 mm. Body shining. Head, thorax, anterior portion of first abdominal segment and legs brown, remainder of abdomen black.

Head much broader than long, with straight sides, rounded posterior corners and straight posterior border. Clypeus broadly rounded in front. Mandibles slender, curved; the tip thick. Eyes large and flat, located in front near sides at about half their length from base of clypeus. Ocelli absent. Antennæ 12-jointed, short and thick, the first joint swollen, as long as the second and third together; second joint shorter than third, joints 3–11 subequal, cylindrical, longer than broad; apical joint about twice as long as penultinate. Head and antennæ shining, minutely punctate, the vertex with four distinct foveæ arranged trapezoidally. Prothorax transverse, narrowed in front to form a short, thick neck, sides slightlyrounded; posterior border concave. Mesothorax transverse, flat above; the pleuræ extended into broad, vertical lamellæ, which incline slightly backward toward the base. Metanotum narrower than mesonotum, longer than broad, widest behind; depressed at middle, the posterior border acutely carinate; posterior surface flat. Abdomen with a short thick petiole; a little longer than head and thorax, subcylindrical. Legs stout, the femora enlarged, flattened, middle tibiæ with five strong spines on outer edge. The entire body with very sparse scattered erect, black hairs, tarsal joints spinose at apex.

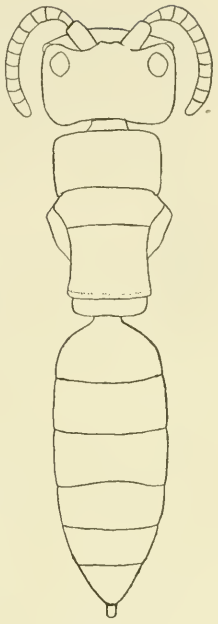

Fig. 4.
Bruesiella formicaria gen. & sp. nov. ♀

Described from a single specimen taken with *Formica microgyna rasilis* var. *nahua* Wheeler at Guerrero Mill.

Family Pteromalidæ.

Pheidoloxenus wheeleri Ashmead.

A single specimen of this wingless parasite was found with *Pheidole ceres* Wheeler var. *tepaneca* Wheeler at Guerrero Mill. Wheeler, who discovered the species in nests of *Pheidole instabilis* in Texas, considered that it is entoparasitic, either on the ants or their brood.

Family Eucharidæ.

Orasema tolteca sp. nov.

Female: Length 4 mm. Head triangular, slightly longer than broad, with convex occipital border and nearly straight sides. Mandibles bidentate, the teeth long and acuminate; front flat; clypeus and frontal area separated from the remainder of front by a deep impression. Eyes oval, large, very convex; ocelli large and

convex, arranged in a broad triangle. Antennæ short and stout, the funiculus extending barely to occipital border; pedicel slightly longer than thick; funicular joints subequal, cylindrical, one and one-third times as long as broad; apical joint conical, one and one-half times the length of penultimate. Thorax trilobed, lobes convex. Scutellum rounded behind, with a strong transverse impression before the posterior border. Metanotum abruptly sloping, with strong lateral sulci. Petiole from side more than twice as long as thick.

Head shining, finely densely punctuate, the temples finely shagreened; flagellum coarsely punctate and opaque. Thorax and petiole coarsely, densely, rugosely punctate; parapsides finely, transversely aciculate; gaster smooth and shining. Scape brown at base, flagellum black, tips of femora, the tibiæ and tarsi ferruginous; rest of body metallic green. Wings slightly infuscated, veins and the distinct stigma brown.

Male: Similar to the female. The thorax is bronze in color, and the petiole proportionally thicker.

One male and two females, together with numerous pupæ were found at San Miguel in nests of *Pheidole vasleti* var. *acohlma.* The pupæ were lying among the brood of the ants, and were always quickly removed by the worker ants when the nest was uncovered.

This species is much larger than *O. occidentalis* Ashmead, from Southern California, but is otherwise very similar. *O. stramineipes* Cameron, from Panama differs in the form of the metanotum which has: "a central area bordered by keels which sharply converge at the top." This is entirely different to the structure of the metanotum in *tolteca.*

THE BACTERIAL DISEASES OF CATERPILLARS.[1]

By R. W. Glaser.

There seems to be a considerable amount of collateral evidence that caterpillars are subject to bacterial diseases, but I am not familiar with a single case where this has been conclusively proved. Such a state of affairs can be explained in part by the fact that much of the work on caterpillar diseases was done before the introduction of Koch's technical methods in 1880 or shortly after, before these methods had been fully perfected. Within compara-

[1] Contribution from the Bureau of Entomology in coöperation with the Bussey Institution of Harvard University. (Bussey Institution, No. 83.)

tively recent times diseases occurring in the same caterpillar, but totally different etiologically were confused with one another. The same name was often given to two distinct diseases and *vice versa*, the same disease was designated differently by different workers. Furthermore, the cultural and biological characters of the bacteria isolated were never thoroughly studied and hence no two investigators knew whether they were dealing with the same or different species. Many people untrained in bacteriology entered this field and helped to swell the enormous literature already accumulated with their inexact observations and careless experiments. Everyone familiar with the subject knows how difficult it is, how careful one has to be in drawing conclusions and how easily serious mistakes are made. From a consideration of some of the more important contributions to our knowledge of the bacterial diseases of caterpillars, the present condition of the subject will become apparent as well as the vast number of problems yet unsolved.

Flacherie and the Clinical Picture of an Infected Silkworm.

The diseases known as "flaccidezza," "lethargia," "negrons," "mortipans," "maladie de tripes," "maladie de morts-blancs," "maladie des morts-flats," "schlaff-sucht," "faulsucht," "flaccidity," "schizomycosis," and "caterpillar cholera" are synonymous with the one known as flacherie.

Flacherie appeared in the silk industry as an epidemic at the end of the sixteenth century. The larvæ usually contract the disease, which is characterized by its acuteness, after the fourth moult or at the time of spinning. Sick caterpillars show very few outer symptoms except loss of appetite and sluggishness. Sometimes their skin becomes black but in other cases they retain a healthy appearance till death. Soon after death the body becomes soft, flabby and dark colored in twenty-four to forty-eight hours and is filled with a brown-black liquid which is said to contain many bacteria.

The Etiological Factor of Flacherie in Silkworms and Other Caterpillars.

In 1870 Pasteur recognized flacherie in silkworms as a distinct disease capable of transmission to healthy larvæ by the infection of their food, either with the excrement of sick individuals or with

the dust of infected silkworm nurseries of the year before. Pasteur believed that a number of organisms, which multiplied in the intestine, were responsible for the disease. In 1873 Bolle found that bacteria were very plentiful in the bodies of silkworms affected with flacherie. In 1886, S. A. Forbes found that the alimentary canal of silkworms during the first stages of the disease was full of micrococci. He also obtained these micrococci from the blood in pure culture and believed them to be identical with *Steptococcus bombycis* described by Cohn. Forbes says that the disease can be transmitted by means of this bacterium and larvæ so infected die after twenty-four to forty-eight hours. He further states that the disease is not transmitted through the egg and that the bacteria retain their vitality for years.

In 1891 Macchiali found two organisms responsible for flacherie, namely, *Streptococcus bombycis* and a *Bacillus bombycis*.

