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A NOTE ON THE MOULTING OF THE TARANTULA. *EURYPELMA HENTZII*[1]

By Phil Rau,

St. Louis, Missouri.

A specimen of this spider was brought to me from Texas by a friend on April 15, 1922. It lived in confinement almost a year, and fed upon various insects which were placed in the cage, such as grasshoppers, *Dissosteira carolina*, cabbage butterflies, larvæ of the pipe mud-wasp, *Trypoxylon politum*, larvæ of the green June-beetle and unidentified small moths. It refused, however, to eat adult May-beetles, *Lachnosterna* sp., dung beetles, *Canthon lævis*, centipede, *Scutigera forceps*, bugs belonging to the family Pentatomidæ, and male wasps, *Polistes pallipes*. It is also possible for this species to go for long periods entirely without food. At one time when I was out of the city, a starvation period of two weeks did not seem to harm it.

On one occasion I caught it in the act of eating a fat larva of the June-bug. The spider stood high up on its legs while under its jaws it held the large mass of meat which shortly before had been the larva. Upon repeated proddings, the spider walked slowly away carrying the morsel in its mouth. Finally under provocation the spider let go and then I saw that the food had been reduced to a mushy mass. So thoroughly was it masticated that only by a small portion of the skin was I able to learn its identity. That the tarantula actually chews its prey was demonstrated in the case of the larva of the mud wasp also, but whether the spider actually eats these food masses or only sucks the juices, I do not know.

This spider lived an uneventful life, with the exception of its maneuvers of moulting. This process took place on August

[1]Identified by J. H. Emerton.

13. For two weeks previous to this date, the spider had refused all food. At eight o'clock that morning it seemed fairly lively. At 2:30 p. m. when I again tried to tempt it with food, I found it lying prostrate on the floor of the cage, with the legs stretched out flat. When I attempted to place it in preserving fluid, I found signs of life, and after watching over it for fifteen minutes I found that the spider was actually in the throes of moulting. First the carapace cracked at the sides and along the front, and fell back on the abdomen and lay there inverted. Then by bodily contortions the skin was slowly slipped off the abdomen, or rather the abdomen slowly emerged from the old skin. At this stage all of the legs, as well as the mouth-parts, were still in the old skin, and it was puzzling to me to guess just how they would be shed. Up to this time the legs had been spread in a very natural, free position, but before the abdomen had completely left the old skin I noticed that the spider was gradually raising itself up, up and up, gradually pulling itself out of the old legs, palpus and chelicera coverings. It was a beautiful process to observe. All eight legs were lifted simultaneously, and soon the spider lay helpless on its side, entirely free from the old skin, all limp and clean, and beautiful as new velvet. The entire process of moulting, from the time that the skin began to crack at the shield to the complete extrication, took twenty minutes. Fig. 1 shows the shed skin intact, just as the spider left it. C—carapace, DC—dorsal covering, v. c.—ventral covering, F—one of the fangs removed from the main portion for photographing.

The spider after moulting was very pleasing to the eye. While the carapace had the same grayish-white color, the abdomen had a beautiful covering of silvery brown hair. Some change had occurred in the color of the legs and cheliceræ, for while they had been brown, after moulting they were of a slate gray color, and remained thus without change until the death of the spider, five months later. However, three weeks after moulting it was noticeable that some of the hairs on the front legs had changed to brown. I suppose that the slate color is not a permanent character, but one that changes with age.

Another item of interest was the behavior of the dorsal groove on the carapace at that time. Under normal conditions, this seems tightly closed, but during moulting it pulsated slowly and constantly, in a way suggestive of air being pumped in. This groove is the point of attachment of the thoracic muscles.

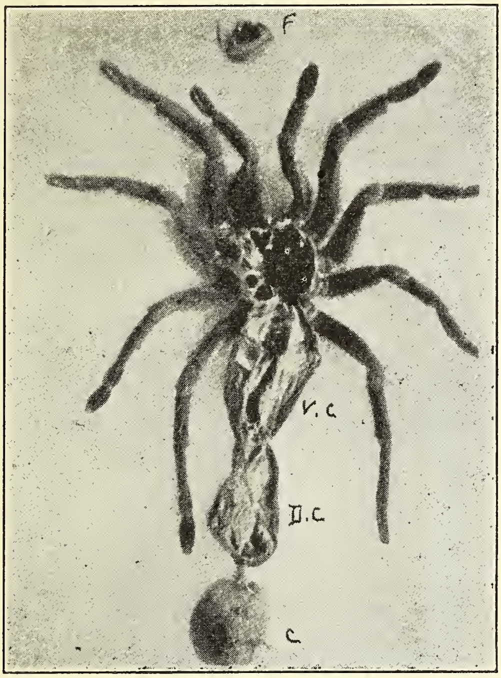


Fig. 1. Moulting Tarantula, *Eurypelma hentzii.*

The animal was probably adult after this moult, and the hazard of moulting had been surmounted.

One other item of interest should be recorded in connection with this narrative. Into this large glass box that served as its house I at one time placed a spider, *Latrodectus mactans.* This creature made a straggly web in one corner, and the tarantula often used it to climb to the top, a distance of fifteen inches. It picked its way carefully and slowly among the strands of web, carefully placing a foot here and lifting one there, as with great dexterity, it lifted its ponderous body, thread by thread, among the apparently insufficient threads.

NEW NEMESTRINIDÆ (DIPTERA) FROM RHODESIA AND NEW GUINEA

By J. Bequaert.

Department of Tropical Medicine, Harvard University Medical School.

The curious and apparently archaic family Nemestrinidæ is rather abundantly represented in South Africa, but very few species are known north of the Orange and Limpopo Rivers. It is, therefore, of much interest to record three new forms, of the genera *Prosœca* and *Stenobasipteron*, which have been recently discovered in Southern Rhodesia. I wish to thank Dr. G. Arnold, Curator of the Rhodesia Museum, Bulawayo, for the opportunity of studying these insects.

On this occasion I shall also describe a new species of *Nycterimyia*, from New Guinea, entrusted to me some time ago by the Paris Museum.

Prosoeca rhodesiensis sp. nov.

Type female from Matopos, Southern Rhodesia, April 17, 1923 (R. Stevenson Coll.); allotype male from Mt. Bambata, Matopos, Southern Rhodesia, March 23, 1924 (without collector.) Both in the collection of the Rhodesia Museum, Bulawayo.

A robust, black species, covered with dull grey tomentum; vertex and dorsum of thorax with short black hair; pilosity otherwise greyish white, very long and dense on the under side; a dorsal row of brownish black, dull spots on the middle of abdomen; legs dark clove brown. Wings of normal shape in the male, with all longitudinal veins turned up at apex; brownish along costa and gradually fading into the hyaline hind margin.

Female: Integument black, faintly clove brown at extreme lower apex of face. Antennæ, palpi, and proboscis black; the proboscis faintly clove brown toward the base. Legs very dark clove brown, the tarsi and claws almost black.

Body short pilose above, densely hairy on the ventral side. Vertex with erect, black hairs as far as the anterior ocellus; the remainder of the head with white pile, which is extremely short on the front, longer on the face and posterior orbits, and very long and dense on the cheeks. Dorsum of thorax with moderately long and rather sparse, erect, black pile; scutellum with similar, but somewhat longer, black hair, except behind its posterior margin, where the pilosity is greyish white; sides and ventral face of thorax densely covered with long, soft, greyish white hairs, which extend as a distinct white stripe above the base of the wing. Abdomen dorsally with sparse and short, erect, black pile; at the base and along the hind margins of the segments there is a mixture of greyish white hairs; ventrally the pilosity is longer, denser, greyish white, and generally appressed. Coxæ and femora with long, greyish white hairs; the pilosity of the tibiæ and tarsi extremely short, black; the longer setæ at the tip of the tibiæ also black. Except where the pilosity is very long and dense, the integument is covered with a dull, ashy grey bloom; on this, one may see, in the proper light, two wide, longitudinal stripes of blackish pruinescence in the anterior half of the thoracic dorsum, on each side of, and close to, the middle line. Brownish black pruinescence also forms a row of median, rounded, dull spots on the second, third, and fourth abdominal tergites; each spot being located close to the anterior margin. In the female I have seen, these spots are quite well marked.

Head large, flattened, much broader than the thorax; semi-elliptical in profile; kidney-shaped and nearly one and one-half times as wide as high when seen in front. Front rather narrow, widest at the insertion of the antennæ, where it measures about half the width of the eye; the inner orbits converge distinctly toward the anterior ocellus, where the front is only half as wide as at the antennæ. Vertex nearly parallel-sided. Ocellar protuberance elongate and low, but slightly separated from the inner orbits, with a transverse, saddle-shaped depression in the middle; ocelli placed in an isosceles triangle, the posterior ocelli being only about half as far from each other as from the anterior ocellus. Eyes bare. Antennæ short, small, placed on the sides of the face, close to the inner orbits; basal segment subcylindrical, slightly longer than wide, broadly truncate and somewhat emarginate at apex; second segment nearly as long as wide, about two-thirds the length of the first, squarely truncate at apex, with rounded edges; third segment flattened, pear-shaped, but little shorter than the first and second segments together, twice as long as wide, broadest in its basal half and thence gradually narrowed to the truncate and slightly sinuate apex. Style longer than the whole antenna, very sharply three-jointed; the two basal divisions thick, of about equal length, together about two-thirds the length of the third antennal segment. Front slightly convex between ocelli and antennæ. Face moderately swollen as a whole, gradually slanting from between the antennæ to the oral margin, without grooves. The lower part of the head distinctly excavated between the cheeks. Proboscis of medium length, reaching about to the hind margin of the scutellum if supposed folded beneath the thorax; rather thick, especially in its basal half; directed downward, with a slight posterior slant. Palpi short and thick, three-jointed; the second segment much the longest; the apical segment bluntly truncate. Body quite broad and heavy. Thorax distinctly broader than thick; dorsum slightly wider than long; transverse suture quite deep on the sides over one-third of the width of the dorsum, continued as a shallow, oblique depression to near the scutellum. Scutellum large, semi-elliptical, cushion-shaped, its posterior margin separated from the disk by an impressed line. Abdomen broad and flat; the four basal segments together shorter than wide; the succeeding apical segments much narrower, decreasing in width, partly retractile within one another to form a telescope-shaped ovipositor; the last segment ends in two short, slender, straight, bluntly pointed lamellæ which are wider in their basal half (in profile). Legs stout and long; the tarsi especially thick; the hind basitarsus but little narrower than the hind tibia.

Wings rather long and narrow, much longer than the body, over three times as long as wide. Costal cell and extreme base of wing, as far as the branching of the fourth and fifth longitudinal veins, infuscate, with a brownish yellow tinge; then fading into greyish in the first basal and subcostal cells and also along the costa to the tip of the wing; the remainder of the wing, including the alula, nearly hyaline. Veins dark clove brown or nearly black. Epaulet and basicosta clove brown; the epaulet with a tuft of long, appressed, white hairs. Venation of the usual *Prosœca*-type; all the longitudinal veins turned upward to end before the apex of the wing; no cross-veins between the terminal branches of the fourth vein nor between the second and the upper branch of the third; fourth posterior cell sessile.

Length not including ovipositor (to apex of tergite 4), 16.5 mm; greatest width of abdomen, 8.5 mm; length of proboscis, 8.5 mm; length of wing, 21 mm; width of wing, 6 mm.

Male. Very similar to the female in every respect. The abdomen is more clove-brown than black, but this is probably due to the fact that the greyish bloom is not as well preserved in the specimen in hand; the dull, black spots on the middle of the abdomen are present, though not quite as distinct as in the female. The vertex is just a trifle narrower at the anterior ocellus than in the female; but the ocellar triangle is still much longer than wide behind. The wings are slightly wider and a little more infuscated than in the female; but there is no prominent thickening of the costa beyond the middle and the passage to the nearly hyaline hind portion of the wing is quite gradual. The venation is as in the female.

Total length, 18.5 mm.; greatest width of abdomen, 9 mm.; length of proboscis, 9 mm.; length of wing, 23 mm.; width of wing, 6.7 mm.

This species is closely related to *Prosœca beckeri* Lichtwardt, of which it was at first thought to be but a variation. Owing to the kindness of Dr. H. Brauns, I was able to examine a male of *P. beckeri* from Montagu Pass, George, Cape Province. It differs from the Rhodesian male in several structural peculiarities which, however, could not be gathered from published accounts. Thus the wing of *P. beckeri* is, in the male, prominently widened beyond the middle, the costa being there considerably thickened (length of wing, 21 mm.; width of wing, 6.5 mm.); the wing being shaped somewhat like that of the males of *Ommatius* (Asilidæ) and of *Stenobasipteron* (Nemestrinidæ). Such a structure of the wing is not found in the male of *P. rhodesiensis*. In addition, *P. beckeri* has the wing much darker in its anterior half; the vertex is quite broad, the ocellar tubercle shorter than wide, the two posterior ocelli being somewhat farther from each other than from the anterior ocellus; the style is much shorter, being about as long as the whole antenna; there are also minor differences in the color of the pilosity, the hairs of the dorsum of the thorax being to a large extent greyish white, and there are two rows of blackish spots on the abdomen, instead of one row as in *P. rhodesiensis.*

Stenobasipteron arnoldi sp. nov.

Type female from Mt. Bambata, Matopos, Southern Rhodesia, March 23, 1924 (without collector); paratype female from the same locality and date. The type in the collection of the Rhodesia Museum; the paratype in my collection.

A slender, black species, covered with dull, cinereous tomentum; head and under side of abdomen paler; antennæ and legs dirty straw yellow; pilosity sparse; longer and denser on the ventral side; proboscis considerably longer than the body. Wings very long and narrow, with the usual venation for the genus, very slightly smoky, more infuscate in the costal cell.

Female. Integument black on upper part of head and on dorsal face of thorax and abdomen. Face pale clove-brown. Sides of thorax blackish, with indistinct, yellowish brown blotches. Ventral face of abdomen pale dirty yellow. Antennæ yellowish brown, the last division of the style black. Palpi clove-brown. Proboscis black. Legs entirely pale testaceous; claws black.

Pilosity sparse (probably but partly preserved in the two specimens seen). Vertex, front and face with very few, but long, erect, black hairs; cheeks and posterior orbits densely covered with long, greyish white pile. Dorsum of thorax and scutellum with sparse, but rather long, erect, black hairs; sides and ventral face, as also under side of scutellum, with more abundant and longer, somewhat yellowish white pilosity. Dorsally on the abdomen the hairs are mostly black, except at the extreme base; the anterior third of the second tergite has a sparse, erect, long, black pilosity; the remainder of the dorsal side bears many scattered, extremely short, slanting, rather stiff, black hairs. Ventrally the abdomen is but poorly covered; there are a few, short, appressed, somewhat silvery white hairs, which are more abundant toward the sides. Coxæ and femora with long, yellowish white pile; that of the tibiæ and tarsi extremely short, white; the under side of the tarsi with more abundant, reddish brown pile. The integument of the entire body is covered with a dull, dark ashy grey bloom; on the front and face the pruinescence has a slight yellowish tinge, and it is much paler, nearly white on the ventral side of the abdomen; there are no spots nor stripes on thorax or abdomen.