In 1893 Wachtl and Kornauth expressed the belief that the bacteria found by Pasteur in 1870 are identical with *Microzyma bombycis* described by Béchamp in 1867 and identical with *Streptococcus bombycis* Cohn. At about the same time Cramer, Cuboni and Garbarini considered *Streptococcus bombycis* to be the causative agent of flacherie.

In general, *Streptococcus bombycis* seemed to be the form most frequently encountered and the controversy practically subsided with the acceptance of this bacterium as the etiological factor of flacherie in silkworms.

In 1903 Kelly made the remarkable statement that "flacherie is but another name for indigestion." Other theories as far-fetched as the above followed in rapid succession, the most extreme, perhaps, being the one advanced by Sawamura in 1906. He says: "The writer has inferred from his experiments that the flacherie of silkworms can be caused by various bacteria of general occurrence. During that disease no specific bacteria can be found which would be restricted to the occurrence in that epidemic. The following bacteria were found by the writer to produce flacherie by multiplying in the body of the silkworm:

1. *Bacillus coli.*
2. *Bacillus Ellenbachi.*
3. *Bacillus ferrugenus.*
4. *Bacillus fuchsinus.*

5. *Bacillus megaterium.*
6. *Bacillus megaterium bombycis.*
7. *Bacillus mycoides.*
8. *Bacillus pyocyaneus.*
9. *Bacillus rubefaciens.*
10. *Bacillus viridans.*
11. Various species of Proteus.
12. *Micrococcus (Staphylococcus) pyogenes aureus.*

Our knowledge of the etiology of flacherie in silkworms has not advanced in the least since Pasteur's time and the same thing can be said of other caterpillar diseases of a supposedly bacterial nature.

Forbes in 1886 and 1888 described flacherie-like diseases in the caterpillars of *Pieris (Pontia) rapæ*, *Datana ministra*, *Datana augusi*, *Mamestra picta*, *Pyrameis cardui*, and *Nephelodes violans*. In 1888 he said that "all the bacterial diseases of insects thus far carefully studied, take first and principal effect on the epithelial layer of the alimentary canal, no distinctively blood disease having yet been distinguished if we except a supposed flacherie of *Cleonus* larvæ reported by Metschnikoff in Russia, but not critically investigated."

The flacherie-like disease in caterpillars of the meal moth, described by Berliner in 1911, seems to begin with an acute intestinal disturbance which later affects the entire body, converting the interior into a brown liquid. In April, 1913, an article on Septicemia-like disease of caterpillars of *Arctia caja* L. appeared in the "Comptes Rendus des Séances de l'Académie des Sciences."

According to the authors Picard and Blanc, caterpillars dead from this disease become flaccid and give off a putrid odor. Their digestive tube is empty and contains a clear liquid often exempt from micro-organisms. The blood, however, contains a pure culture of what Picard and Blanc call a coccobacillus and with which they have artificially reproduced the disease. This coccobacillus for which they propose the name *Coccobacillus cajæ* measures about 1.5μ and is slightly oval. It is motile, and Gram negative but takes the anilin dyes readily. Cultures in bouillon grow in twelve hours at temperatures ranging from 15 degrees to 35 degrees, with an optimum growth at 25 degrees. The cultures have an odor resembling putrid eggs and in 24 hours assume a greenish fluorescent tint best obtained at the optimum growth temperature. The

cultures do not contain pyocyanin, however, as can be shown by extracting with chloroform. The coccobacillus grows rapidly on gelatine which it liquifies and on gélose (agar) the growth in two cases was slightly fluorescent. Streak cultures on gélose (agar) spread in a short time all over the surface. On potato the growth is feeble and begins to develop only after 48 hours without producing the greenish fluorescent pigment. Caterpillars of *Arctia caja* inoculated in the prolegs with a fine needle dipped in virulent blood or in a culture of bouillon die regularly in three days when kept at 15 degrees and present an intense multiplication of the bacillus in their blood. Inoculated caterpillars die in 12–24 hours when they are kept at a temperature of 25 degrees and the blood of such individuals appears more virulent than the blood of those which die at 15 degrees. If several drops of the culture are introduced into the pharynx by means of a pipette caterpillars die in 24 hours at 25 degrees and the coccobacilli invade the blood. This fact, that caterpillars can be infected by ingesting the etiological factor, leads the authors to hope for the employment of the disease practically.

Picard and Blanc found that brown-tail caterpillars are very susceptible to the coccobacillus. The authors inoculated several Coleoptera and Hemiptera, but found that the bacterium was non-pathogenic to these forms. White rats are also nonsusceptible to the intraperitoneal injection of a cubic centimeter of a virulent culture in bouillon, but the green frog (*Hyla arborea*) is susceptible and dies in 24–48 hours when inoculated in the lymphatic spaces. The blood from such a frog is again virulent for caterpillars.

The above results obtained by Picard and Blanc may have been correctly interpreted, but they can hardly expect bacteriologists to accept them for the following reasons: No account of their actual experiments is given; we know nothing about the number of caterpillars which were used, and no mention was made of controls. The absence of accurate controls alone places the article among worthless publications. Furthermore, the morphological description of their coccobacillus is very superficial and cultural features are almost entirely disregarded. They say nothing about colonies on nutrient gelatine or agar other than a growth was obtained on these media. Many other media absolutely essential

for a scientific treatment of the subject have been omitted. Apart from the pyocyanin test and the mention of temperatures all physical and biochemical characters have been ignored and the question which I would like to ask is: How do Picard and Blanc know that they were dealing with the same organism at all times?

Many of the authors reviewed seem to agree in one point, namely, that the flacherie-like diseases are primarily intestinal affections and that the bacteria concerned are found outside of the intestine, in the body cavity, only during the later stages when the alimentary canal ruptures.

Among certain human diseases somewhat analogous cases can be found. In typhoid fever, for instance, the main lesions of the disease occur in the intestine. Cholera is purely an intestinal affection characterized by diarrhœa in the form of the so-called rice water discharges. Among insects, European foul brood, a disease in bees caused by *Bacillus pluton*, is another example of such an intestinal malady.

While it therefore seems possible that some of the caterpillar diseases now grouped under the name of flacherie are intestinal disturbances caused by toxic products liberated within the alimentary tract by specific bacteria, it is not at all unlikely that other diseases affect other parts of the body such as the disease described by Picard and Blanc. The entire subject, however, is still one for controversy.

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PROTHETELY OR SEMI-PUPAL STAGE IN *LOPHEROS FRATERNUS* RAND.

By H. S. Barber,
Bureau of Entomology, Washington.

In the August number of Psyche (Vol. XXI, pp. 126–129) Williams mentions and illustrates an abnormal larva of *Photuris pennsylvanicus* that had developed the pupal wing pads, assigning Kolbe's term prothetely to the phenomenon, and citing the five previous records of this precocious development. Since photographic records of a parallel case in another genus of Malacoderm beetles are at hand they may be useful in close proximity to the above note to which an omitted case of similar nature may be added. Böving[1] 1906 speaks of an abnormal Donaciid larva:

"In a cocoon a larva with two large pupa wings on one side of the thorax, and a pupal abdomen was found. There was consequently no appendage, but the head and limbs were that of a larva. At the side of this monster, a cast off, entirely normal skin was lying, with the coverings of both cranium and limbs."

[1] Bidrag til kundskaben om Donaciin-larveneres naturhistorie, Copenhagen, p. 241. Translated into English 1910, Sonderabd. Int. Rev. Hydrobiol. Hydrograph. p. 101.