Head moderately flattened, much broader than the thorax; semi-elliptical seen from above; triangular in profile, due to the conically projecting face; kidney-shaped and nearly twice as wide as high in the middle, when seen in front. Front rather narrow, widest at the insertion of the antennæ, where it measures about half the width of the eye; inner orbits distinctly converging toward the anterior ocellus, where the front is but half as wide as at the antennæ. Sides of the vertex slightly diverging behind. Ocellar protuberance short and low, about as wide as long, but slightly separated from the inner orbits; ocelli placed in an equilateral triangle; anterior ocellus over twice the size of each of the posterior ocelli, transversely elliptical, occupying more than half the width of the front. Eyes bare. Antennæ (Fig. 1*a*) short, small, placed on the sides of the face, close to the

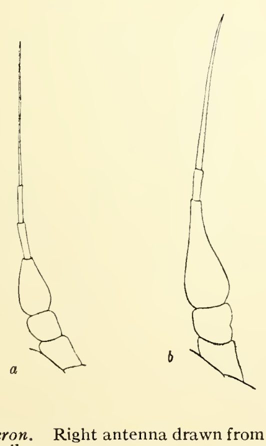


Fig. 1. *Stenobasipteron.* Right antenna drawn from the inner side: *a, S. arnoldi*; *b, S. difficile*; *c, S. gracile.*

inner orbits; basal segment cylindrical, nearly one and a half times as long as wide, squarely truncate at the apex; second segment a little over half the length of the first, about as long as wide, slightly broader at the apex which is broadly rounded off; third segment slightly flattened, short pear-shaped, but little longer than the first, and slightly over one and one-half times as long as wide, widest in its basal third and thence gradually narrowed to the straightly truncate apex. Style about twice the length of the whole antenna, sharply three-jointed; the two basal divisions together but little shorter than the second and third antennal segments; the second division somewhat longer than the first. Front very feebly convex between anterior ocellus and antennæ. Face much swollen, projecting anteriorly as a blunt cone, without grooves. The lower portion of the head is deeply and broadly excavated in the middle between the cheeks, the eyes continuing for about one-quarter their length below the oral margin. Proboscis very long and slender, reaching considerably beyond the tip of the abdomen when folded beneath the body, in which position it is in the type; while in the paratype it is directed downward with a slight anterior slant; labella thin and elongate. Palpi short and slender, distinctly three-jointed; the two apical segments much longer and of about equal length; the third truncate at apex. Body slender. Thorax about as broad as thick; dorsum distinctly longer than wide; transverse suture deep on the sides over less than one-third the width of dorsum, continued backward to near the scutellum. Scutellum large, semi-elliptical, cushion-shaped; its posterior margin faintly separated from the disk by an impressed line. Abdomen flattened dorsally, slightly wider than the thorax; the four basal segments together about as long as wide; the succeeding, apical segments much narrower, gradually decreasing in width, partly retractile as a telescope-shaped ovipositor. The last segment ends in two short, slender, straight, bluntly pointed lamellæ. Legs long and thin; femora slightly swollen toward the base, more distinctly so on the front legs; tips of tibiæ faintly thickened.

Wings very long and narrow, much longer than the body, over four times as long as wide. Costal margin nearly straight;

the posterior margin much constricted in its basal quarter, where a very narrow trace of the alula extends from the axillary excision to the base of the wing. Wings very faintly infuscate all over; more distinctly yellowish grey in the costal cell and at the extreme base. Veins dark clove-brown; epaulet and basicosta nearly black; the epaulet mostly covered with black pile. Venation of the usual type of the genus; fourth posterior cell with a long petiole at base; sixth longitudinal vein faintly undulate (more so than in *S. gracile* Lichtwardt); no "bulla" at base of second vein; axillary vein not developed beyond axillary incision.

Length not including ovipositor (to apex of tergite 4), 10.5 mm.; greatest width of abdomen, 4.5 mm.; length of proboscis, 14.5 mm.; length of wing, 14 mm.; width of wing, 3.4 mm. In the paratype these measurements are respectively 11 mm.; 5 mm.; 16 mm.; 15.5 mm.; 4 mm.

This species is allied to *Stenobasipteron gracile* Lichtwardt, also of Southern Rhodesia. From published accounts alone, it would have been difficult to point out the differences. Fortunately, I was able to compare specimens of the two species. The proboscis is decidedly longer in *S. arnoldi*, being always much over body length; the wings are narrower (in a female of *S. gracile* they measure 14 by 4 mm.) and much less infuscated; the third segment of the antennæ is decidedly shorter (in *S. gracile* it is about twice as long as wide at base and amply as long as the two basal segments together).

Stenobasipteron difficile sp. nov.

Type female from Cloudlands, 6,000 ft., Vumbu Mts., Southern Rhodesia, 6 to 17 April, 1923 (without collector). In the collection of the Rhodesia Museum.

A medium-sized, rather thickset, black species, covered with cinereous tomentum on the under side, with a black bloom on the upper side, the dorsal surface of the abdomen somewhat shiny. Antennæ and legs reddish brown; the last antennal segment and the hind tarsi darker. Pilosity moderately long and dense on head, thorax and base of abdomen, yellowish white ventrally, pale russet dorsally. Proboscis about as long as the body. Wings moderately long, uniformly smoky all over.

Female. Integument black even on the face; scutellum clove-brown. Two basal segments of antennæ reddish clove-brown; the last segment much darker; the style black. Palpi clove-brown. Proboscis brownish black. Legs reddish clove-brown; the tip of the tibiæ and the tarsi more infuscated; the hind tarsi almost black; claws black.

Pilosity rather long and abundant on head, thorax, and base of abdomen. Vertex, front, and face with numerous, erect, black hairs; cheeks and posterior orbits with a long and dense beard of greyish white pile. Dorsum of thorax and scutellum uniformly covered with loose, erect, moderately long, reddish yellow pile, more russet on the scutellum; sides and ventral face with long and dense, greyish white hairs, more yellowish below the wings. Dorsally the abdomen bears on the first and basal half of second tergites long, erect, reddish yellow pile, similar to that of the thoracic dorsum; the remainder of the dorsal side bears many scattered, short and more or less appressed, black hairs; and in addition a very sparse, long, erect, black pilosity; ventrally there is on the sides a dense, yellowish white, matted pile, but the largest part of the sternites has but a very few, short, appressed, white hairs. Coxæ and femora with long, erect, greyish white pile; the hairs on the tibiæ and tarsi very short and black. The ground color of the integument on the ventral side of thorax and abdomen is completely hidden by a dull, cinereous white bloom. On head and dorsum of thorax the pruinescence is dull and very dark brown, somewhat more cinereous on the sides of the dorsum and on certain areas of front and face. The sides of the face rather shiny. On the dorsal face of the abdomen the pruinescence is velvety black, with a somewhat oily sheen, and there are two transverse, ill-defined spots of a yellowish grey, dull bloom near the anterior margin of the second, third and fourth tergites, so that the abdomen appears quite distinctly spotted.

Head moderately flattened, much broader than the thorax; semi-elliptical seen from above; in profile the face is moderately projecting, much less so than in *S. arnoldi*; when seen in front the head is kidney-shaped and nearly twice as wide as high in the middle. Front rather wide, broadest at the insertion of the antennæ where it measures a little over half the width of the eye; inner orbits moderately converging toward the anterior ocellus, where the front is slightly over half as wide as at the antennæ. Sides of the vertex parallel. Ocellar tubercle short and flat, with a slight transverse depression below its middle, hardly separated by a notch from the inner orbits; ocelli placed in a short isosceles triangle, the posterior ocelli distinctly, but slightly, closer to each other than to the anterior ocellus; anterior ocellus larger than, though not quite twice the size of, a posterior ocellus, short elliptical, occupying a little less than one-third of the width of the front. Eyes bare. Antennæ (Fig. 1*b*) short, small, placed on the sides of the face, close to the inner orbits; basal segment cylindrical, nearly one and a half times as long as wide, squarely truncate at apex; second segment but little shorter than the first, slightly longer than wide, broadly truncate at apex; third segment much flattened, very elongate pear-shaped, over twice as long as wide, much longer than the two basal segments together, widest in its basal half and thence rather rapidly tapering to the straightly truncate, narrow apex. Style about the length of the whole antenna, only two-jointed; the basal division a little shorter than the second antennal segment. Front very feebly convex between anterior ocellus and antennæ. Face moderately swollen, forming a low, blunt cone, without grooves. The lower portion of the head is but slightly and very broadly excavated in the middle between the cheeks. Proboscis very long and slender, reaching about the tip of the abdomen when folded beneath the body; in the specimen in hand it is directed vertically downward, with the apical third curved forward; labella very thin and elongate. Palpi short and slender, three-jointed; the two apical segments much longer and of about equal length; the third obtuse at apex. Body rather thickset. Thorax about as wide as thick; dorsum nearly square; transverse suture deep on the sides over about one-third of the width of dorsum, continued backward to near the scutellum. Scutellum large, semi-elliptical, its posterior margin distinctly separated from the disk by an impressed line. Abdomen flattened dorsally, much wider than the thorax; the four basal segments together much shorter than wide; the succeeding, apical segments much narrower, gradually decreasing in width, partly retractile as a telescope-shaped ovipositor. The last segment ends in two comparatively wide, long, straight, bluntly pointed lamellæ. Legs moderately heavy; femora slightly thickened, more distinctly swollen on the forelegs.

Wings moderately long and narrow, not quite four times as long as wide. Costal margin nearly straight; the posterior margin gradually narrowed in its basal quarter, where a narrow, but distinct alula extends from the axillary excision to the base of the wing. Wings distinctly and uniformly smoky; veins dark clove-brown; the epaulets and basicosta black; the epaulet with a few black hairs. Venation of the usual type of the genus; fourth posterior cell with a short petiole at the base; sixth longitudinal vein very slightly undulate (nearly as in *arnoldi*); no "bulla" at base of second vein; axillary vein not developed beyond axillary incision.

Length not including ovipositor (to apex of tergite 4), 11.5 mm.; greatest width of abdomen, 6.5 mm.; length of proboscis, 11.5 mm.; length of wing, 15 mm.; width of wing, 4 mm.

This species is exceedingly close to *Stenobasipteron gracile* Lichtwardt, much more so than *S. arnoldi*. There are, however, a number of differences: the body is more thickset; the legs are stouter; the anterior ocellus is smaller, not quite twice the size of a posterior ocellus; the third antennal segment has a different shape; the style is only two-jointed; the sixth longitudinal vein is quite straight; the lamellæ of the ovipositor are broader, etc. It is difficult to believe that these discrepancies are all due to individual variation. Moreover, the unknown male may show further characters.

Stenobasipteron gracile Lichtwardt

The original description of this species (Deutsch. Ent. Zeitschr., 1910, p. 615) is extremely brief and is reproduced here for the benefit of Rhodesian entomologists. It is said to be so similar to *S. wiedemanni* Lichtwardt, that only the differences are noted: "Smaller and more elegant in the whole build of the body; the color is markedly paler than in *S. wiedemanni* and has a more greyish tinge; while the uniformly colored surface of the wing is also more smoky grey, showing but a narrow, yellowish-brown stripe along the anterior margin. Sharp differences are the absence of the "bulla" in the wing of both sexes; the inequality in size of the ocelli, of which the anterior one is twice as large as one of those placed at the occiput; and the bud-like, rounded shape of the male hypopygium, which is larger in proportion to the size of the animal. Length of the body, 13 mm.; of the proboscis, 10 mm.; of the wing, 15 mm." This description was drawn on a male and female from Mazoe, Mashonaland (Southern Rhodesia), in the British Museum. Later, Lichtwardt recorded as *S. gracile* two females from Barberton, Transvaal, in the South African Museum (Entom. Mitteil. Berlin, IX, 1920, p. 97). Bezzi (Ann. South African Mus., XIX, 1924, p. 171) does not appear to have seen it.

I have referred to *S. gracile* one female and two males of Cloudlands, 6,000 ft., Vumbu Mts., Southern Rhodesia, 6 to 17 April, 1923 (without collector). It must be stated, however, that the description quoted above does not allow a positive identification, so that I feel justified in giving some additional data that might help in separating *S. difficile* from what I take to be *S. gracile*.

The measurements of the three specimens before me are as follows:

Female. Length not including ovipositor (to apex of tergite 4), 11.5 mm.; greatest width of abdomen, 5.7 mm.; length of proboscis, 10.5 mm.; length of wing, 14 mm.; width of wing, 4 mm.

Males. Total length, 11 and 11 mm.; greatest width of abdomen, 5.5 and 5 mm.; length of proboscis, 11 and 10 mm. length of wing, 13 and 12.5 mm.; width of wing, 4.2 and 4 mm.

In these examples the proboscis may therefore be said to be about as long as the body. Quite apart from individual variation, a certain latitude should be allowed in judging these relative lengths, as the body length certainly changes after death, while the proboscis is to some extent retractile. Lichtwardt's measurements seem to indicate that in his specimens the proboscis was considerably shorter than the body, but this may be deceptive. It is not stated whether the measurements referred to the male or to the female, and, if the latter was measured, whether the body length includes the ovipositor.

In the Cloudlands female the integument is generally black; face, antennæ, palpi, and legs rather bright reddish clove-brown; the femora more yellowish brown. The long pilosity is greyish white ventrally; black dorsally, even on the dorsum of thorax and scutellum; on the dorsum of the abdomen there is a mixture of a few, shorter, white hairs. The pruinescence is dull all over, cinereous white ventrally, very dark greyish brown dorsally. The abdomen is not spotted. Face more prominent than in *S. difficile*, more as in *S. arnoldi*. Ocelli in a short isosceles triangle, as in *S. difficile*, but the anterior ocellus is larger, being distinctly twice the size of a posterior ocellus and occupying a little more than one third of the width of the front. The antennæ (Fig. 1*c*) are shaped much as in *S. difficile*, the third segment being slender, pear-shaped and over twice as long as wide at base; but the arista is considerably longer than the whole antenna and three-jointed. The legs are relatively thinner and the lamellæ which terminate the ovipositor narrower than in *S. difficile*. The sixth longitudinal vein is perfectly straight before the apical curve.

The two males are structurally alike and differ mainly from the female in the usual sexual peculiarities (wing much widened at anterior margin, beyond the middle; front much narrowed above so that the anterior ocellus occupies nearly the whole width; abdomen ending in a bluntly swollen hypopygium). The integument of scutellum and dorsal side of abdomen is to a large extent clove-brown. The long, black pilosity of dorsum of head and thorax shows a tendency to be russet brown, especially on the front and the scutellum. The third antennal segment is a little shorter than in the female, but still at least twice as long as wide at base.

Key to the Known Species of Stenobasipteron.

1. Wings relatively short (7.5 mm.); with a short, but chitinized axillary vein, bent at an angle in the middle. Proboscis shorter than body (4.5 mm.). Ocelli of same size, in an equilateral triangle. Front (♀) a little narrower than one eye. Small species (7 mm.) (♂ unknown). . . . .
S. minimum Bezzi.

Wings much longer than body, with the axillary vein hardly distinguishable, not chitinized, straight. Front of female much narrower than one eye. Larger species. . . . . .2.

2. First basal cell with a "bulla" near the base of second longitudinal vein.[1] Ocelli of nearly same size, in an isosceles triangle. Style of antenna three-jointed. Proboscis much longer than the body (24 mm.). Large species (17 mm.)
S. wiedemanni Lichtwardt.

First basal cell without "bulla." Medium-sized species (10.5 to 13 mm.). . . . . .3.

3. Proboscis much longer than the body (14.5 to 16 mm.). Third antennal segment short, slightly over one and one-half times as long as wide; style three-jointed, about twice the length of the antenna. Length (♀): 10.5 to 11 mm. (♂ unknown). . . . . *S. arnoldi,* sp. nov.

Proboscis about as long as the body or a little shorter. Third antennal segment over twice as long as wide at base. . . . . .4.

4. Style two-jointed, about as long as the whole antenna. Anterior ocellus (♀) occupying a little less than one-third of the width of the front. Length (♀): 11.5 mm. (♂ unknown). . . . . *S. difficile,* sp. nov.

Style three-jointed, much longer than the whole antenna. Anterior ocellus (♀) occupying a little over one-third of the width of the front. Length (♀, without ovipositor): 11.5 mm.; (♂): 11 mm. . . . .*S. gracile* Lichtwardt.

[1]This bulla probably corresponds to the minute swellings of the wing membrane known as "nygmata" in certain Neuroptera, Trichoptera, Panorpata, and Hymenoptera. They are apparently not known in other Diptera. See W. T. M. Forbes, Ent. News, XXXV, 1924, pp. 230-232, Pl. V.

Nycterimyia Lichtwardt

This extraordinary genus of flies is at present known in seven species: *N. dohrni* (Wandolleck) of Sumatra, Mafor,[1] and the Andaman Islands; *N. horni* Lichtwardt, of Northern Queensland; *N. kertészi* Lichtwardt, *N. fenestro-clatrata*, and *N. fenestro-inornata* Lichtwardt, of Formosa; *N. capensis* Bezzi, of Natal; and the New Guinean species described below. Although all species are closely allied, the distribution of the genus is extremely discontinuous.

The structure of the antennæ appears to be quite different in *N. papuana* from what has been described in other species. Of *N. dohrni*, Wandolleck (Entom. Nachricht., XXIII, 1897, p. 251) wrote originally: "Fühler 3-gliedrig, gelb, drittes Glied stabförmig mit welligen Conturen; and der Spitze trägt es ein ganz kurzes, feines, durchsichtiges Tasthärchen." Lichtwardt (Deutsch. Entom. Zeitschr., 1909, p. 647) says of the same species: "An den Fühlern ist das dritte Glied nach vorn verbreitert und mit einer stiftartigen, starken, apikalen Borste versehen." Bezzi (Ann. South African Mus., XIX, 1924, p. 169) describes the antennæ of *N. capensis* as "very short, with the third joint rounded and smaller than the preceding one; they are pale yellowish like the rather thick style, which is twice as long as the antenna." In my example of *N. papuana* (Fig. 2*a*), the third joint is extremely slender and ends in a narrower, seta-like portion, although no trace of suture could be discovered between the basal and apical sections. It agrees therefore best with Wandolleck's account, but I can not find a differentiated tactile hair at the tip. I am inclined to believe that the "thick style" in Bezzi's description of *N. capensis* represents the true third antennal segment, while his "third joint" is what I describe as the second segment.

Nycterimyia papuana sp. nov.

Type male from "Baie du Geelvink, New Guinea," (Raffray and Maindron Coll., 1878). In the collection of the Paris Museum.

[1]This appears to be a misspelling for Mapor, one of the Rhio Islands, between Singapore and Sumatra.

A medium-sized, robust, brown black species, covered with a dull, reddish brown tomentum; legs and antennæ testaceous. Pilosity brownish grey on head and thorax; abdomen almost destitute of hairs. Wings long, deeply bisinuate along the posterior margin, deep reddish brown; an elongate and narrow hyaline streak in the fourth posterior cell and faint indications of hyaline in the center of the combined first and second posterior and of the second basal cells.

Male. Integument apparently black, though the body is so uniformly covered with tomentum that it is difficult to see the proper color. Antennæ and legs pale testaceous; coxæ more brownish; apical half of claws brownish black.

Head and thorax with abundant, long, erect, brownish grey pilosity, which is denser on the ventral side. Hairs of the abdomen very short and sparse, dark grey; somewhat more abundant and longer ventrally and on the sides of the second tergite. Coxæ and femora with moderately long, reddish grey hairs; the pilosity of tibiæ and tarsi much shorter, but of the same color. Head, thorax, and abdomen are covered with a dull, cinnamon red bloom. There are no traces of dull stripes on the thorax nor of spots on the abdomen; but the second tergite bears close to its base a deep, transverse groove, which is shiny except on the middle; in addition there is a short, transverse, shiny depression on the side of each of the tergites 2, 3, 4, and 5.

Head large, much flattened, a little broader than the thorax; semi-elliptical in profile and from above; kidney-shaped and nearly twice as wide as high when seen in profile. Front narrowly triangular, widest at the antennæ where it measures about one-half the width of the eye; the inner orbits strongly converging above, where they come extremely close together for a short distance below the anterior ocellus, though not actually touching. Vertex triangular. Ocellar protuberance quite prominent, short, deeply divided behind from the inner orbits which project a considerable distance beyond the occipital margin of the vertex. Ocelli large, of about the same size, placed in an equilateral triangle. Eyes bare, composed in their upper half of large facets which gradually merge into the much smaller ommatidia of the lower half. Antennæ (Fig. 2*a*) very small, placed a short distance from the inner orbits on the upper portion of the curved slope which leads into the deep transverse depression that separates the front from the face; basal segment short, much thicker than long, widened and crescent-shaped at the apex; second segment disk-shaped, almost circular from the side, as long as the first; third segment apparently fused with the style, the whole being over twice the length of the two basal segments together, extremely slender and narrow, strongly tapering from the basal third to the apex which is very sharply pointed Front regularly curved from vertex to antennæ, below which it droops deeply into a very pronounced transverse groove sep-

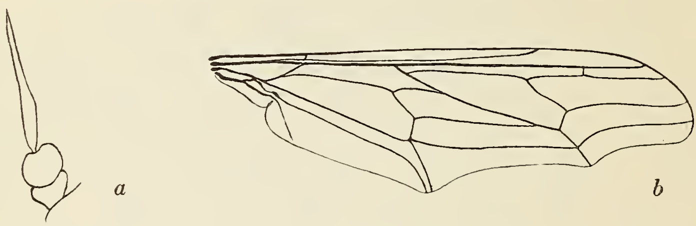


Fig. 2. *Nycterimyia papuana.* *a*, right antenna drawn from the inner side; *b*, wing.

arating the face. Face sunken between the eyes, the median, shorter portion sharply divided from the lateral areas by deep, vertical grooves. Palpi and proboscis if present, extremely reduced and not to be distinguished among the long pilosity. Body broad and thickset. Thorax about as thick as, but shorter than, wide; its dorsum distinctly convex. Transverse suture well-marked on the sides over less than one-third of the width of the dorsum, obliquely continued behind to a short distance from the scutellum. Scutellum large, nearly elliptical, its posterior margin not separated from the disk. Abdomen broad and short, but little longer than wide, quite convex dorsally and somewhat curved down at the apex. The several segments are distinctly constricted, their apical portion being slightly swollen. The first tergite is very short and mostly covered by the scutellum. Second tergite much the longest, about as long as the two following tergites together; in its basal half it is broadly grooved transversally, the bottom of the channel being shiny (except medially) and finely alutaceous; in addition there is on the posterior third of the tergite on each side a short, narrow and rather shallow, transverse groove, where the integument is also shiny and alutaceous. Third, fourth, and fifth tergites of about equal length, each on the sides, shortly behind the anterior margin, with a short, transverse shiny groove similar to that found on the hind third of the second tergite. The apical tergites are much shortened and somewhat retracted ventrally; they end in a prominent knob containing the large genitalia. Legs long and stout; the hind legs considerably longer than the anterior and middle pair. Fore and mid femora moderately and rather uniformly swollen, much thicker than the tibiæ; hind femora elongate club-shaped, distinctly swollen toward the apex. Tibiæ slender, not appreciably thickened at the apex. Tarsi short, narrower than the tibiæ.

Wings (Fig. 2*b*) long and moderately wide, over three times as long as the greatest width, which lies at the apex of the anal cell. The fore margin quite straight; the hind margin wavy between the tip of the fifth longitudinal vein and the apex of the wing: of the two, deep sinuations the proximal one, between the tips of the diagonal and fifth veins, is much the longest. Alula small, but quite well developed (as figured by Lichtwardt for *N. horni* and allies). Epaulet and basicosta clove-brown. Wings of a deep brown, opaque color, with a distinct cinnamon red tinge. A whitish hyaline, narrow, somewhat curved, longitudinal streak, with a pearly sheen, occupies the center of the fourth posterior cell (the cell immediately below the discal[1]); it begins quite a distance from the base of the cell, where it is widest, and gradually tapers to a short distance from the diagonal vein. There are no other well-marked hyaline spots; but the center of the combined first and second posterior and of the second basal cells is distinctly subhyaline and there is even a faint indication of a hyaline area in the second basal cell. The two wings are exactly alike in this respect. Veins bright reddish

[1]In *Nycterimyia* there are only four posterior cells differentiated. To make the nomenclature of the wing homologous with that of the majority of Nemestrinidae which have five posterior cells, it is necessary to assume that the first and second are fused; the cell here called the fourth then corresponds to the cell of the same name in *Prosoeca*, for example.

brown, darker basally. Venation as in the other species of the genus: in details it agrees best with Lichtwardt's figure of *N. kertészi* (Entom. Mitteil., I, 1912, Pl. II, fig. 2), but the short cross-vein which unites the first and second longitudinals is much farther removed from the long cross-vein connecting the second and third longitudinals. It should also be noted that the auxiliary vein (or subcosta), which both Wandolleck and Lichtwardt figure as uniting with the first longitudinal about the middle of the wing, really continues its course independently to near the base, as in other Nemestrinidæ; furthermore it is connected, a short distance from the base, with the costa by a humeral cross-vein, apparently overlooked by these authors. The apex of the discal cell is far removed from the base of the combined first and second posterior cells. The costa extends to beyond the tip of the fourth longitudinal vein, whence it gradually fades away to the apex of the wing.

Total length, 11 mm.; greatest width of abdomen, 5 mm.; length of wing, 13.5 mm.; greatest width of wing, 4 mm.

The species is closely allied to *N. dohrni* and *N. horni*, but differs conspicuously in the markings of the wing.

SOME SPECIES OF THE GENUS LEUCOSPIS.[1]

By Charles T. Brues.

The recent paper by Mrs. Weld[2] has encouraged me to undertake the identification of the species of Leucospis which have accumulated in my collection. Among these are several undescribed forms of which descriptions are given below, together with a few notes on known species, mainly in regard to their geographical distribution.

Leucospis birkmani sp. nov.

♀. Length 12.5 mm. Black, with yellow and ferruginous markings and strong metallic reflections. The yellow is distributed as follows: antennal scape; median round spot near anterior margin of pronotum; entire posterior and lateral margins of pronotum; transverse band on mesonotum just before base of scutellum; four anterior knees; triangular spot at base of hind femur below and band along apical two thirds of upper edge; outer two thirds of hind tibia and extreme outer tip of hind coxa. The ferruginous markings include the base of antennal scape; tegulæ; inner side of front femora and their tibiæ and tarsi; middle legs; hind coxæ, except lower surface; inner margin of hind tibiæ and their tarsi entirely; sides of propodeum; middle of first abdominal segment above and the elongate ventral plates of the abdomen. Face finely punctate reticulate; inter-antennal projection with a strong median carina; narrowest width of face clearly less than its height; malar space one-third longer than the second flagellear joint; ocelli on a distinctly elevated tubercle, the paired ones as close to one another as to the eye margin; occipital margin prominent medially, as high as the ocellar tubercle; vertex rather finely punctate, confluently so in front; occiput irregularly reticulate, aciculate only near the middle. Antennæ with the second and

[1]Contribution from the Entomological Laboratory, Bussey Institution, Harvard University, No. 246.

[2]Clara Jamieson Weld, Studies on Chalcid-flies of the Subfamily Leucospidinae, with Descriptions of New Species. Proc. U. S. Nat. Mus. Washington, vol. 61, art. 6, 43 pp., 1922.

third flagellar joints clearly longer than wide, those beyond becoming quadrate and then distinctly transverse; inner eye-margin not emarginate. Pronotum without trace of a transverse carina, its surface densely, coarsely, separately punctate, the posterior yellow band smooth, except at the sides; mesonotum more irregularly so, with some of the punctures confluent, especially at the sides; scutellum strongly convex, more shining, with well separated but shallower punctures; post-scutellum broadly crescentic, coarsely reticulate with a smooth raised margin. Propodeum medially as long as the postscutellum, with a median carina that is strongly raised behind; lateral and apical carina distinct, the surface between reticulate coarsely at the sides, very finely near the middle. First abdominal segment scarcely one-half longer than wide, narrower toward base, its dorsal grooves broad and shallow, the sides coarsely sparsely punctate at base and very densely and finely so at apex; abdomen considerably widened beyond the first segment, the fifth (the one preceding the base of the ovipositor) fully one half wider than the first; apex narrowly rounded; fourth segment with moderately coarse, well separated punctures at the base, becoming shagreened on the apical half; fifth coarsely punctured on its basal three fourths, with the apex very finely punctate or shagreened; following segments coarsely punctate, much more closely so above. Ovipositor reaching the tip of the scutellum. Propleuræ finely closely punctate below, shining and obsoletely punctate reticulate above; mesopleura, metapleura and sides of propodeum increasingly more coarsely and sparsely punctate. Hind coxæ entirely shining, finely and densely punctate on the underside; sides below confluently punctate, above with separate punctures and with a small smooth space near the upper angle; upper edge thin and sharp behind, without tooth. Hind femur shining, very minutely and closely punctate above, more coarsely and sparsely below, the punctures widely separated on the lower edge; length distinctly more than twice the width; basal tooth the largest, but not conspicuously enlarged, followed by nine much smaller ones of which those near the basal tooth and at apex are more minute than the intermediate ones. Anterior wings distinctly infuscated on their anterior half.

The metallic reflections on the body are mainly green, noticeable on the head in the antennal grooves, vertex and occiput, on the under surface of middle and hind coxæ, the apices of first, third and fifth abdominal segments and upper side of propodeum. On the face and front of vertex there are some purplish reflections.

Type from Fedor, Lee County, Texas (Birkman). The species is named for its discoverer, the Rev. G. Birkman whose collections have added greatly to the knowledge of the insect fauna of this portion of Texas.

This species will run to *L. cayennensis* Westw. in Schletterer's key (*loc. cit.*) and also in the one given by Weld (*loc. cit.*, p. 8) but differs by the punctate hind coxæ, distinctly clavate abdomen and maculate thorax. From *L. distinguenda* Schletterer, the much longer ovipositor will serve readily to distinguish it.

It is a surprise to find this large fine species undescribed and I had thought that it might be regarded as a northern subspecies of *L. cayennensis*, but there are so many striking differences that it can hardly be regarded as such.

Leucospis muiri sp. nov.

♂. Length 8 mm. Black, with yellow markings and some fulvous or ferruginous ornamentation. The lemon-yellow is as follows; scape of antenna; a broad transverse band on pronotum, curving forward and attaining the anterior margin at the sides; a streak above each tegula and a pair of discal spots on mesonotum; scutellum, except large triangular spot medially in front; transverse streak on postscutellum; large spot above on mesopleura; large triangular one above hind coxa; first abdominal segment above, except basally and at sides before apex; two transverse bands on gaster, the first quite narrow. The tegulæ and second and third joints of antennæ are ferruginous and the body spots are more or less margined with ferruginous. Legs blackish basally but yellow and ferruginous beyond; the outer tips of four anterior femora and lower edge of hind femur yellow; remainder of femora and tarsi entirely ferruginous, except that the hind femur is black along the middle and its tibia is streaked with black internally. Wings rather deeply infuscated, except at base. Face finely vertically shagreened or punctulate with a short median carina below the antennæ; malar space as long as the second flagellar joint; antennal cavities strongly transversely striate; vertex densely and rather finely punctate, the posterior ocelli but little further from one another than from the eye; occipital carina sharp medially, coming very close to the ocelli; occiput finely circularly striate-punctate and shining. Antennæ with all the flagellar joints decidedly longer than thick. Prothorax, mesonotum and scutellum rather finely and very densely but not confluently punctate, less distinctly shining than usual; pronotum with a single transverse carina medially close to the posterior margin, unusually long, three-fourths the length of the mesonotum. Scutellum oval, with the hind edge distinctly margined. Postscutellum somewhat prominent, semicircular, the crenate margin with a median emargination. Propodeum very coarsely rugose with a strong, almost dentiform median carina at each side of which lies a less prominent carinate line; sides also distinctly carinate. Pleuræ punctate, much more sparsely and coarsely so behind. Abdomen short and very strongly clavate, the gaster fully thrice as wide as the petiole. Petiole slightly wider than long, its sides parallel; highly convex above and armed below near apex with a conspicuous long slender erect tooth; abdomen shining at base, more opaque apically, closely punctate, the punctures elongated and giving the appearance of a longitudinal trend to the sculpture. Hind coxæ very finely and densely punctate below and inwardly above, the punctures becoming very sparse and the surface shining outwardly above; upper edge without tooth and broadly rounded, not sharply ridged as in most species. Hind femur very minutely punctate; with a large triangular tooth at the middle, followed by three widely spaced small teeth, followed by five or six still smaller ones becoming minute at the apex of the femur.

Type from Laloki, Papua, 1910 (F. Muir). The body is not conspicuously pubescent, although the face and abdomen are clothed with short, pale glistening hairs. There is no trace of metallic color on the body.

This species is similar to *L. mysolica* Kirby[1] in color and in the dentition of the hind femora. It may be separated readily by the sculpture of the vertex, position of ocelli, and form of the antennæ, as well as by the single carina on the pronotum.

Leucospis malabarensis sp. nov.