In September, 1908, Mr. Schwarz and the writer found several scattered larvæ of *Lopheros fraternus* Rand. under a log on the Virginia shore of the Potomac River near Plummer's Island, Md. Some of these were left in place, the rest being taken to the office for breeding where the abnormally warm condition upset their transformation. Several of them developed wing-pads and all died before spring. But an early spring visit to the log disclosed normal pupæ, with their larval skins, where the few larvæ had been left

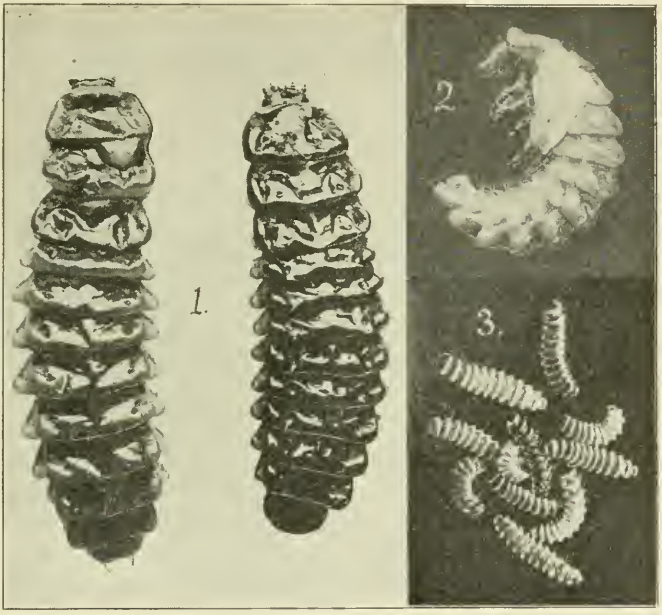

Fig. 1. *Lopherus fraternus* Rand.
1, larvæ x 5; 2, semipupa or prothetelic state x 4; 3, group of larvæ, natural size.

the previous fall and from these adults issued. It was thought at the time that a long period of slow internal change at low temperature was required in preparation for pupation which would be induced by the rise in temperature in the spring, but that the early rise in temperature when the first lot of larvæ were taken to the warm office, had stimulated an attempt at the second operation before the first was completed, causing the abnormal and fatal

development which was then termed a "semi-pupa." It is doubtful if larvæ assuming this state ever successfully develop into adults.

The accompanying illustration shows the dorsal view of the glossy, brown larvæ (enlarged five diameters) a lateral view of the semi-pupa or prothetelic state (four diameters), and a natural size view of the first lot of larvæ.

ASILIDS AND THEIR PREY.

By Stanley W. Bromley,
Southbridge, Mass.

While collecting insects during the summers of 1912–13 at Southbridge, Mass., I was attracted by the predaceous habits of certain Asilidæ and the apparent partiality of some of the species for Hymenoptera, while others, as for example, *Asilus sericeus*, would almost invariably seize a Lepidopterous insect. To ascertain more fully the feeding habits of the species, I made a special collection of Asilidæ with their prey.

Asa Fitch in his Ninth Report, page 251, pl. 4, fig. 7, refers to what is now called Promachus fitchii O. S., as the "Nebraska Bee-killer"—*Trupanea apivora*, stating that he had received it from Nebraska where it was destructive to the honey bee and also to the rose bug. As to robber-flies killing bees, I have not seen them do much damage, but I have never observed them closely in the vicinity of hives. Most of the bees taken were in the field, probably at quite a distance from any apiary. They might, however, become injurious if abundant near a hive, for they always capture their prey on the wing and would undoubtedly seize indiscriminately any bee that came within their range. As the various species of Vespa and other Hymenoptera were more plentiful in the fields than the honey bee, these fell victims to the ravenous appetites of the Asilids which preyed also on members of their own family and, indeed, even on those of the same species.

As far as my observations go, there are very few insects that will attack robber-flies. I have seen a species of *Crabro* sting and

carry off a male *Erax æstuans*, and have also seen hornets kill small Asilids. Spiders are, however, formidable enemies of robber-flies I have taken three *Proctocanthus philadelphicus* from webs of spiders; one from an Epeirid web and two from a web of *Agalena;* six *Deromyia umbrina* from *Argiope riparia*, *Dasyllis thoracica* from *Theridium tepidarorium*, and many small Asilids and *Erax æstuans* from *Theridium*, *Epiera* and *Linyphia*.

I am greatly indebted to Mr. C. W. Johnson of the Boston Society of Natural History for many suggestions and kind assistance in naming the insects included in the following lists.

List of Insects and Number of Specimens Taken from Asilids.

Asilus sericeus Say.

(Lepidoptera)

1 *Euvanessa antiopa*
1 *Satyrus alope*
2 *Colias philodice*
2 *Chrysophanus hypophlæus*
1 *Archytas analis*
1 *Eudamus tityrus*
1 *Noctua* sp.

(Diptera)

Asilus lecythus Walker.

(Odonata)

1 *Enallagma* sp?

Asilus orphne Walker.

(Hemiptera)

1 *Typhlocyba* sp?

Asilus notatus Wiedemann.

(Diptera)

2 *Metopia leucocephala*
2 *Sarcophaga* sp?

(Neuroptera)

1 *Chrysopa* sp?

Asilus erythrocnemius Hine.

(Hymenoptera)

1 *Formica* sp? ♀

Asilus latipennis Hine♂.

(Diptera)

1 *Asilus latipennis*♂

Proctacanthus philadelphicus Macquart.

(Hymenoptera)

10 *Apis mellifica*
7 *Bombus vagans*
5 *B. impatiens*
2 *B. perplexus*
1 *B. affinis*
1 *B. bimaculatus*
1 *B.* sp?
1 *Mclissodes dentiventris*
1 *Andrena nubicula*
2 *A.* sp?
2 *Halictus nymphacorum*
2 *H. lerouxii*
2 *H.* sp?
1 *Sphecodes* sp?
1 *Crabro scxmaculatus*
1 *Tachysphex* sp?
1 *Sccliphron cemcntarium*
6 *Formica fusca* and vars? ♀ ♂
1 *Lasius umbratus* ♀
2 *Myrmica rubra* ♀
5 *Pimpla pedalis*
1 *Anomalon* sp?
1 *Pamphilius* sp?
3 *Vespa maculata*
5 *V. arenaria*
2 *V. vulgaris*
25 *V. diabolica*
17 *V. germanica*
9 *V.* sp?
1 *Ancistrocerus capra*
1 *Gorytes simillimus*
4 *Aphilanthops frigidus*
1 *Ccropales fraterna*
1 *Psammochares biguttata*
1 *P. cylindrica*
1 *P.* sp?
4 *Tiphia inornata*
3 *T. transversa*
3 *T.* sp?
1 *Camponotus pennsylvanicus* ♀
1 *Ichneumon trizonatus*
3 *I. creperus*
1 *I. montanus*
1 *I. parvus*
1 *I. lætus*
2 *I. lustabilis*
9 *I.* sp?