♀. Length 9 mm. Black, with yellow ornamentation and some ferruginous markings, without metallic color. The yellow markings are as follows; antennal scape below, oval spot on each frontal prominence, as long as the scape; two narrow transverse bands on pronotum, the anterior one curved forwards laterally and the posterior one not reaching the sides; a thin streak above the tegulæ and a pair of small spots on middle of mesonotum; narrow arcuate band on posterior margin of scutellum; large triangular mark below tegula; short streak on metapleura above; spot at upper angle of hind coxa; pair of broad lateral stripes on basal half of first abdominal segment, their bases nearer to the median line; narrow band at base of fourth segment, extending halfway down the side; broader, complete apical band on fifth and a pair of short vertical lines just before tip of abdomen; margin of hind femur, except the toothed portion; small elongate spot just above apical teeth; anterior knees, external streak on all tibiæ, not attaining the base on the hind pair. Tegulae, apices of all coxæ and more or less of fore and middle femora and of all tibiæ rufopiceous; tarsi ferruginous. Antennæ more or less rufous; wings moderately infuscated, except at base. Face microscopically reticulate punctate, external margin of antennal cavity distinctly carinate; punctures of vertex moderately large and well separated; posterior ocelli almost twice as far from each other as from the eye margin; occipital carina rather weak; occiput shining, distinctly striate only at the middle; malar space slightly longer than the second flagellar joint. First three joints of flagellum longer than wide, those beyond quadrate. Pronotum three-

[1]Journ. Linn. Soc. vol. 17, p. 69 (1882); *cf.* also Schletterer, Berliner Entom. Zeits., vol. 35, p. 236 (1890) and Enderlein Arch. f. Naturg., Jahrg. 67, vol. 1, p. 216 (1901).

fourths as long as the mesonotum, with a single carina near the posterior margin which is also quite distinctly carinate; surface shining, with the punctures rather small and closely placed; mesonotum behind and the scutellum more coarsely punctured; postscutellum short, transverse, simple. Propodeum short, finely reticulated, not carinate except for the lateral carinæ which are very distinct although not prominent. Abdomen shining, its punctures not densely placed except at apex; first segment two-fifths the length of the abdomen, twice as long as wide and distinctly broadened at the middle. Ovipositor very long, reaching well beyond the apex of the scutellum. Propleura rather weakly confluently punctate; mesopleura and metapleura more coarsely so, especially the metapleura where the punctures become confluent above. Hind coxa finely densely punctate below, very sparsely above where the surface is highly polished; upper edge very sharp behind, but without tooth. Hind femur broad, including the teeth scarcely twice as long as wide; the surface shining and finely, evenly punctate; basal tooth very small; three succeeding ones long and widely spaced, the third broadest and blunt at apex; following tooth close and somewhat shorter followed by several closely crowded ones that become rapidly shorter. Body with a moderately dense coat of short white pubescence longer on the pleuræ and especially on the sides of the propodeum.

Type from North Malabar, Southern India (A. P. Nathan).

In Schletterer's key (*loc. cit.*, p. 167) this species will run to *L. japonica* Walker from which it differs in the type of dentition of the hind femora. In general appearance and in dentition of the hind femora it is similar to *L. macrodon* Schletterer, but the first abdominal segment is much narrower and longer, the ovipositor is longer and the ocelli much more widely separated. *L. macrodon* is very variable in color, but the spot is reduced only in very dark specimens. From *L. quettaensis* Cam. and *L. nursei* Cam. both from Baluchistan, this species differs conspicuously in color and in the simple postscutellum. *L. viridissima* Enderl. from Ceylon is entirely different from the present form.

Leucospis japonica Walker.

Notes on Chalcidiæ, pt. IV, p. 56 (1871).

This species occurs also in China from whence I have a specimen collected by N. Gist Gee at Soochow.

Leucospis affinis Say.

A female from Jacumba, California (W. M. Wheeler) has the pale whitish ornamentation of *L. bicincta* Viereck. The hind femora have the basal and apical pale areas connected by a pale band below, a condition which seems never to occur in individuals from the eastern states.

THE EFFICIENCY OF BIRDS IN DESTROYING OVER-WINTERING LARVÆ OF THE EUROPEAN CORN BORER IN NEW ENGLAND.[1]

By Geo. W. Barber.

Cereal and Forage Crop Insect Investigations, Bureau of Entomology, U. S. Dept. of Agriculture.

Several years ago, not long after investigations of the European corn borer (*Pyrausta nubilalis* Hübn.) were begun by the Bureau of Entomology of the United States Department of Agriculture, it was frequently observed that cornstalks infested by the larvæ of this insect showed in the spring of the year numerous holes along the stalks, the burrows of the insect beneath these holes being empty. This was the first evidence of any appreciable feeding by birds on this insect. Such evidence of bird feeding has been found each spring and it is now possible to associate this work with the downy woodpecker (*Dryobates pubescens medianus* Swainson) a winter resident in this region. In numerous instances, this bird has been observed at close range at work on the infested standing cornstalks. Plate 1A, shows sections of cornstalks from which the larvæ of the corn borer have been removed by this bird. This type of feeding by chickadees (*Penthestes atricapillus atricapillus* Linn.) has also been observed by Mr. F. H. Mosher.

Within the last few years observations have shown another type of feeding by birds on the overwintering larvæ of this insect. This is the shredding of cornstalks illustrated in Figure 1*B*, and is the result of feeding by grackles, blackbirds, starlings and probably several other species of migrating birds. These birds arrive in the latitude of Boston, Mass., from the middle to the last of April. Such work was especially noticeable in cornstalks that had been piled in the fall or in stalks that had fallen over for one reason or another and lay on the surface of the soil. These birds have frequently been observed feeding in flocks in the spring, and in a short time they are able to gather the larvæ

[1]Contribution from the Bureau of Entomology, U. S. Department of Agriculture in cooperation with the Entomological Laboratory of the Bussey Institution, Harvard University, Bussey Institution No. 248.

from quite a number of cornstalks. They are able also to shred infested corn stubble and take the larvæ in the more exposed positions, but apparently are not able to reach the larvæ contained in standing stalks.

In the fall of 1922, when it was apparent that the birds were becoming a really important factor in the reduction of the numbers of the corn borer, experiments were undertaken to determine how extensive such feeding was. These experiments were also carried on during the winter of 1923-1924. The object of this work was to obtain information on the extent of the combined feeding by all species of birds concerned rather than the extent of feeding of any particular species, the intention being to obtain as far as possible a picture of the present importance of birds as a group in relation to this insect rather than a study of the value of any one particular species.

The studies pursued during the fall of 1922 and the spring of 1923 may be treated under two heads; first, the extent of bird feeding on the larvæ in infested cornstalks placed in the field for this purpose; second, the extent of feeding by birds on larvæ in host plants that remained undisturbed in natural positions during the winter.

In the first part of this work twenty representative locations were selected throughout the infested area of eastern New England. In each of these locations ten stakes were set upright in the soil, there being six infested stalks fastened to each of these stakes. The three following types of corn were represented at each location: pop corn, sweet corn (Golden Bantam) and field corn (Longfellow Flint). Counts of the larval population of representative stalks during the fall gave an average figure as to the number of larvæ expected from each stalk, and from this average the number of larvæ expected from each station was computed. This series of experiments was placed in the field in November, 1922, after all larval activity had ceased, and the stalks were collected in April, 1923, before larval activity had commenced in the spring. The chance of losing an appreciable number of larvæ by migration was small, since during this period the larvæ were entirely dormant and inactive. Of these twenty experiments five showed extensive feeding by birds when examined in the spring, mostly the work of woodpeckers. Of the remaining fifteen experiments one was destroyed by an over-anxious farmer, one was partly destroyed by a tractor and the others showed only very slight traces of feeding by birds or no evidence of bird feeding whatever. Table Number 1 shows the extent of bird feeding on the five experiments attacked, and the recovery of larvæ from stations that escaped noticeable bird feeding. The average recovery of larvæ from experiments not attacked by birds was 1,090 larvæ per station as compared with the average expectancy of 1,223.2. This apparent loss of 10.8 per cent of expected larvæ per station was undoubtedly

TABLE I

Extent of Feeding by Birds on Experimental Material in the Spring of 1923.

Experiments on which birds fed.

Location	Date placed 1922	Date recovered 1923	No. larvæ expected	No. larvæ recovered	Apparent loss	Per cent of larvæ credited to bird feeding based on average larval content of stalks	Per cent of larvæ credited to bird feeding based on average spring infestation of stalks that escaped attack.
Scituate, Mass.	XI-3	IV-11	906	123	783	86%	84%
Newbury, Mass.	XI-10	IV-14	1289	214	1075	83%	81%
Rockport, Mass.	XI-10	IV-12	1289	209	1080	83%	81%
Medford, Mass.	X-25	IV-9	1289	390	899	69%	66%
Arlington, Mass.	XI-2	IV-9	809	576	233	27%	12%

Experiments on which birds did not feed.

Bristol, N. H.	XI-8	IV-29	1289	1397
Framington, N.H.	XI-7	IV-29	1289	1341
Wells, Me.	XI-7	IV-28	1289	1132
Concord, Mass.	XI-4	IV-10	809	854
Falmouth, Mass.	X-31	IV-7	1289	1135
Quincy, Mass.	XI-4	IV-11	906	944
Harwich, Mass.	XI-1	IV-6	1289	909
Methuen, Mass.	XI-2	IV-14	1289	1014
Manomet, Mass.	X-30	IV-6	1289	1081
Tyngsboro, Mass.	XI 8	IV-14	1289	990
Wareham, Mass.	XI-1	IV-8	1289	1066
Wellfleet, Mass.	X-31	IV-7	1289	1106
Worcester, Mass.	X-26	IV-11	1289	1222

caused by migration of a few larvæ and the loss of small pieces of stalks containing larvæ during transportation of the cornstalks used in the experiment.

The average winter mortality in the 18 experiments listed in table No. 1 was 10.5% per cent. The average per cent of larvæ credited to bird feeding in the five stations where stalks were attacked, was 61. The average per cent of larvæ credited to bird feeding in the 18 stations recovered was 17.

The stations that showed extensive feeding by birds (Fig. 1) are all within the area most heavily infested by the European corn borer and localities where infestation has been severe for several years. Because of this fact and because no marked evidence of bird feeding was found in areas slightly infested or areas that had become heavily infested by the insect within the last year or two, it would appear that woodpeckers are aware of the fact that infested cornstalks contain desirable food only in this heavily infested area, and that in more sparsely infested regions or in areas where infestation had but recently become severe they are for the most part still unfamiliar with the existence of this source of food.

Several of the more commonly infested weeds and cultivated plants were also tied to stakes to observe possible feeding by birds on larvæ contained in such plants. These were placed with the experiment at Medford, Mass., mentioned in Table 1, where birds took 69 per cent of the larvæ from the cornstalks tied to stakes.

Of the several plants thus observed, common sunflower (*Helianthus annuus* L.), Princesplume (*Polygonum orientale* L.), *Polygonum* sp., and cocklebur (*Xanthium* spp.) showed extensive feeding by birds of the same sort attributed to woodpeckers while no evidence of such feeding was noticed in Abutilon (*Abutilon theophrasti* Medic.), pigweed (*Amaranthus retroflexus* L.), ragweed (*Ambrosia* sp.,) beggar-ticks (*Bidens* sp.), pot-marigold (*Calendula officinalis* L.), aster (*Callistephus* sp.), feather cockscomb (*Celosia argentea* L.), *Cosmos bipinnatus* Cav., *Dahlia* sp., barnyard grass (*Echinochloa crusgalli* L.), Japanese millet (*Echinochloa* sp.), Gladiolus sp., strawflower (*Helichrysum bracteatum*

Andr.), geranium (*Pelargonium hortorum*), lima bean (*Phaseolus lunatus*, L.), and African marigold (*Tagetes erecta* L.).

The field examinations of cornstalks showed much the same evidence as was obtained from the experimental work described in the preceding paragraphs. Numerous instances were found where birds had removed a high percentage of the larval content of cornstalks and such instances were found only in heavily

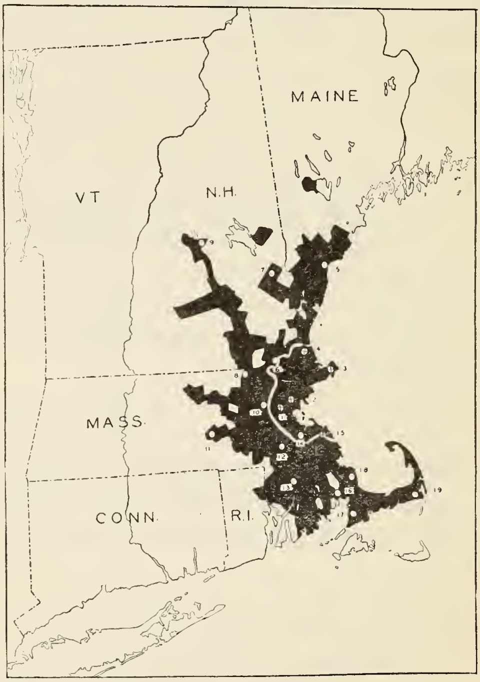


Fig. 1. Map of the area known to be infested by the European Corn Borer in New England in 1922. Circles show localities where experiments were placed in the fall of 1922; clear circles indicate that no feeding by birds was found, while circles having a cross in the center indicate localities where birds fed on larvae contained in the corn stalks of the experiment.

A white line surrounds the area known to be infested up to July 1, 1919.

1—Arlington, Mass.
2—Medford, Mass.
3—Rockport, Mass.
4—Newbury, Mass.
5—Wells, Me.
6—Methuen, Mass.
7—Farmington, N. H.
8—Tyngsboro, Mass.
9—Bristol, N. H.
10—Concord, Mass.
11—Worcester, Mass.
12—Walpole, Mass.
13—Taunton, Mass.
14—Quincy, Mass.
15—Scituate, Mass.
16—Wareham, Mass.
17—Falmouth, Mass.
18—Manomet, Mass.
19—Harwich, Mass.

infested areas and in localities that had been infested for several years. In sparsely infested localities or in areas where infestation had been severe only recently, no extensive feeding was noticed although in some cases there were traces of feeding by birds. The following table shows the condition as found in certain heavily infested fields that were found to be attacked by birds.

TABLE II.

Extent of Feeding by Birds on Material Undisturbed by Man in the Spring of 1923.

Locality	Date examined	Type of corn	Condition of corn-stalks	Size of area	Estimated number of larvæ taken by birds	Estimated per cent of larvæ taken by birds
Watertown, Mass.	IV-2-23	Sweet	Standing and broken over	1½ acres	186,480	92%
Watertown, Mass.	IV-6-23	"	standing and broken over	¼ acre	26,957	78%
Milton, Mass.	IV-13-23	"	Lying on soil	1 acre	....	30%
Marblehead, Mass.	V-3-23	"	standing and broken over	½ acre	140,946	97%
Melrose, Mass.	V-11-23	"	In piles partly burned	....	....	80%

The figures mentioned in this table were obtained by counting the number of cornstalks in the several fields, estimating the fall infestation of the stalks, and comparing this figure with the average infestation found on the date of the examination. The spring infestation per cornstalk was obtained by averaging several series of counts made in different parts of each field. In all these instances both types of bird feeding shown in figure 1 were found, the feeding attributed to woodpeckers being extensive in standing stalks and the stalks lying on the ground being shredded by other birds.

In weeds instances were found of the removal of considerable numbers of larvæ from cocklebur (*Xanthium* sp.) and barnyard grass (*Echinochloa crusgalli* L.). In one field several score of dahlia plants were found from which birds had removed nearly all the larvæ of the European corn borer that these plants had harbored.

Although birds (particularly the downy woodpecker) feed to a limited extent on the larvæ of this insect in the fall and winter, most of the feeding is done in the spring, especially the shredding of stalks lying on the ground. The experiment placed in Medford, Mass., (table 1), showed on April 9, 1923, that birds had by that time taken 65 per cent of the larvæ from the cornstalks. A similar experiment in the same locality was continued until June 27, 1923, a date when most of the insects had transformed to adults. At that time examination showed that birds had apparently taken 82 per cent of the insects from the cornstalks.

In the fall of 1923 a series of experiments much similar to those previously described was placed in the field for the purpose of obtaining information on the extent of feeding by birds on this insect. However, this time fifty stations were chosen instead of twenty as in the previous work. Each station was composed of four stakes to each of which was fastened five infested cornstalks, the larval expectancy as obtained from stalk counts being on an average of 15.5 larvæ per stalk.