(Diptera)

2 *Pachyrhina* sp?
2 *Tabanus microcephalus*
4 *Pangonia rasa*
1 *Chrysops univittatus*
1 *Psilocephala hæmorroidalis*
1 *Asilus notatus*
1 *A. sadytes*
1 *Erax æstuans*
1 *Proctacanthus philadelphicus* ♂ (this was killed by a large ♂)
4 *Deromyia umbrina* ♂ ♀
3 *Deromyia winthemi*
2 *Eristalis tenax*
1 *Chrysotoxum derivatum*
2 *Tachina* sp?
4 *Ptilodexia tibialis*
1 *Othalia cornicina*
2 *Sarcophaga* sp?
1 *Phormia regina*
1 *Muscina stabulans*
1 *Pollenia rudis*
1 *Eurosta comma*

(Lepidoptera)

1 *Chrysophanus hypophlæus*
1 *Pamphila hianna*
1 *Feltia herilis?*
1 *Crambus leachellus*

(Coleoptera)

3 *Cincindela punctulata*
5 *Aphodius fimetarius*
1 *Onthophagus hecate*
1 *Balanius uniformis*

(Hemiptera)

1 *Ceresa biceros*
1 *Jassus olitorius*
1 *Alydus eurinus*
1 *Campylenchnia curvata*
1 *Eurygaster alternata*
1 *Banasa dimidiata*
1 *Euschistus fissilis*
1 *E. tristigmus*
1 *Stictocephala* sp.?

(Orthoptera)

1 *Camnula pelucida*
6 *Orphulella speciosa*
1 *Nemotettix cristattus*

(Odonata)

1 *Enallagma* sp?
1 *Sympetrum rubicundulum*

Erax æstuans Linne.

(Hymenoptera)

1 *Fomica fusca* var?
1 *Ichneumon* sp?

(Diptera)

1 *Atomosia puella*

(Coleoptera)

1 *Melanotus* sp?
1 *Pachybrachys atomarius*
1 *Carpophilus hemipterus*

(Hemiptera)

1 *Carynota muskokensis*

Erax rufibarbis Macquart.

(Hymenoptera)

1 *Halictus nymphœorum*
1 *Ich neumon* sp?
1 *Pimpla pedalis*

(Diptera)

1 *Eristalis tenax*
1 *Sarcophaga* sp?
1 *Muscina* sp?
1 *Stomoxys calcitrans*
1 *Peleteria robusta*

(Lepidoptera)

1 *Crambus* sp?

(Hemiptera)

1 *Tomaspis bicincta*

Promachus bastardi Macquart.

(Hymenoptera)

1 *Halictus ligatus*
2 *H. nymphacorum*
1 *H. lerouxii*
1 *H.* sp?
3 *Vespa diabolica*
1 *Ambyteles rubivagus*
1 *Ichneumon flavizonatus*
1 *I. lætus*
1 *I.* sp.?
2 *Pimpla pedalis*

(Diptera)

1 *Asilus orphne*
1 *A. novæ-scotiæ*
1 *Sarcophaga* sp?

(Coleoptera)

1 *Hoplia equina*
1 *Limonius* sp?

(Hemiptera)

1 *Lygus pratensis*

Promachus fitchii Osten Saken

(Hymenoptera)

2 *Apis mellifica*
1 *Bombus vagans*
2 *Andrena nubicula*
1 *Megachile avara?*
2 *Halictus ligatus*
9 *H. nymphæorum*
2 *H. provancheri*
7 *H.* sp?
1 *Vespa diabolica*
2 *Augochlora* sp?
1 *Ancistrocerus capra*
1 *Aphilanthops frigidus*
2 *Tiphia inornata*
1 *T. transversa*
1 *T.* sp?
8 *Formica fusca* and vars? ♀ ♂
1 *Ichneumon trizonatus*
1 *I. rubivagus*
1 *I. comes*
2 *I.* sp?
2 *Pimpla pedalis*

(Diptera)

1 *Tabanus microcephalus*
1 *Asilus snowii*
2 *A. notatus*
7 *Erax æstuans* ♀ ♂
1 *Promachus fitchii*
1 *Promachus bastardi*
2 *Atomosia puella*
1 *Mesogramma marginatus*
1 *Syrphus* sp?

(Coleoptera)

1 *Cicindela punctulata*
1 *Amara vida*
1 *Haplandrus femoratus*
1 *Elater* sp?
2 *Melanotus* sp?
2 *Hoplia equina*
1 *Macrodactylus subspinosus*
1 *Onthophagus hecate*
7 *Aphodius fimetarius*

(Lepidoptera)

1 *Chrysophanus hypophlæus*
1 *Pamphila peckius*
1 *Pyrausta* sp?

(Hemiptera)

1 *Corizus* sp?
1 *Lygus pratensis*
1 *Emblethis vicarius*
1 *Eurygaster alternatus*
1 *Chlorochroa persimillis*
1 *Euschistus fissilis*

Dasyllis thoracica Fabricius.

(Hymenoptera)

1 *Halictus lerouxii*

(Coleoptera)

1 *Macrodactylus subspinosus*
1 *Glyptoscelis pubescens*

Dasyllis posticata Say.

(Coleoptera)

2 *Aphodius fimetarius*

Dasyllis flavicollis Say.

(Coleoptera)

1 *Telephorus carolinensis*

Cyrtopogon marginalis Loew

(Trichoptera)

1 *Trichopterid*

(Hemiptera)

1 Winged aphid

Deromyia umbrina Loew.

(Hymenoptera)

10 *Apis mellifica*
1 *Bombus impatiens*
2 *B. fervidus*
2 *B. vagans*
1 *Andrena* sp?
1 *Halictus* sp?
1 *Colletes americana*
11 *Vespa diabolica*
2 *V. vulgaris*
2 *V. arenaria*
1 *Gorytes simillimus*
1 *Cerceris deserta*
2 *Crabro interuptus*
1 *Ammophila* sp?
1 *Sceliphron cementarium*
1 *Bembidula ventralis*
1 *Campoplex* sp?
1 *Anthophilus bilunatus*
1 *Taxonus nigrisoma*
1 *Exochilium nigrovarium*
4 *Ichneumon* sp?
2 *I. saucius*
3 *Pimpla pedalis*
1 *Thyreodon morio*

(Diptera)

3 *Pangonia rasa*
1 *Asilus sericeus*
1 *A. novæ-scotiæ*
1 *A. snowii*
1 *Erax æstuans*
1 *Leptogaster badius*
1 *Eristalis tenax*

(Coleoptera)

1 *Trichius affinis*

(Hemiptera)

1 *Ceresa taurina*

Deromyia winthemi Wiedemann.

(Hymenoptera)

1 *Halictus nymphæorum*
1 *Evania appendigaster*
1 *Formica fusca* var?
1 *Augochlora similis*
1 *Campoplex* sp?
1 *Ichneumon w-album*
1 *Anomalon* sp?

Ceraturgus cruciatus Say.

(Hymenoptera)

2 *Formica fusca* ♀
1 *Formica* sp? ♀

(Coleoptera)

4 *Aphodius fimetarius*
1 *Macrodactylus subspinosus*

EXCHANGE COLUMN

Will exchange insects of various orders for Parasitic Hymenoptera from any part of the world.—C. T. Brues, Bussey Institution, Forest Hills, Mass.

Wanted. Ants from all parts of the world.—W. M. Wheeler, Bussey Institution, Forest Hills, Mass.

I pay cash or give American and exotic insects in exchange for fertile eggs of Catocala spp., *living* Catocala ♀ ♀ (captured specimens only), hibernating pupæ and larvæ of any other group of Lepidoptera.—William Reiff, 366 Arborway, Jamaica Plain, Boston, Mass.