These stations were so selected as to cover the entire area infested by this insect in New England and were run out in lines as straight as possible from Arlington, Mass., as a center as follows: first line comprising 12 stations in a northeasterly direction as far as Sebago, Me.; second line comprising 5 stations in a northerly direction as far as Farmington, N. H.; third line comprising 8 stations in a direction north by northwest as far as Bristol, N. H.; fourth line to the northwest as far as Gardner, Mass. comprising 3 stations; fifth line comprising 4 stations to the west as far as Worcester, Mass.; sixth line to the southeast as far as Touisset, Mass., composed of 4 stations; seventh line to the south as far as Mattapoisett, Mass., composed of 4 stations; eighth line composed of 9 stations to the southeast and extending on Cape Cod as far as Provincetown, Mass. Fig. 2.

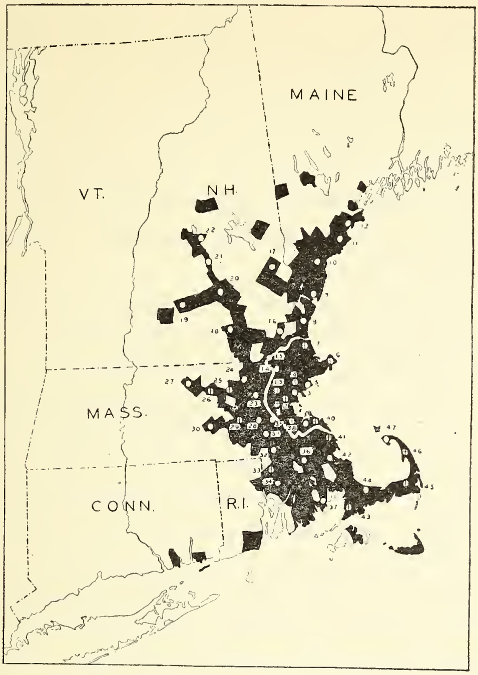


Fig. 2. Map of the area known to be infested by the European Corn Borer in New England in 1923. Circles show localities where experiments were placed in the fall of 1923;—clear circles indicate that no feeding by birds was found, while circles having a cross in the center indicate localities where birds fed on larvae contained in the corn stalks of the experiment. A white line surrounds the area known to be infested up to July 1, 1919.

1—Arlington, Mass.
2—Medford, Mass.
3—Saugus, Mass.
4—Beverly, Mass.
5—Marblehead, Mass.
6—Rockport, Mass.
7—Newbury, Mass.
8—Hampton, N. H.
9—Kittery, Me.
10—Wells, Me.
11—Biddeford, Me.
12—Scarboro, Me.
13—Woburn, Mass.
14—Andover, Mass.
15—Methuen, Mass.
16—Kingston, N. H.
17—Farmington, N. H.
18—Bedford, N. H.
19—Hillsboro, N. H.
20—Concord, N. H.
21—Franklin, N. H.
22—Bristol, N. H.
23—Concord, Mass.
24—Westford, Mass.
25—Harvard, Mass.
26—Leominster, Mass.
27—Gardiner, Mass.
28—Natick, Mass.
29—Southboro, Mass.
30—Worcester, Mass.
31—Medfield, Mass.
32—Foxboro, Mass.
33—Attleboro, Mass.
34—Touisset, Mass.
35—Needham, Mass.
36—Bridgewater, Mass.
37—Mattapoisett, Mass.
38—Milton, Mass.
39—W. Hingham, Mass.
40—Cohasset, Mass.
41—Marshfield, Mass.
42—Kingston, Mass.
43—Falmouth, Mass.
44—Sandwich, Mass.
45—Brewster, Mass.
46—Wellfleet, Mass.
47—Provincetown, Mass.

Examinations of the cornstalks of these experiments in the spring of 1924 showed that 16 of these stations exhibited feeding by birds to a noticeable extent, while the remainder showed either a mere trace of bird feeding or no evidence of such feeding at all. In Table 3 those stations that showed bird feeding are listed together with the number and percentage of larvæ apparently removed from the stalks by birds.

The average winter mortality for the 38 stations listed in table no. 3 was 4 per cent.

The average per cent of larvæ apparently taken by birds in the 16 stations that showed bird feeding (based on the average recovery per stalk in experiments not touched by birds) was 54.

The average per cent of larvæ apparently taken by birds in the total number of 47 experiments (based on the average recovery per stalk in experiments not touched by birds) was 19.

Three stations were lost or destroyed, leaving 31 that showed either a mere trace of bird feeding or none at all. The infestation in the fall was on an average 310 larvæ per station. Spring examinations of the 31 stations that showed no important feeding by birds proved that the average infestation at that time was 14.7 larvæ per stalk or 294 larvæ per station, an apparent loss per station of 16 larvæ or approximately 5 per cent of the expected larvæ. This loss is slight when it is remembered that in some stations birds apparently did take a few of the larvæ, and that the cornstalks were necessarily handled several times and were transported for considerable distances, so that small pieces were sometimes broken off and lost. These figures, however, are offered to show that the findings as regards bird feeding, shown in Table no. 3, present a fair picture of the extent to which birds fed on this material.

These results show a considerable increase in the area in which birds fed extensively, (Fig. 2 and 3) over the results obtained in the spring of 1923. This may be due to the fact that the larger number of stations provided a much more accurate test of conditions and so gave a much better picture, or it may indicate a widening field over which birds have become aware of an existing food supply. There is also a possibility of the element of chance entering to the extent that if the right species of birds found the stations, feeding would result, whereas if the experiments remained undiscovered by birds able to take larvæ from the cornstalks no evidence of feeding would be found. Whatever the reason, however, the fact of evidence of bird feeding on overwintering larvæ of this insect in cornstalks over a much more extended area during the spring of 1924 than was observed previously remains, and it is the writer's belief that birds were a more important factor in reducing the numbers of the European corn borer in the spring of 1923 than in a corresponding period in 1922, and that in the spring of 1924 they were of greater importance than in the same period in 1923; in other words, that the importance of birds as a means of natural control has been increasing each spring for the last three years.

The figures showing the percentage of larvæ taken by birds as shown in Table 3 represent the feeding up to the time that the experimental material was collected in the spring and so do not show the total amount of feeding that birds might have done had the material remained in the field a few weeks longer. As already mentioned, this same condition prevailed in the consideration of the experiments examined in the spring of 1923. It was necessary, however, to collect these experiments early in April because of a desire to examine the cornstalks before the larvæ had moved from the exact locations in the stalks in which they rested at the time the material was set out the previous fall.

It is probable also that birds were unable to remove some of the larvæ from the staked experiments because in tying cornstalks to the stakes that part of the stalks lying next to the stakes was rendered inaccessible to the birds.

In the series of experiments examined in the spring of 1924, several of the experiments that showed no feeding by birds were located in areas that had been heavily infested by the insect for several years. Noticeable among those was the experiment located in Saugus, Mass. (table 3). This experiment was placed on a farm where corn had been severely infested each year since 1919. In this instance, however, little corn was grown in 1923 because of the heavy infestation previously experienced. A second instance of this condition was found in Marblehead,

TABLE NO. 3.

Extent of Feeding by Birds on Experimental Material in the Spring of 1924.

Experiments on which birds fed.

Locality		Date Placed 1923	Date Examined 1924	Total larval expectancy	Number of larvae recovered	Apparent number of larvae taken by birds	Per cent of larvae taken by birds[1]	Per cent of larvae taken by birds.[2]
Arlington,	Mass.	11–14	4–13	310	125	185	59.6	57.4
Attleboro,	Mass.	11–28	4–11	310	81	229	73.8	72.4
Beverly,	Mass.	11–14	4–11	310	203	102	32.9	29.2
Brewster,	Mass.	11–24	4–14	310	81	229	73.8	72.4
Cohasset,	Mass.	11–20	4–11	310	201	109	35.1	31.6
Falmouth,	Mass.	11–23	4–12	310	118	192	61.9	59.8
Harvard,	Mass.	11–23	4–12	310	241	69	22.2	19.
Leominster,	Mass.	11.23	4–10	310	105	205	66.1	64.2
Marshfield,	Mass.	11–20	4–12	310	203	102	32.7	29.2
Medford,	Mass.	11–3	4–25	310	99	211	68.	66.3
Milton,	Mass.	11–23	4–12	310	131	179	57.7	55.4
Newbury,	Mass.	11–14	4–11	310	62	248	80.	78.5
Rockport,	Mass.	11–14	4–10	310	119	201	64.8	59.5
Southboro,	Mass.	11–27	4–10	310	77	233	75.1	73.4
Wellfleet,	Mass.	11–24	4–14	217	76	141	64.9	63.1
Woburn,	Mass.	11–14	4–12	310	237	73	23.5	19.3

Experiments on which birds did not feed

Andover,	Mass.	11–19	4–16	310	180	
Bridgewater,	Mass.	11–27	4–10	310	262	
Concord,	Mass.	11–16	4–12	310	256	
Foxboro,	Mass.	11–28	4–11	310	262	
Gardner,	Mass.	11–29	4–20	310	357	
Hingham,	Mass.	11–20	4–12	170	137	(partly destroyed)
Kingston,	Mass.	11–24	4–12	310	414	
Marblehead,	Mass.	11–15	4–12	310	388	
Mattapoisett,	Mass.	11–27	4–10	310	387	
Medfield,	Mass.	11–24	4–11	310	318	
Methuen,	Mass.	11–19	4–16	310	256	
Natick,	Mass.	11–23	4–10	310	346	
Needham,	Mass.	11–16	4–14	310	268	
Provincetown,	Mass.	11–24	4–14	310	325	
Sandwich,	Mass.	11–23	4–11	310	333	
Saugus,	Mass.	11–14	4–11	310	303	
Touisset,	Mass.	11–28	4–10	310	228	
Worcester,	Mass.	11–27	4–10	310	228	
Westford,	Mass.	11–15	4–12	310	357	
Biddeford,	Me.	11–22	4–14	310	328	
Kittery,	Me.	11–22	4–14	310	285	
Scarboro,	Me.	11–22	4–14	310	295	
Wells,	Me.	11–22	4–14	310	232	
Bedford,	N. H.	11–21	4–17	310	281	
Bristol,	N. H.	11–22	4–16	310	228	
Concord,	N. H.	11–21	4–16	263	203	(partly destroyed)
Farmington,	N. H.	11–21	4–16	310	340	
Franklin,	N. H.	11–21	4–16	310	181	
Hampton,	N. H.	11–22	4–14	310	366	
Hillsboro,	N. H.	11–21	4–16	310	200	
Kingston,	N. H.	11–20	4–28	310	276	

[1] Based on the average larval contents of stalks in the fall.
[2] Based on the average larval recovery at stations not attacked by birds.

Mass., where birds did not feed on the larvæ contained in the cornstalks of the experiment (table 3) although it was found in the spring of 1923 that they had removed a high per cent of the borers from a field of heavily infested cornstalks (table 2). From these instances it appears that birds might not be depended on to feed on corn borer larvæ in cornstalks in the same locality each year. On the other hand, heavily infested localities are known, noticeably Medford, Mass., where birds have fed on overwintering larvæ consistently in the springs of 1922, 1923 and 1924.

Throughout the infested area of Massachusetts there was very little corn standing in the field during the winter of 1923-1924. The condition of all the experiments was the same, therefore, in that practically no cornstalks other than the experiments were to be found by the birds and for this reason there was no influence brought to bear, as far as the extent of feeding was concerned, by proximity of the experiments to infested cornfields. Because of the general scarcity of standing corn during the winter of 1923-1924 it might appear that a condition of concentrated feeding on the experimental material might result. It does not seem that any such phenomenon took place, however, because in the experiments examined in the spring of 1924, in no case was the bird feeding found to be as extensive as on the

TABLE NO. 4.

The Extent of Bird Feeding on Experimental Material at Medford, Mass., on different dates in the Spring of 1924.

Date Examined	Number of stalks	Number of expected larvæ	Number of larvæ recovered	Apparent number taken by birds	Apparent per cent taken by birds
IV-4-24	10	155	100	55	35.5
IV-11-24	10	155	73	82	53.
IV-17-24	10	155	62	93	60.
IV-24-24	10	155	108	47	30.3
V-2-24	10	155	50	105	67.7
V-8-24	10	155	32	123	79.3
V-15-24	10	155	18	137	88.4

stalks of several cornfields examined in the spring of 1923 and listed in table 2.

When birds feed in the spring on larvæ contained in cornstalks that were piled up the previous fall and remained in such condition through the winter, an interesting phenomenon is frequently noticed. In the spring, larvæ desert the wet cornstalks in the lower parts of such a pile, migrating to the dry stalks above where conditions for transformation are much more favorable. It is on the larvæ contained in these dry stalks on the top of the pile that birds such as grackles and blackbirds feed extensively so that as the spring advances it is frequently found that few larvæ remain in the lower stalks of the pile because of the migration of the stalks above, and a few larvæ remain in the dry stocks on the top of the pile because birds have shredded the stalks and removed a high percentage of them. This condition has been found several times experimentally, and has been noticed in several localities in the field where cornstalks have passed the winter in piles.

Observations as to the extent of feeding by birds on larvæ in cornstalks standing undisturbed in the field in the spring of 1924 were possible in only a few localities, mostly in very small lots of stalks because of a law in the state of Massachusetts compelling all persons to destroy standing corn in the fall of 1923. Those found, for the most part in small back-yard gardens, often showed evidence of extensive feeding by birds. Thus a small plot of about 1,500 hills of standing corn in Wakefield, Mass., showed that birds had removed a very high percentage of the larvæ from the stalks. In various localities stubble and stalks lying on the ground were shredded and many larvæ no doubt removed. As far as these observations were possible, they coincide with the results obtained in the experimental work already described.

The question has been asked whether birds know that infested cornstalks contain larvæ or whether the feeding that they do is more in the nature of an accident. Beside the experiment at Medford, Mass., mentioned in table 3 from which birds are credited with removing 68 per cent of the larvæ a like experiment was placed in the fall of 1923, similar in every respect except that the cornstalks showed no trace whatever of infestation by the European corn borer. Spring examinations showed that whereas birds had fed extensively on larvæ in the infested stalks, there were only one or two shallow incisions that might be credited to birds in the stalks that were entirely free from infestation by this insect. These uninfested stalks were, therefore, probably examined by the birds but the experiment showed that they were soon undeceived as to the fact that these stalks, although so much like the nearby infested ones in appearance, contained no larvæ of the corn borer. Field observations have shown that birds also feed in the spring on the pupæ of this insect, the nature of the feeding being similar in every respect to that described in the case of their feeding on larvæ. In some cases portions of the pupæ remain in the burrows of the insect as if the birds were not entirely pleased with the change that its food supply had undergone.

These studies have been confined mostly to the feeding by birds on the larvæ of the European corn borer in the fall, winter and spring, at which time the insect is in overwintering quarters within the host plant, because no such extensive feeding has been observed during the growing season. Adults of the insect are active only at night, resting during the day on the under sides of leaves unless disturbed when their flight is short and low and is to the nearest cover from the seat of disturbance. The larvæ for the greater part of their lives feed hidden within the food plants, leaving their burrows infrequently except during the warmer nights of midsummer. It is known, however, that birds readily take the adult of the insect although observations seem to indicate that up to the present time they have not taken larvæ from growing plants in any noticeable numbers. On two occasions, during studies of the capabilities of flight of the moths, birds took the flying insects to such extent as to interfere seriously with the success of the experiments. It is probable, therefore, that the reason that they do not feed more extensively on the moths is not because of any distaste for them, but because of the inactivity of the moths during the hours of sunlight.

Since the larvæ of the European corn borer in the overwintering condition are nearly destitute of hairs and the skin is rather thin and sparingly chitinized, they are ideal food for birds. Furthermore, at this time of the year the body of the larva is filled with so-called fat body so that the insect becomes food of the highest value with only a small portion of waste matter. The larvæ in standing stalks, during times of heavy infestation, provide a plentiful supply of food for birds, such as woodpeckers, during the winter, provided the stalks are not completely covered with snow, at a time when other food is scarce. They also provide a source of food for migrating insectivorous birds in the spring, especially those arriving early before other insects become active and available in abundance. There is, therefore, every reason to hope that birds will take advantage of this food supply to the benefit not only of themselves, but also of man. This they may readily do, provided that they are able to locate the larvæ in the stalks, as these experiments seem to indicate they are doing more and more, and if they are able to remove the larvæ from the stalks after finding them, a feat of which not all insectivorous birds will be capable. However, there is ample evidence to indicate that their industry may help to hold the insect partially in check, or even so to reduce its numbers in some localities during the winter and spring that damage by the species may not be extensive enough to cause heavy loss to crops in such localities the following summer.