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Offered for cash, but exchange preferred. Fitch and early Illinois reports; Insect Life; Harris's Insect; many others.—J. E. Hallinen, Cooperton, Okla.

Histeridæ. North American Histeridæ identified or unidentified, desired in exchange for beetles of other families. F. G. Carnochan, Bussey Institution, Forest Hills, Massachusetts.

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Wanted: Psyche, Vol. VIII, No. 265 (May, 1898); No. 267 (July, 1898); No. 268 (August, 1898); Vol. IX, No. 300 (April, 1901). Address, giving price, Librarian, Stanford University, Cal.

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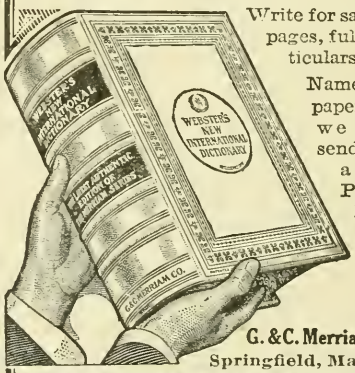

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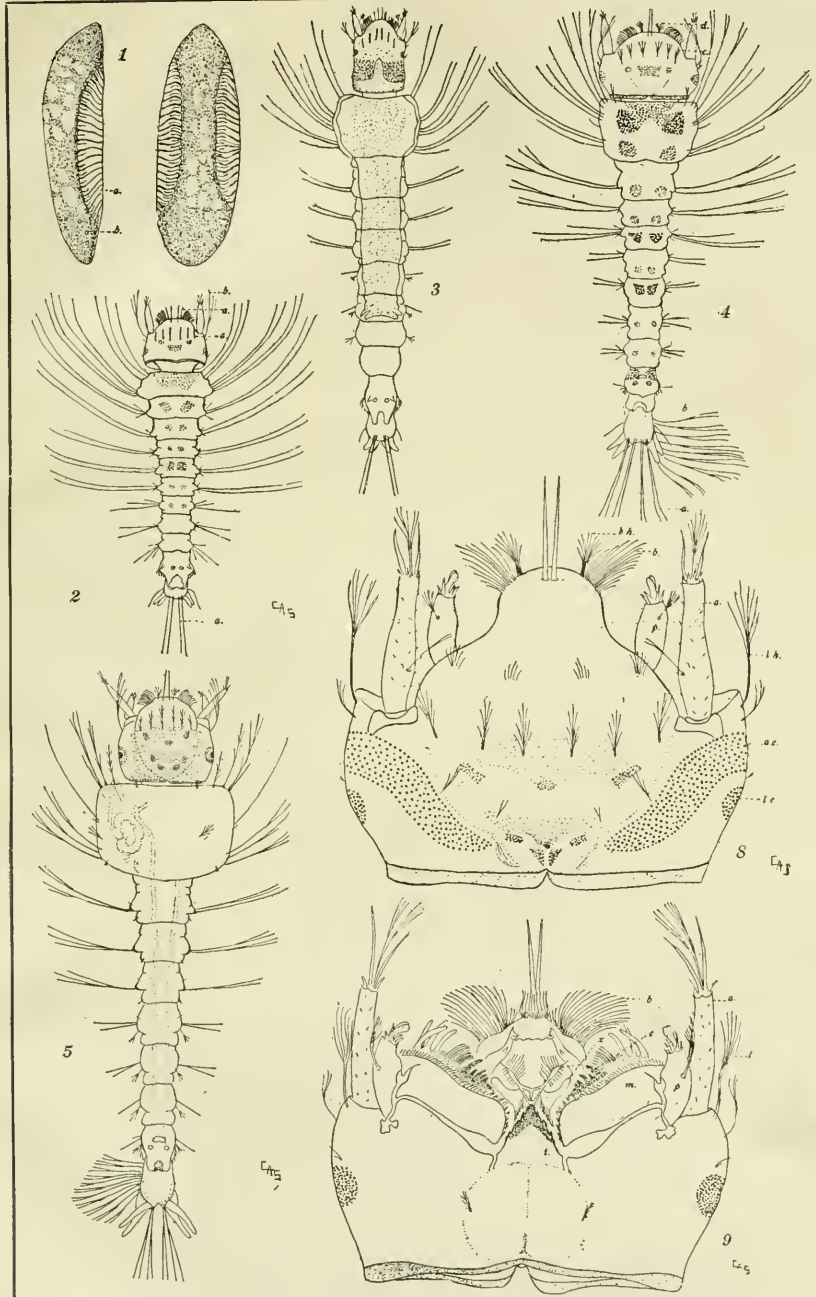

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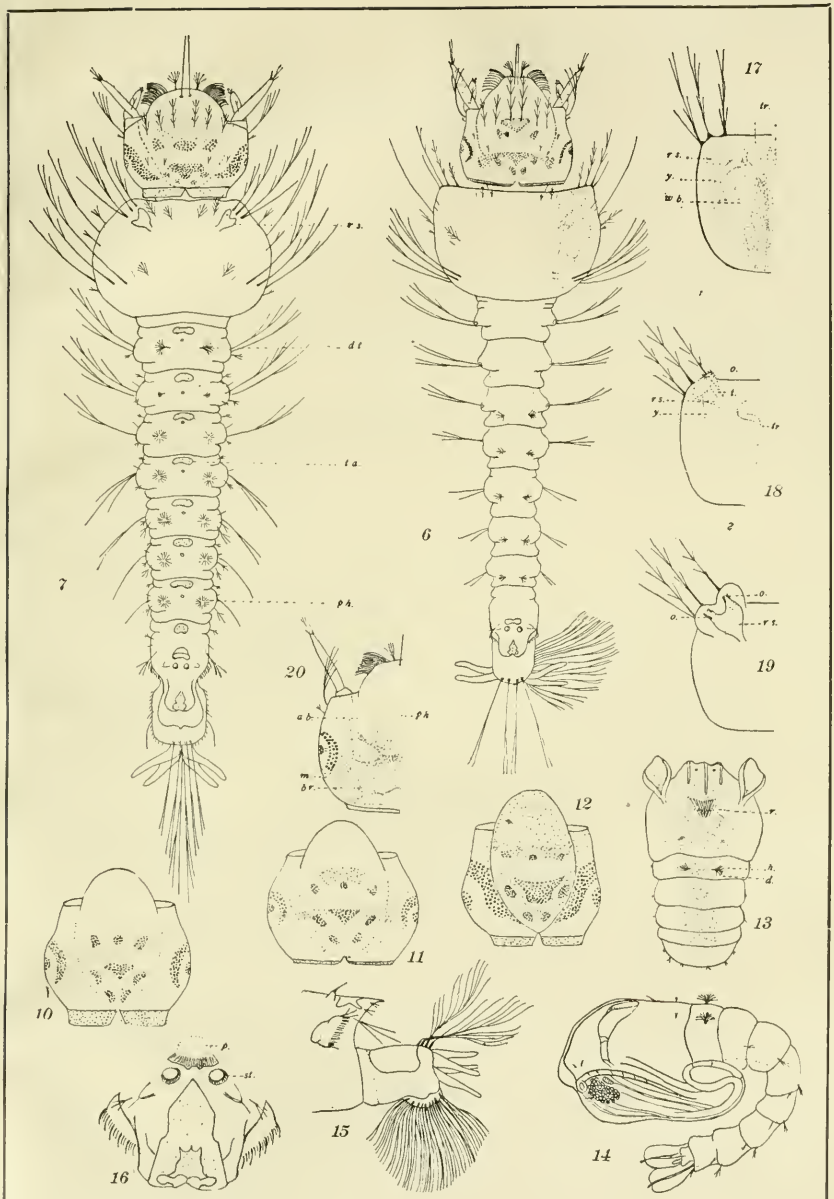

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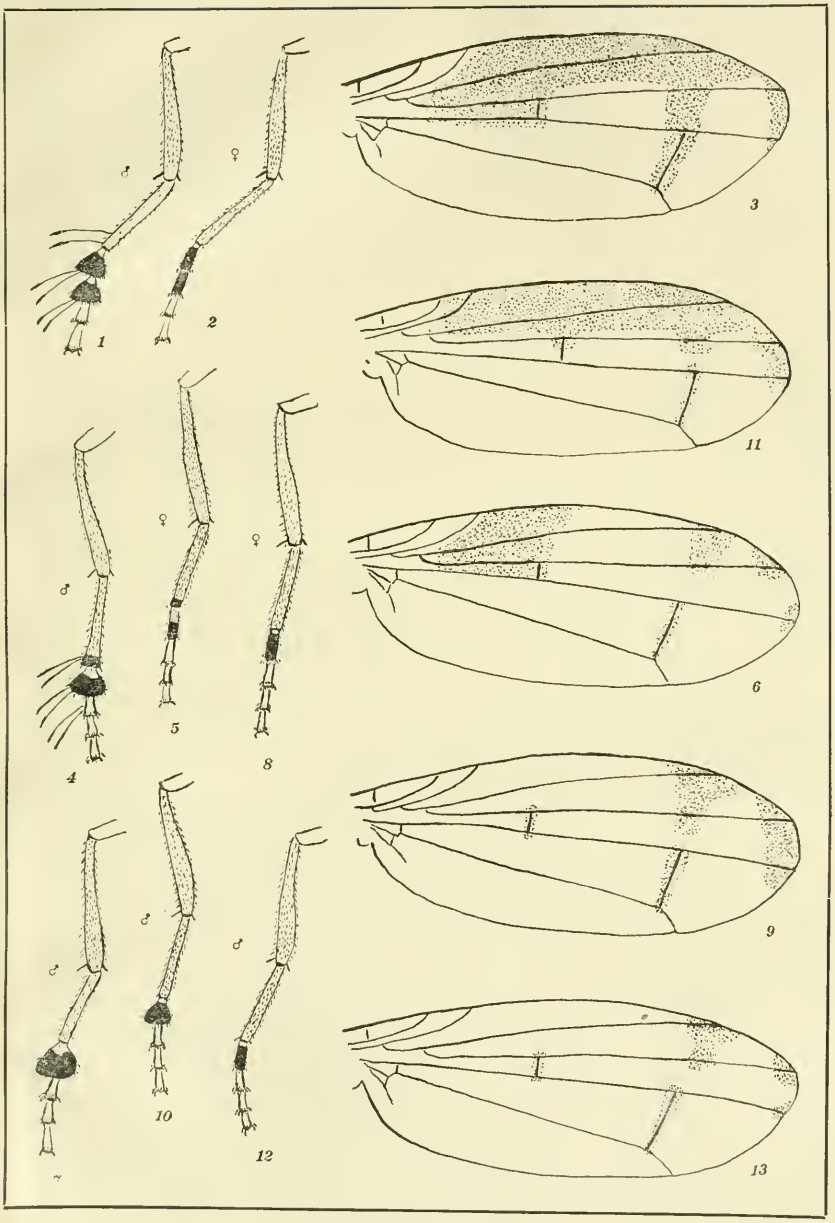

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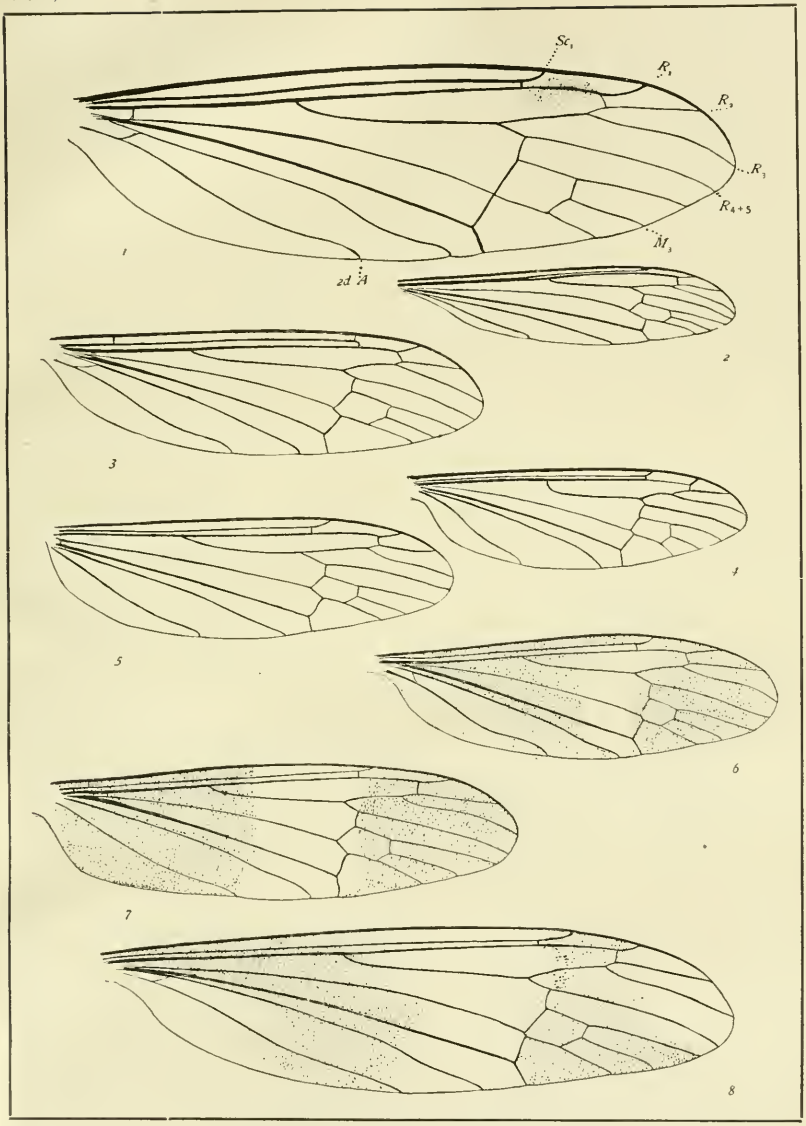