Summary.

Evidence of feeding by birds on larvæ of the European corn borer has been found each spring for several years in New England. Such work was of two distinct types; the work of woodpeckers, particularly the downy woodpecker, which drills holes into standing stalks in order to reach the overwintering larvæ of this insect; and work by grackles, blackbirds, starlings and other species which shred stalks that have fallen over and devour the hiding larvæ.

For the most part such feeding by birds has been confined to localities that have been heavily infested for several years, the extent of such feeding having been found to vary greatly, but counts have shown that in some fields of sweet corn over

90 per cent of the overwintering larvæ have been removed from the stalks.

Experiments where infested cornstalks were placed in representative localities in the infested area of New England in the fall of 1922 and 1923 were examined the following spring in each case, before larvæ had become active. These experiments were for the purpose of determining whether or not the habit of feeding on larvæ of this insect was general. The experiments examined in the spring of 1923 showed that of 18 localities the cornstalks of which were recovered in good condition, birds had fed extensively on larvæ contained in the cornstalks of 5 localities, the proportion of larvæ credited to such feeding ranging from 12 percent to 84 per cent, and averaging 61 per cent for these 5 localities and 17 per cent for the whole 18 experiments. Examined in the spring of 1924 showed that of 47 localities the cornstalks of which were recovered in good condition, birds had fed extensively on the larvæ contained in the cornstalks of 16 localities, the extent of such feeding ranging from 19 percent to 78.5 per cent. The average proportion of larvæ taken from these 16 localities was 54 per cent and the average of larvæ taken from the whole number of 47 localities was 19 per cent. The feeding, which was mostly the work of woodpeckers, was found to be over a much more extended area in the spring of 1924 than in the spring of 1923.

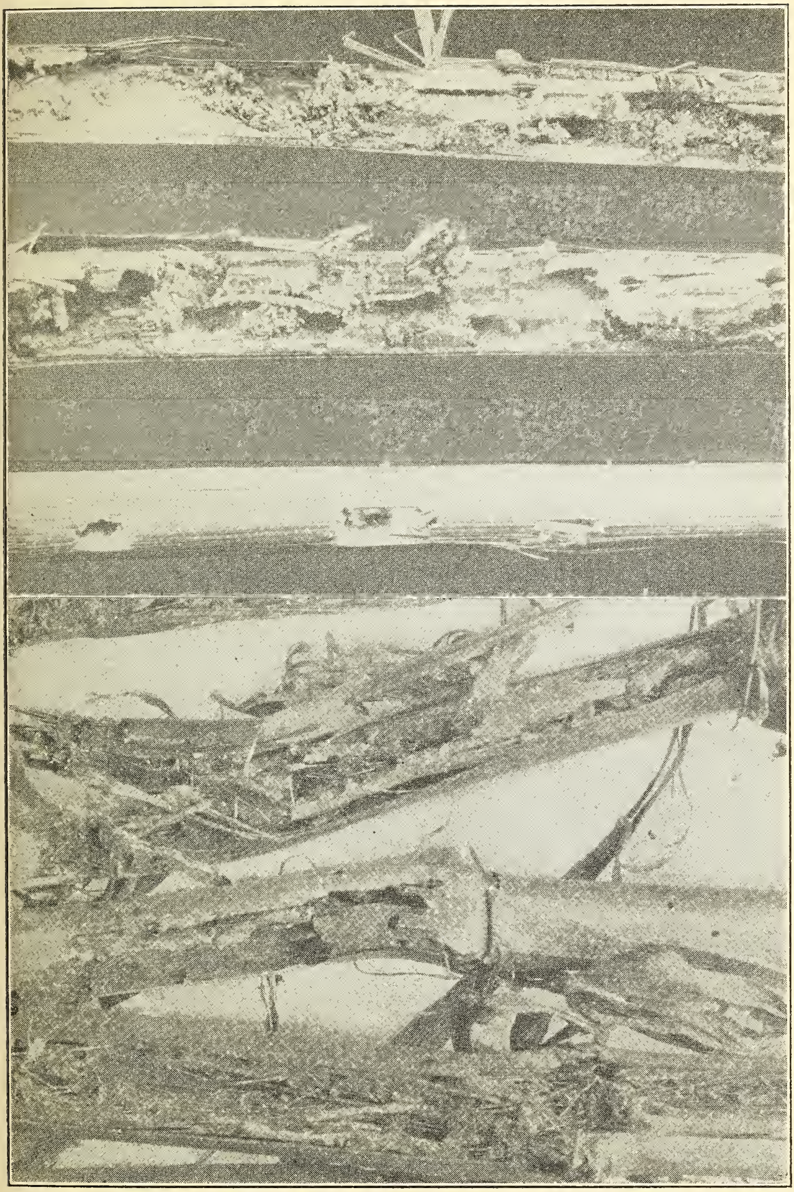
Feeding by woodpeckers on the larvæ of this insect overwintering in sunflower, (*Helianthus annuus* L.), Princesplume (*Polygonum orientale* L.), *Polygonum* sp., and cocklebur (*Xanthium* spp.) have also been found in experiments and in barnyard grass (*Echinochloa crusgalli* L.) and cocklebur (*Xanthium* spp.) in the field.

The importance of the feeding by birds on overwintering larvæ of this insect at the present time, taking the infested area in New England as a whole, is not great, but in small areas the importance of their feeding must be considerable, since these small areas are often very heavily infested. The important point at present is that birds are finding the overwintering larvæ of the corn borer, that they are feeding on them, and that such feeding seems to be on the increase.

Explanation of Plate I.

At left. The appearance of corn stalks after woodpeckers have fed on the larvæ of the European corn borer that the stalks harbored. The section to the right shows the holes made by these birds in reaching the larvæ. The two sections to the left are of one corn stalk split open to show the condition of the center of the stalk, all the larvæ having been removed by these birds.

At right. Corn stalks infested by the European corn borer showing the appearance of the stalks after birds such as blackbirds and grackles have broken them open and devoured the larvæ that they contained.



BARBER—EUROPEAN CORN BORER.

A NEW SPECIES OF THE GENUS GAURAX.

By Charles W. Johnson.

Boston Society of Natural History.

Gaurax dorri sp. nov.

Upper part of front, vertex, and occiput dull black, with short black hairs, lower part of front and orbits yellow, face whitish, oral margin above black, cheeks with a narrow black line which extends as a faint brownish line to the base of the antennæ, the latter yellow, the margin of the third joint and arista dark brown. Thorax and pleura black, shining, with two small yellow spots near the base of the scutellum, the latter yellow, the disc slightly darkened. Abdomen black, shining, the middle of the first segment and venter yellow, in the female the first segment is entirely yellow. Front coxæ black, middle and hind coxæ yellow, femora black, with bases and apices yellow, front and middle tibiæ and tarsi yellow, posterior tibiæ black, first and second joints of the posterior tarsi yellow, the others black. Halteres yellow. Wings hyaline. Length 2 mm.

Holotype and allotype, Great Pond, Mt. Desert, Maine, June 27, 1922 (C. W. Johnson). In the collection of the Boston Society of Natural History. The species is dedicated to Mr. George B. Dorr, Director of the Lafayette National Park, who has greatly aided in the work on the insect fauna of Mt. Desert.

NEW NEOTROPICAL THYSANOPTERA COLLECTED BY C. B. WILLIAMS.

By J. Douglas Hood,
University of Rochester.

The present paper brings forward several new genera and a number of new species collected by Mr. C. B. Williams during his residence in Trinidad from 1916 to 1919 and also during a short trip to the Lesser Antilles in March and April 1915.

It was originally intended by Mr. Williams that the material be worked up by us jointly; but my own delay in getting at the task until he had been appointed to the distant post of Entomologist to the Egyptian Ministry of Agriculture has made such co-operative work seem inadvisable. During his various visits to the United States the systematic position of many of the genera and species was worked out by Mr. Williams and tentative manuscript names assigned. These names have been retained except in the case of several of the more interesting and conspicuous forms which, I think, are better named after their collector in recognition of his exceedingly valuable work on this group of insects.

The following descriptions are preliminary to other papers in press or in preparation, and are published at this time in order that the worth of this splendid collection—certainly the largest ever brought out of tropical America—may not be lessened by the otherwise inevitable loss of priority in many of the names.

The holotypes, allotypes, and a portion of the paratypes have most generously been placed by Mr. Williams in my collection.

Stomatothrips septenarius sp. nov.

Female (macropterous).—Length about 1.4 mm. Color testaceous, with head, prothorax, two pterothoracic transverse bands (one near middle and one at base), abdominal segments 3-9, all tibiæ and tarsi, and antennal segments 4-9, blackish brown; antennal segments 1-3 yellowish white, 4 paler basally; fore wings pale gray-brown, with two white cross bands, one narrow and at basal sixth, the other wider and at apical seventh, intermediate brown area somewhat paler at middle; hind wings light gray with two pale bands corresponding in position with those on fore wings. Maxillary palpi *seven*-segmented, the basal segment large; labial palpi five-segmented, the basal segment short. Fore wings somewhat expanded apically, broadest at apical sixth, where they are about 1.6 times as wide as at basal fourth.

Trinidad and St. Thomas; C. B. Williams; taken by sweeping.

The seven-segmented maxillary palpi, the dark brown fourth antennal segment and the narrower fore wings distinguish this species at once from *S. flavus* Hood, the type of the genus, to which it bears a close superficial resemblance.

Frankliniella parvula sp. nov.

Female (macropterous).—Length about 1.1 mm. Color light brown, apex of abdomen darkest; femora usually brown, much paler at apex, tibiæ and tarsi pale yellowish gray; antennæ with segments 1, 2 and 4-8 brown, 2 darkest, 3 light yellowish gray, 4 and 5 paler basally; wings pale brownish, narrowly lighter along median line; ocellar pigment dull orange. Head about 1.33 times as wide as long. Segment 2 of antennæ slightly thickened on dorsum at apex and bearing 2 rather prominent dark bristles; length of antennal segments in microns: 1, 24; 2, 36; 3, 75; 4, 51; 5, 39; 6, 53; 7, 10; 8, 17.

Male (macropterous).—Pale yellow, with a gray-brown blotch at middle of abdominal tergites 2-8; wings almost clear; antennæ nearly white, segments 4 and 5 tipped with gray, 6-8 gray.

Trinidad, Grenada, Panama, and Costa Rica; C. B. Williams; on cacao, in various flowers, etc.

Easily recognized by the long third antennal segment. The prolongation of the second segment can be seen to advantage only when viewed from the side.

Frankliniella nigricauda sp. nov.

Female (macropterous).—Length about 1.4 mm. Color bright orange-yellow, head paler, abdomen shading from yellow at base to dark blackish brown or black in apical segments.

Trinidad; C. B. Williams; swept.

The coloration is unique in the genus.

Anaphothrips bicinctus sp. nov.

Female (macropterous).—Length about 1.0 mm. Color dark brown (tip of abdomen darkest), with prothorax, abdominal segments 3-6, legs and segments 3 and 4 of antennæ, abruptly pale yellow; segment 5 of antennæ gray, 6-8 dark brown; wings light gray, with a dark, brownish band across fore wings from basal fifth to near middle.

Trinidad; C. B. Williams; swept.

Very close to *A. alternans* (Bagnall), but separable by the smaller size and the coloration of the abdomen.

Astrothrips angulatus sp. nov.

Female (macropterous).—Length about 1.0 mm. Dorsal surface deeply reticulate. Color yellowish brown, with base of abdomen and sides of pterothorax darker; abdominal segments 8 and 9 with a distal gray band; antennæ yellow, with segments 1 and 2 darker and apices of segments 4, 5 and 6, and all of segment 7, brownish; fore legs yellow, the femora and tibiæ brownish at sides, especially near middle; middle and hind femora and middle tibiæ brown, yellow at either end; middle and hind tarsi and hind tibiæ yellow, the last clouded with brown in apical third; fore wings brown, with three transverse, narrow, white bands, situated at basal fifth, apical two-fifths, and extreme apex, respectively. Vertex slightly elevated but not at all produced or overhanging. Antennæ seven-segmented; segment 1 short, subcylindrical, about as broad as long; 2 the broadest in entire antenna, goblet-shaped, pedicellate; 3 slender, vasiform, pedicellate, about four times as long as wide; 4 about

0.8 as long as 3 and somewhat stouter; 5 about 0.7 as long as 4 and of the same width, oval, pedicellate; 6 equal in length to 5 but more slender, of the same form but inverted, the pedicel being apical and delimited by an oblique transverse line; 7 shorter, very slender; sense cones simple. Prothorax three-fourths as long as head. Abdomen strongly and sharply constricted beyond base of segment 2, which is the longest in entire abdomen; 10 tubular, about 0.7 as wide at base as long, divided above by a longitudinal suture.

Grenada, Guadeloupe and Trinidad; C. B. Williams; on cacao, an unidentified creeper and fustic (*Chlorophora tinctoria*).

Readily known by the seven-segmented antennæ with simple sense cones, the non-produced vertex, and the short prothorax, which is angulate at the sides.

Astrothrips constrictus sp. nov.

Female (macropterous).—Length about 1.1 mm. Dorsal surface deeply reticulate. Color yellowish brown, paler at middle of pterothorax and in last three abdominal segments; segment 10 of abdomen nearly black in apical third; antennæ yellow, with segments 1 and 2 darkened with brown, and apical three-fifths of segment 5 and all of segment 6 unevenly darkened with blackish brown; femora brown; tibiæ brown, narrowly yellow at either end; tarsi yellow; fore wings brown at base (scale darker) and with brown blotches of varying lengths scattered along veins, these blotches forming more or less distinct transverse bands at basal third and apical fourth; ring vein at extreme tip of wing dark brown. Vertex produced, overhanging the insertion of antennæ. Antennæ six-segmented; segment 1 short, subcylindrical, about as broad as long; 2 broadest in entire antenna, goblet-shaped, pedicellate; 3 slender, vasiform, pedicellate, fully five times as long as wide; 4 somewhat more than half as long as 3 and slightly stouter, subfusiform, pedicellate, with an oblique, transverse line beyond middle; 6 about one-third as long as 5, slender; sense cones slender, those on segments 3 and 4 bifurcate beyond base. Abdomen strongly and sharply constricted beyond base of segment 2, which is the longest in the entire abdomen; 10 strongly constricted at basal fourth, widened beyond, and narrowed again at apex, divided above by a longitudinal suture.

Trinidad; C. B. Williams; on *Lantana* sp.

Recognizable at once by the basal constriction of the tenth abdominal segment and the six-segmented antennæ with their Y-shaped sense cones.

Coremothrips gen. nov.

(Κορεμα, a broom; θριψ, a wood worm.)

Body and all appendages very slender, and all bristles of monstrous size, hooked and pinnatifid apically. Head with two pairs of such bristles, one interocellar and the other postocellar; prothorax with two at each of its four angles. Wings very narrow; median vein of fore wing fused with costa, the strengthened anterior margin armed with about fifteen of the usual tremendous bristles disposed in two series, one inclined forward and the other backward; fringing hairs weak and sparse. Segment 9 of abdomen with two pairs of enlarged bristles, segment 10 with one pair.

Genotype: *Coremothrips pallidus* sp. nov.

A striking genus, of undoubted affinities with *Scolothrips*, but far more extreme than even that bizarre form in the development of the bristles of the body and fore wings.

Coremothrips pallidus sp. nov.

Female (macropterous).—Length about 0.9 mm. Color uniform, pale yellowish white.

Trinidad, Panama, and St. Vincent; C. B. Williams; on leaves of cacao and avocado pear.

Plesiothrips octarthrus sp. nov.

Female (macropterous).—Length about 0.9 mm. Head, prothorax and abdomen brown, the latter darker posteriorly; pterothorax pale brownish yellow; legs pale yellow; antennæ uniform dark brown, somewhat darker than head, except segment 3 which is pale brown, with pedicel and apex pale gray; wings brown, the fore pair without pale band at base, but with an indistinct, narrow, median, pale streak. Antennæ 8-segmented; segment 3 decidedly less than twice as long as wide. Segment 10 of abdomen divided above.