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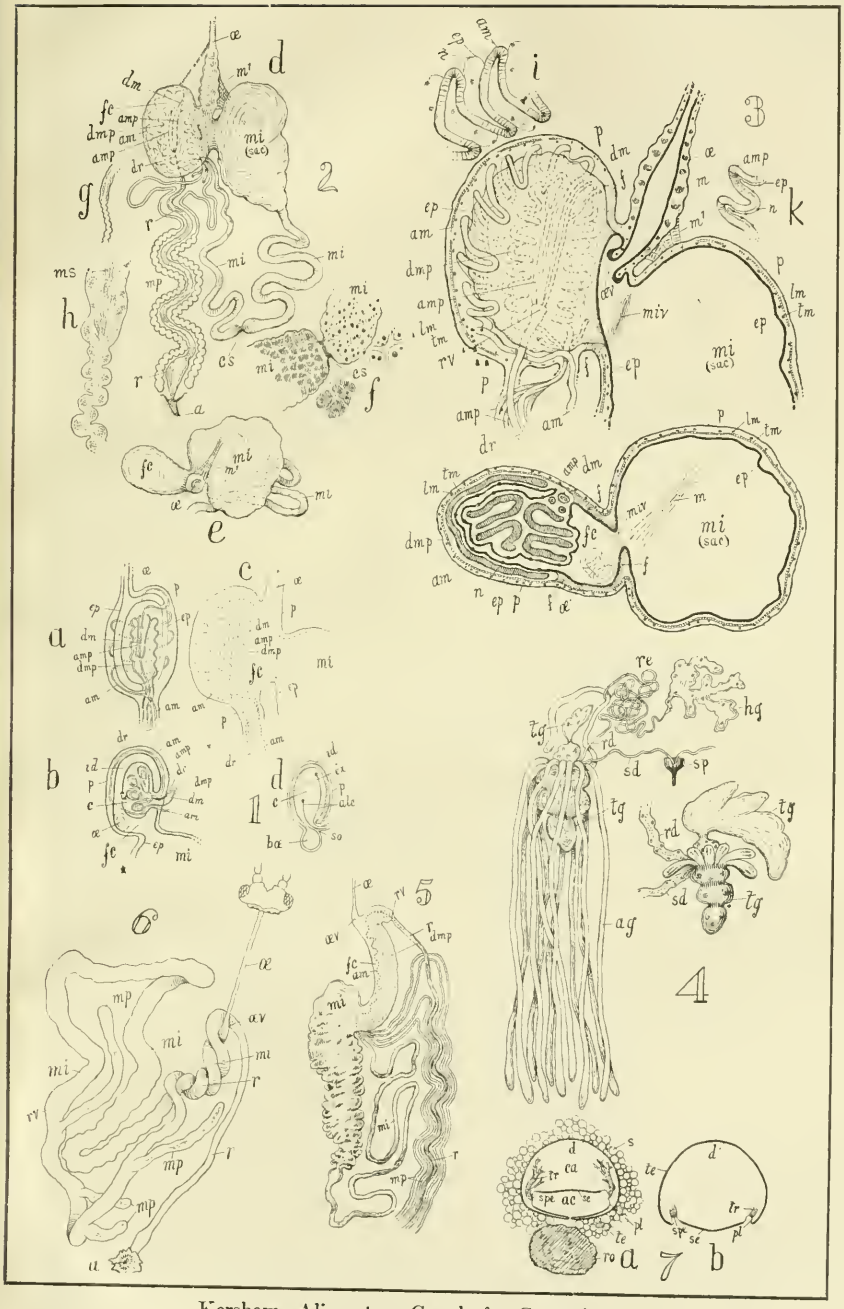

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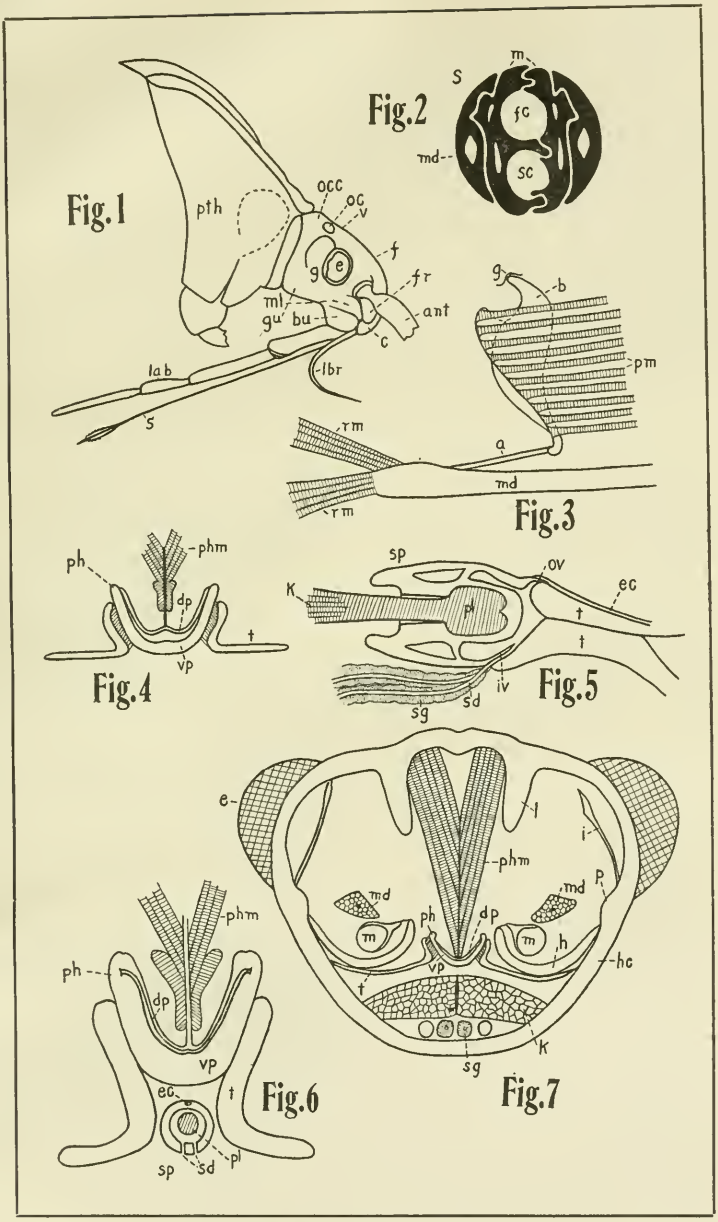