Trinidad; C. B. Williams; no further data.

An undoubted *Plesiothrips*, remarkable for the distinctly eight-segmented antennæ.

Plesiothrips amblycauda sp. nov.

Female (macropterous).—Length about 1.1 mm. Color brown, head darkest, prothorax with bright crimson subhypodermal pigmentation; femora brown, the fore pair yellow at apex; tibiæ gray, fading to pale yellow apically; tarsi pale yellow; antennæ dark brown, about concolorous with head, except segment 3, which has the pedicel and apex pale gray; wings dark brown, without pale band at base. Segment 3 of antennæ more than twice as long as wide. Segment 10 of abdomen not divided above. Ovipositor extremely minute, vestigial, entirely functionless; tip of abdomen rounded, rather than conical.

Trinidad; C. B. Williams; on leaf of Arum lily.

The long third antennal segment and the undivided tenth abdominal segment, together with the dark coloration, make this a very distinct species. It is a true *Plesiothrips*, with antennæ presumably seven-segmented, though the extreme tips of both are missing in the unique type.

Merothrips cognatus sp. nov.

Female (macropterous).—Length about 1.0 mm. Very close indeed to *M. fusciceps* Hood and Williams, but with head smaller (width 0.105 mm.) and eyes larger, these prolonged on ventral surface to a point directly beneath posterior dorsal margin of head, and about equal in width to their interval; tooth on fore tibia minute.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	18	33	36	32	20	25	27	33
Width (μ)	29	27	22	23	17	17	16	13

Trinidad; C. B. Williams; on dead branch of *Lagerstrœmia* infested with bromeliads.

This species is separable from *williamsi* Priesner, described from Paraguay, by the much shorter and stouter antennal segments, particularly the fourth, which in *williamsi* is nearly twice as long as wide.

Adraneothrips gen. nov.

(*αςρανης*, feeble; *θριψ*, a wood worm.)

Allied to *Haplothrips*, but wings narrowed and parallel-sided beyond base, not constricted at middle, sparsely fringed. Body weakly chitinized. Eyes often prolonged on ventral surface of head. Terminal segment of antenna long and slender, not closely united to 7.

Genotype: *Haplothrips* (?) *tibialis* Hood. The species described by Hood and Williams as *Haplothrips* (?) *bellus* also belongs here, together with the five new species described below.

Adraneothrips simulator sp. nov.

Female (macropterous).—Length about 1.1 mm. Bicolorous; thorax and all of abdomen except tube pale yellow, with a band of bright crimson subhypodermal pigmentation along each side, broadest in pterothorax and abdominal segments 4 and 5; head and tube light brown, segments 8 and 9 of abdomen lightly shaded with brown; antennæ with most of segment 3 and base of 4 pale; tibiæ pale yellow or grayish white; femora shaded with brown. Eyes prolonged on ventral surface of head beyond their posterior dorsal margins; anterior marginal bristles of prothorax long and knobbed.

Male (macropterous).—Smaller and more slender than female.

Trinidad; C. B. Williams; "along midrib on under surface of leaves of undetermined plant."

Like *A. alternatus* in color, but with the eyes distinctly prolonged on ventral surface of head.

Adraneothrips abdominalis sp. nov.

Female (macropterous).—Length about 1.1 mm. Bicolorous; head, thorax, and abdominal segments 1 and 7-10 brown, head darkest, no subhypodermal pigmentation; antennæ with most of segment 3 and bases of 4-6 pale; segments 2-6 of abdomen pale yellow, or 6 lightly brownish; tibiæ pale yellow or grayish white; femora not, or only slightly, darker. Eyes prolonged on ventral surface of head beyond their posterior dorsal margins. Anterior marginal bristles of prothorax long and knobbed.

St. Thomas, West Indies; C. B. Williams; grass.

Easily separable by the abdominal coloration and prolonged eyes.

Adraneothrips alternatus sp. nov.

Female (macropterous).—Length about 1.1 mm. Bicolorous; head, pterothorax and abdominal segments 4 and 5 and 8-10 light brown, much darker than intervening portions and with bright crimson subhypodermal pigmentation; prothorax pale yellow, with a narrow band of crimson pigmentation along sides; legs pale; antennæ with bases of segments 3-6 pale. Head 1.1 times as long as wide; eyes not prolonged on ventral surface of head, about equal in width to their interval and nearly as long as their distance from posterior margin of head.

Male (macropterous).—Smaller and more slender than female, and usually paler in coloration; segment 8 of abdomen usually much paler than 9, often concolorous with paler portions of abdomen.

Trinidad and Panama; C. B. Williams; common on dead banana leaves, on upper side along midrib.

Adraneothrips fuscicollis sp. nov.

Female (macropterous).—Length about 1.1 mm. Bicolocous; head, prothorax, pterothorax and abdominal segments 4 and 5 and 8-10 brown, much darker than the intervening portions and with bright crimson subhypodermal pigmentation; legs pale; antennæ with most of segment 3 and bases of 4-6 pale. Head nearly as wide as long; eyes not prolonged on ventral surface of head, three-fourths as long as their distance from posterior margin of head, about two-thirds as wide as their interval.

St. Lucia, British West Indies; C. B. Williams; from miscellaneous bushes.

Adraneothrips uniformis sp. nov.

Female (macropterous).—Length about 1.1 mm. Unicolorous; pale brown, with bright crimson subhypodermal pigmentation at front and along sides of head, throughout thorax, along sides of abdomen, and in last two abdominal segments; antennæ nearly uniform brown, segment 3 paler basally; legs brown, with trochanters, tarsi, and both ends of all tibiæ, pale. Head 1.09 times as long as wide; eyes not prolonged on ventral surface of head, about equal in width to their interval and only slightly more than one half as long as their distance from posterior margin of head.

Trinidad; C. B. Williams; on dead banana leaves with *A. alternatus*.

Zygothrips speciosus sp. nov.

Male (macropterous).—Length about 1.0 mm. Color dark brown, with abdominal segments 1-6, all tibiæ and tarsi, and antennal segments 3-5, clear pale yellow, almost white; segment 2 of antennæ pale apically, 6 pale in basal half; wings nearly colorless. Postocular bristles nearly pointed. Prothorax with distinct bristles at posterior angles only, outer pair broadly dilated at tip, inner pair nearly pointed.

St. Croix, Dutch (now American) West Indies; C. B. Williams; from grass.

The only species of the genus so colored.

Hindsiana rhopalocera sp. nov.

Female (macropterous).—Length about 1.1 mm. Color yellow; head decidedly darkened with brown, particularly anteriorly; prothorax and sides of pterothorax lightly brownish; abdomen shading to pale grayish brown in segments 8 and 9; tube nearly black except for a narrow, pale, brown band at base and one of equal width at apex; legs uniform pale yellow; antennæ yellow in segments 1-3, uniform dark blackish brown beyond, segment 1 shaded with brownish basally; wings faintly yellowish at base, nearly clear beyond. Head about 1.3 times as long as wide, cheeks parallel; eyes less than one-fourth as long as head, about two-thirds as wide as their interval; postocular bristles long, broadly dilated apically; antennæ with segments 7 and 8 compactly united to form a heavy club which is twice the length of segment 6, segment 8 less than half as long as 7, which is distinctly the longest in entire antenna. Prothorax with all bristles present, subequal to or shorter than postoculars and similarly dilated; median thickening distinct. Wings of fore pair without accessory hairs; outer subbasal bristle short and pointed, others dilated, about as long as those at anterior angles of prothorax. Tube about 0.6 as long as head, less than twice as long as basal width, which is less than twice the apical; sides somewhat concave; terminal bristles more than twice the length of tube.

Guadeloupe, French West Indies; C. B. Williams; from an undetermined plant.

The structure of the last two antennal segments distinguish this species from its congeners.

Trichothrips calcaratus sp. nov.

Female (apterous).—Length about 2.3 mm. Color brownish yellow, with prothorax, pterothorax and basal three-fourths of tube darkened with brown; extreme tip of tube light gray; abdominal segments 3-8 with a dark brown transverse band on upper surface near base; antennal segments 1 and 2, and basal half of segment 3, yellow and concolorous with head, remainder of antenna dark blackish brown except for the yellowish pedicels of segments 4 and 5; hypodermal pigmentation orange, opaque. Head with two, more or less evident, setose lateral tubercles just behind eyes. Fore tibia produced at lower, inner surface of apex to form a flattened, obtuse spur which is about one-third as long as width of tibia; fore tarsus with a large, straight, acute tooth. Tube 0.75 as long as head.

Male (apterous).—Much like female, but with the two lateral tubercles just behind eyes well-developed and usually very prominent. Fore tibia with an acute, additional projection on inner surface of apex, directly above the flattened, obtuse spur; fore tarsus with the tooth longer than width of tarsus.

Trinidad; C. B. Williams; from dead branch of *Lagerstrœmia* infested with Bromeliads, and from bamboo.

The form of the head is suggestive of *T. flavicauda* Morgan. It is the only species of the genus with strongly armed fore tibiæ.

Eurythrips collaris sp. nov.

Male (macropterous).—Length about 1.1 mm. Color blackish brown with purple subhypodermal pigmentation; legs paler, mid and hind tibiæ and all tarsi, pale yellow, fore tibiæ shaded with brown. Antennæ with basal half of segment 3, basal third of 4, and basal fourth of 5 pale yellow. Vertex sharply conical. Antennæ long and slender, all segments elongated. Mouth cone long, fully attaining posterior margin of prosternum. Bristles long, knobbed; prothorax with anterior angulars wanting, all others present, anterior marginals shortest. Fore tarsus unarmed. Wings slender, sparsely fringed, 2 or 3 accessory bristles. Tube very much shorter than head.

Trinidad; C. B. Williams; from dead tree in forest.

The only species of the genus without long bristles at the anterior angles of the prothorax.

Eurythrips gracilicornis sp. nov.

Female (macropterous).—Length about 1.1 mm. General color yellow, with pterothorax and tube dark brown; head brownish yellow, shading to dark brown at sides; legs nearly uniform yellow, femora lightly shaded with brown; abdomen brownish at sides and apically; antennæ brown (excepting segment 3 which is clear yellow), segments 1 and 2 darkest, 1 paler at base, 2 paler at apex, 4-6 paler at base and apex. All segments of antennæ, excepting 1 and 2, very long and slender for the genus, 4 and 5 three times as long as wide. Mouth cone very short, broadly rounded, hardly attaining middle of prosternum. Bristles long and dilated at apex; prothorax with anterior angulars well developed and anterior marginals wanting. Fore tarsus with a long, hooked tooth. Wings brown, fore pair without accessory bristles. Tube very much shorter than head.

Trinidad; C. B. Williams; swept.

Distinguishable by the short mouth cone and tube, and the slender antennæ.

Lissothrips breviceps sp. nov.

Female (brachypterous).—Length about 0.9 mm. Color dark brown with red subhypodermal pigmentation; segments 1, 2 and 4-8 of antennæ nearly concolorous with body, 2 slightly paler, 3 light gray, much the palest in entire antenna; legs dark, tarsi slightly paler. Head hardly 0.8 as long as wide; segment 3 of antennæ conspicuously small and weak. Prothorax with all bristles present and broadly dilated at tip. Fore tarsus unarmed. Tube about 0.8 as long as head, 1.4 times as long as basal width, which is distinctly more than twice the apical.

Male (brachypterous).—Essentially like female but smaller.

Trinidad; C. B. Williams; from dead branches.

The antennal coloration, short head, and short, broad tube are distinctive.

Lissothrips pallipes sp. nov.

Female (apterous).—Length about 1.1 mm. Color shading from bright yellow in anterior half of head, through yellowish brown at sides and posterior part of head and in thorax, to nearly black in abdominal segments 5-10, tube brown in apical two-fifths; legs and antennal segments 1 and 2 bright yellow; antennæ shading from yellowish gray in segment 3 to dark brown at tip. Head about 1.1 times as long as wide. Prothorax with anterior marginal bristles wanting, anterior angulars short, midlaterals shorter than postoculars and shorter than the two pairs at the posterior angles, all bristles pointed. Fore tarsus unarmed. Tube less than 0.8 as long as head and 1.4 times as long as basal width, which is distinctly less than twice the apical.

Trinidad; C. B. Williams; from faggots and branches.

The coloration, long head and pointed bristles readily distinguish this species.

Williamsiella gen. nov.

Head and thorax very small; abdomen exceedingly large and broad. Eyes small. Antennæ 7-segmented; segment 3 very small, shorter and narrower than any of the following segments. Mouth cone long, broadly rounded at tip, fore tarsus unarmed.

Genotype: *Williamsiella bicoloripes* sp. nov.

Evidently a derivative of *Lissothrips*. Separable by the 7-segmented antennæ.

Williamsiella bicoloripes sp. nov.

Female (apterous).—Length about 0.9 mm. Color nearly uniform dark blackish brown, tube paler apically; segments 1 and 2 of antennæ and all femora decidedly paler, the femora somewhat darker in basal half or more; all tibiæ and tarsi and antennal segments 3-7 (except the pale pedicel of 3) dark blackish brown. Head wider than long; postocular bristles pointed, equal in length to head. Prothorax decidedly longer than head, with prominent pointed bristles at posterior angles only, the outer pair much longer than prothorax. Fore tarsus unarmed. Tube more than half as long as head, nearly as wide at base as long (!).

Male (apterous).—Like female in all essential respects, but smaller.

Trinidad; C. B. Williams; on faggots.

Easily known by the seven-segmented antennæ, long bristles, exceedingly short and broad tube, and the coloration of the legs and antennæ.

Plectrothrips impatiens sp. nov.

Female (macropterous).—Length about 1.7 mm. Prothorax with midlateral and anterior marginal bristles longer than postoculars. Antennal segments 3-5 each with five (!) sense cones, 6 with three.

Trinidad; C. B. Williams; on cacao leaf.

The only species of the genus with well-developed midlateral and anterior angular bristles on the prothorax, and the only one with more than three sense cones on any antennal segment.

Pristothrips gen. nov.

(πρίστις, a saw; θριψ, a wood worm.)

Head much longer than wide, cheeks with one or two strong bristles at basal third or two-fifths; eyes large, much wider than their interval, reniform as seen from above and very closely facetted; intermediate antennal segments moderately elongated, clavate, sense cones not unusually long; mouth cone slender, long and pointed. Fore femora enlarged in both sexes, always with a large subapical tooth on inner surface, sometimes with a row of small teeth basally; fore tibiæ with several (3-8 in the two known species) strong teeth on inner surface; fore tarsus with one long tooth. Wings broad, narrower apically, not constricted at middle, without venation. Tube shorter than head.

Genotype: *Pristothrips aaptus* sp. nov.

Strongly suggestive of *Acanthothrips* and its allies in the armature of the apex of the fore femur and the general details of body structure, but differing from them all in having the fore tibiæ armed with several teeth. In several respects it approaches *Machatothrips*, in which, however, the fore tibiæ are unarmed. *Ischyrothrips* and *Macrothrips* lack the subapical femoral tooth. *Eupathithrips* has the prominent femoral tooth, but the cheeks are set with large spiniferous tubercles, and the urn-shaped intermediate antennal segments are provided with exceedingly long, slender, sense cones.

Pristothrips albipunctatus sp. nov.

Male (macropterous).—Length 3.0 mm. Color dark brown, abdominal segments 3-7 each with a pair of small, snow-white, lateral spots; intermediate antennal segments yellow, irregularly mottled with brown, 4-6 with a touch of dark blackish brown at extreme base; femora brown; fore tibiæ yellow, mottled with brown, mid and hind tibiæ brown, distinctly yellowish at either end; tarsi yellow. Head about 1.8 times as long as wide, with two pairs of long, stout bristles in basal two-fifths of cheeks, the apical bristle longer. Prothorax about 0.6 as long as head; bristles at anterior angles exceedingly slender, nearly as long as prothorax, blunt; bristles at posterior angles two-thirds as long, much stouter, blunt; all other bristles wanting. Fore wings with about 30 accessory hairs; two outer subbasal bristles long and pointed, the other shorter and blunt. Fore femur with two subapical teeth on inner surface, the basal one largest and triangular; fore tibia with a row of three large, stout teeth along inner surface, the basal one paired with a fourth one standing alone in another row; fore tarsus with a very long, stout, straight tooth. Tube two-thirds as long as head, 2.5 times as long as basal width, which is fully twice the apical.