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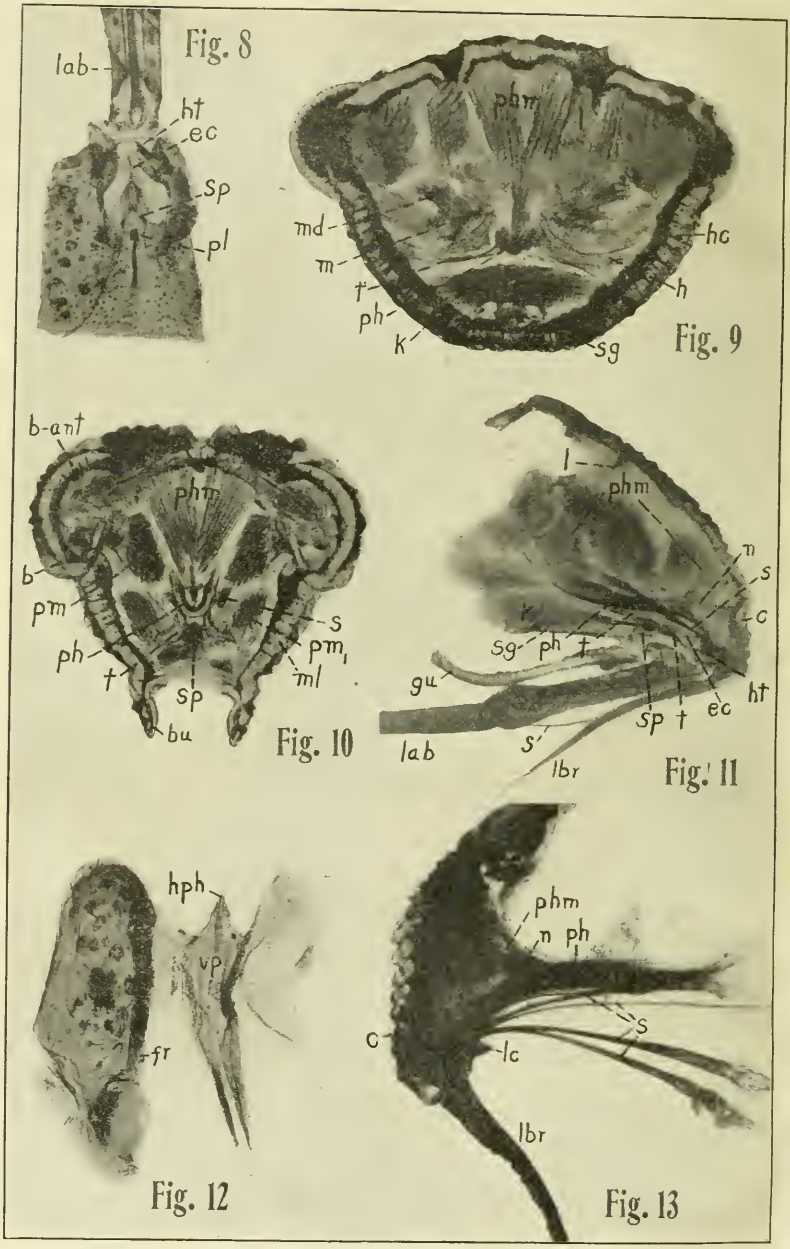

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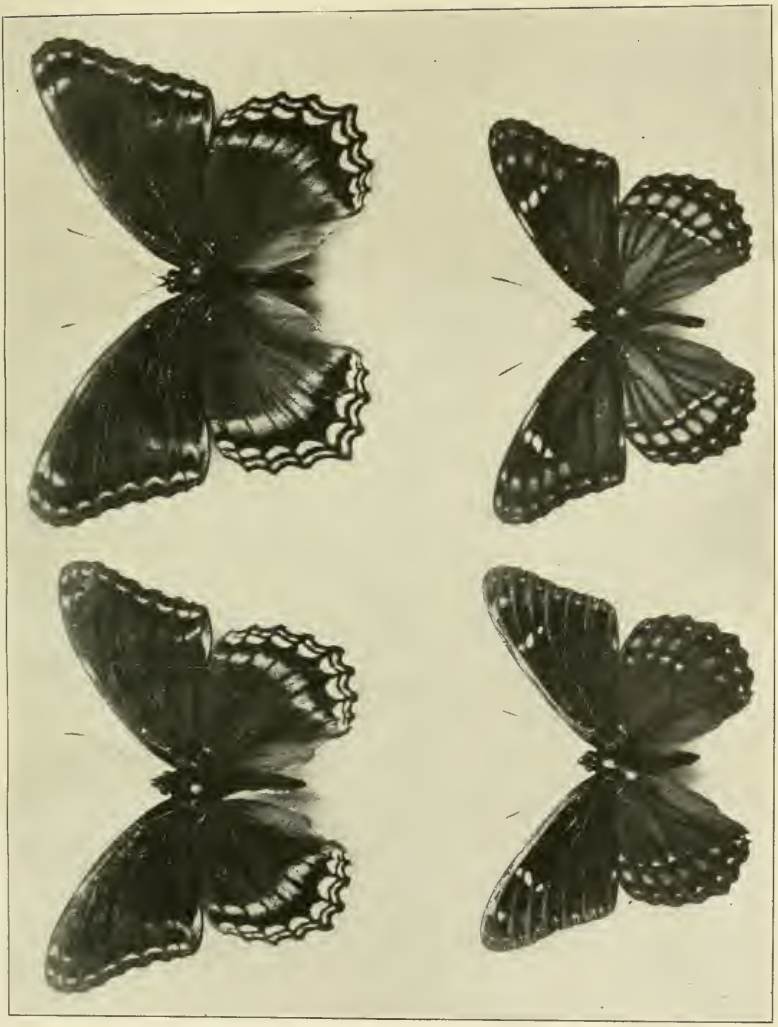

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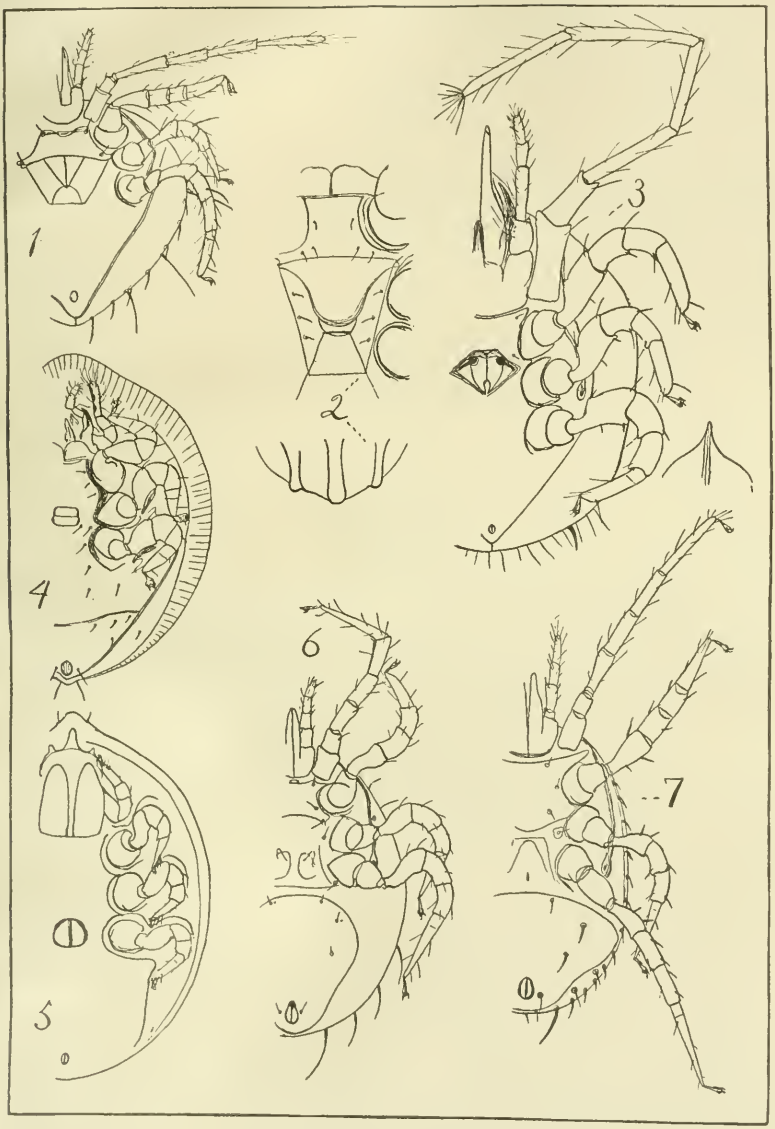

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