Trinidad; C. B. Williams; on bark and faggots.

Pristothrips aaptus sp. nov.

Female (macropterous).—Length 3.2 mm. Color dark brown or black, with intermediate antennal segments irregularly slightly paler; legs concolorous with body. Head about 1.9 times as long as wide, as broad across eyes as at middle, narrowed to base, with a pair of long, stout bristles at basal two-fifths of cheeks. Prothorax about 0.4 as long as head, anterior margin deeply roundly emarginate, posterior margin perfectly straight; bristles at anterior angles dilated apically, very short, shorter than those at posterior two-fifths of cheeks; one pair of bristles at posterior angles, four times as long as those at anterior angles and dilated apically; all other bristles wanting. Fore wings with about 35 accessory hairs on posterior margin; outer subbasal bristle long and pointed, others shorter, dilated at tip. Fore femora with two subapical teeth on inner surface, the basal one largest and triangular, and followed by a row of about eight smaller, spiniferous tubercles, of which the basal is decidedly the largest; fore tibiæ with a row of 7 or 8 strong teeth along inner surface, the apical one longest, the others successively shorter; fore tarsus with a longer, stout, straight tooth. Tube three-fourths as long as head, fully 2.5 times as long as basal width, which is more than twice the apical.

Trinidad; C. B. Williams; on cacao.

The more distal of the two subapical teeth on the inner surface of the fore femur could easily be overlooked in a dark specimen, or one in which the femur is not in just the right position.

Neurothrips williamsi sp. nov.

Female (macropterous).—Length about 1.9 mm. Very close to *N. magnafemoralis* (Hinds) in general structure and in color, but without the femoral tooth of that species. Tube one-half as long as head, uniform blackish brown; segment 9 of abdomen pale brown.

Panama; C. B. Williams; on faggots.

Macrophthalmothrips williamsi sp. nov.

Female (macropterous).—Length about 1.4 mm. Color yellowish white, with the space between eyes, and abdominal segments 6-10, abruptly nearly black; antennæ nearly white, with segment 2 at sides, all of 5 except pedicel, and all of 7-8 dark brown; legs nearly white, mid and hind tibiæ with a narrow ring of gray near middle; cup of tarsi dark; wings colorless; eyes bright red, a dash of brown behind each; mesothorax lightly marked with brown at sides; metathorax with a brown spot at middle of metascutum and one at each posterior angle; abdominal segments 2 and 3 each with two pairs of minute brown dots, one pair latero-dorsal, the other latero-ventral; segment 4 with the latero-ventral pair only; segments 6-10 with bright red subhypodermal pigmentation.

Trinidad; C. B. Williams; on dead branch of *Lagerstrœmia.*

A very beautiful species, as strikingly colored, perhaps, as any in the family. Named after Mr. C. B. Williams, its discoverer.

Cryptothrips gradatus sp. nov.

Female (brachypterous).—Length about 1.6 mm. Color yellow; abdomen shading from brownish yellow in segment 2 to nearly black in basal three-fifths of tube, apex of tube pale; head in front of eyes, and first two antennal segments brownish yellow; segment 3 of antennæ brown, pedicel yellowish; 4-8 dark blackish brown; legs uniform yellow. Head 1.5 times as long as wide, narrowed behind eyes and at base; eyes small, composed of a few large, separated facets; ocelli wanting; postocular and postocellar bristles subequal, knobbed; dorsum of head with a pair of pointed bristles behind postoculars. Segment 8 of antennæ conical, closely united to 7. Fore tarsi unarmed. Prothoracic bristles all present, knobbed, those at posterior angles longer than postoculars, others subequal to postoculars. Tube about 0.6 as long as head, less than twice as long as width at base, which is somewhat more than twice the apical.

Tobago, British West Indies; C. B. Williams; from grass.

A true *Cryptothrips*, allied to *C. icarus* Uzel, but readily known by the color, and the form of the last antennal segment.

Cryptothrips acuticornis sp. nov.

Female, forma macroptera.—Length about 1.6 mm. Color nearly uniform dark brown, head somewhat darker than rest of body; tarsi, fore tibiæ and articulations of legs paler, as is also the apical portion of segment 2 of the antennæ and all of segment 3 except the brown apex and a barely perceptible shading at basal two-fifths; segments 4 and 8 of antennæ uniform dark brown. Head very slightly longer than wide, roundly converging from eyes to base; vertex tumid; eyes more than one-third as long as head, slightly more than one-half as wide as their interval; ocelli small, widely separated; postocular bristles blunt but not dilated at tip; postocellars and mid-dorsal pair minute. Segment 8 of antennæ long and slender, four times as long as greatest width, not pedicellate. Fore tarsi unarmed. Wings not narrowed at middle, brownish at extreme base; fore pair with 6 or 7 accessory hairs and with only two subbasal bristles, which are blunt at apex. Prothoracic bristles all present, hardly pointed, the two pairs at posterior angles longest and subequal to postoculars. Tube 0.9 as long as head, more than twice as long as width at base, which is somewhat less than twice the apical.

Female, forma brachyptera.—Almost indistinguishable from the macropterous form save for the short wings.

Male (*brachypterous*).—Decidedly paler than female, the tube and head dark brown and the intervening portion brownish yellow, darker posteriorly. Fore tarsus armed.

St. Croix and Barbados, West Indies; C. B. Williams; from grass.

A true *Cryptothrips.* The structure of the terminal antennal segment is distinctive.

Cryptothrips connaticornis sp. nov.

Male (macropterous).—Length about 1.4 mm. Color bright yellow, with anterior part of head and all of prothorax brown; mesothorax brownish at sides and along anterior margin; abdomen lightly shaded with brown in basal three or four segments; tube yellow, tipped with gray; subhypodermal pigmentation maroon red, disposed in head, thorax and abdomen wherever they are shaded with brown and also along sides of abdomen; antennæ bright yellow in segments 1 and 2, segment 3 grayish at tip, 4 shading from yellowish gray at base to brownish gray apically, remaining segments successively darker, 5 and 6 somewhat lightened basally, 7-8 dark blackish brown; mid and hind femora yellowish gray, remainder of legs clear yellow. Body bristles expanded but not divided at apex.

Trinidad; C. B. Williams; from faggots.

Structurally almost indistinguishable from the North American *Cryptothrips junctus* Hood. The figures of that species given in the Canadian Entomologist, Vol. XLIV, p. 140, 1912, would serve almost equally well for this. The coloration, however, is utterly different.

Barythrips heterocerus sp. nov.

Female (macropterous).—Length about 2.1 mm. Color brown, head darker than thorax, abdomen shading to black in tube; legs yellow, femora and tibiæ somewhat darkened with brown, mid and hind tarsi slightly *darker*; antennæ with segments 1 and 2 about concolorous with legs, 1 darker, 2 paler at apex; 3 pale yellowish white in basal sixth, bright lemon yellow in apical two-fifths, darkly shaded with blackish brown between; 4 bright yellow in apical three-fifths, remainder darkened with brown; 5 brown basally and apically, brownish yellow at middle; 6 brown, with a yellowish tinge, particularly at middle; 7 and 8 dark blackish brown. Head 1.2 times as long as wide; cheeks slightly rounded, with three prominent bristles; segment 8 of antennæ inserted on ventral surface of apex of 7. Prothorax about 0.6 as long as head; two pairs of bristles at posterior angles moderately long and pointed, others short. Fore tarsus with a long, stout, curved tooth. Wings short, broad, nearly colorless, fore pair with 12 or 13 accessory hairs; subbasal bristles subequal, short, pointed. Tube about equal in length to head, fully 2.5 times as long as basal width and 2.3 times as wide at base as at the abruptly constricted apex.

St. Thomas, West Indies; C. B. Williams; swept from grass and in epiphytic bromeliad on tree.

Male (brachypterous).—Very much like female in color and structure, but smaller and slenderer.

I am not perfectly satisfied with the assignment of this species to *Barythrips,* but have put it here until the female of *Barythrips sculpticauda* Hood and Williams shall have been made known. Both species agree in most of the important details of structure, and furthermore have the intermediate antennal segments dark at base and pale apically—an inversion of color pattern which is unusual. The mode of insertion of the eighth antennal segment in *heterocerus* is of interest.

Pygothrips conifer sp. nov.

Female (macropterous).—Length about 1.3 mm. Brown, shading to almost black in segments 8 and 9 of abdomen; tarsi and articulations of legs paler; "tube" bright brownish orange, tipped with black; segments 1 and 2 of antennæ clear yellow, 3 yellow at extreme base, remainder of antennæ shading to dark blackish brown in last segment; wings light brown, darker at base, with a pale median streak. Head fully as wide as long; eyes about 0.4 as long as head and two-thirds as wide as their interval. Prothorax 0.6 as long as head, all bristles pointed. Wings without accessory hairs on posterior margin. Fore tarsus with a short, strong tooth. "Tube" sub-conical, fully 1.4 times as long as basal width, sides nearly straight.

Trinidad; C. B. Williams; from dead branch of *Lagerstrœmia* infested with bromeliads.

More closely allied to *metulicauda* Karny from Java, than to *rugicauda* Hood, the genotype. This and the following are the first species of their group to be recorded from the New World.

Pygothrips nigricauda sp. nov.

Female (macropterous).—Length about 1.7 mm. Color dark brown, shading to opaque coal-black in "tube" and distal half of abdomen; femora brown at base, shading to bright yellow apically; fore tibiæ yellow, shaded with brown at sides, mid and hind tibiæ darker than femora; tarsi brownish yellow; antennæ yellow in segments 1 and 2, 1 lightly shaded with darker at base; 3 yellowish brown, paler at base of pedicel and distinctly lighter in color than rest of antenna, which is nearly black. Head 1.3 times as long as wide, broadest just behind eyes, thence tapering to base, which is about 0.85 as broad; eyes about one-fourth as long as head, hardly four-fifths as wide as their interval. Prothorax slightly more than half as long as head, bristles pointed. Wings with 5-7 accessory hairs. Fore femora long, swollen, fore tarsi with a long, stout, curved tooth. "Tube" subconical, about 1.36 times as long as basal width, sides slightly arched.

Male (brachypterous).—Slenderer than female, with fore femora greatly swollen and longer than head; tarsal tooth long and curved.

Trinidad; C. B. Williams; from branches.

The long head is distinctive.

Bradythrips Hood and Williams, gen. nov.

(*βραδυς*, slow; *θριψ*, a wood worm).

Antennæ seven-segmented. Vertex of head with one pair of prominent bristles; antennal segments 3-5 decidedly longer than wide; tube much longer than head, very slender, fully ten times as long as greatest width and with four long hairs at tip.

Genotype: *Bradythrips hesperus* Hood and Williams, sp. nov.

Allied to *Urothrips* Bagnall by the 7-segmented antennæ but abundantly distinguished by the other characters given in the diagnosis.

Bradythrips hesperus Hood and Williams sp. nov.

Female (apterous).—Length about 1.8 mm. Color straw yellow, with head (except sides), pterothorax, and middle legs, brown; abdomen at sides, tip of tube, hind legs, and last antennal segment, shaded with brown or gray; bright red subhypodermal pigmentation in head, pterothorax, and along sides of abdomen.

British Guiana; C. B. Williams; at base of *Imperata caudata*.

This and the following are the first species of their superfamily to be recorded from the New World.

Stephanothrips occidentalis Hood and Williams, sp. nov.

Female (apterous).—Length about 1.4 mm. Color straw yellow, with head, prothorax, and fore femora (except apex) dark brown; tube brightened with yellow, shading to dark brown at extreme apex. Vertex of head with three pairs of long bristles, which are slightly expanded at tip, the middle pair about three-fifths as long as third antennal segment, others shorter, outer pair set close to, but at a lower level than, the other. Ninth abdominal segment about 2.6 times as long as eighth. Tube nearly 1.5 times as long as head and about 1.8 times as long as ninth abdominal segment.

St. Croix and Trinidad; C. B. Williams; from bushes.

Readily known from its congener by the characters given above.

SOME HITHERTO UNDESCRIBED HABITS OF MESKEA DYSPTERARIA GROTE.

By Richard L. Schwartz,
University of Texas, Austin, Texas.

A number of lepidopterous galls were collected during the summer of 1923 in the stems of *Abutilon incanum* while the plants were still in foliage. When opened these galls were found to contain lepidopterous larvæ of the internal borer type, naked and spotted with brown. The gall chambers were entirely free of excrement, yet there was no apparent opening of the gall. Upon careful inspection, it was discovered that there were several minute holes scattered over the gall and through these holes the tiny pellets of excrement were thrust out by the moth larvæ after discharge. Since these early galls were immature, none of them were kept.

On February 8, 1924, about thirty galls were collected from the dry stalks of another species of mallow, *Malvaviscus drummondii* near Austin. From that date on during the winter and early spring more galls were obtained until the total number collected and examined reached sixty-three. In February when the first galls were gathered, photographs were taken of the galls and caterpillars. These are shown in the accompanying figures (1a; 1b) including one case in which three larvæ were so close together that the result was a single gall. All of the galls gathered were on the stems except a single one which was attached to a leaf petiole.

Galls were broken open from time to time to observe the time of pupation and the first pupæ were found on March 24. In the galls collected in February, the caterpillars had eaten out all the tender pith of the stems, but the hard lignified outer wall of the stem was not penetrated. In all the galls which contained pupæ it was found that the larvæ had cut through the hard wall a small, round perforation large enough to allow the mature moth to emerge, but the paper-like outer membrane of the stem was intact. The sawdust accumulated by the boring of this hole was piled up in both ends of the gall, and in the upper end was also the last larval skin. The sealed aperture is undoubtedly a

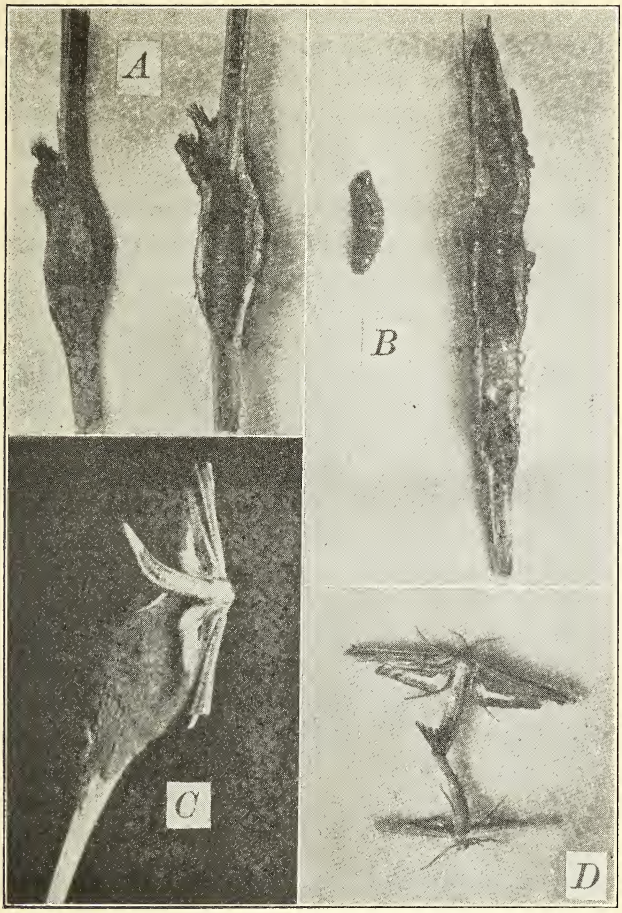


Fig. 1. *Meskea dyspteraria* Grote. *A*, galls; *B*, communal gall formed by three larvæ; *C*, moth resting on gall; *D*, moths in copula.

precaution which permits the easy emergence of the moth, and at the same time prevents the location of the place of emergence by parasites and enemies of the pupæ. The moths usually pupate upside down with the head placed directly in front of the future doorway through which the adult is to come out. The position of the pupæ in the gall is shown in figure 2b.

On the morning of March 15, 1924, the first moth emerged.

This was the female which was sketched as shown in figure 2a. No other moths came out till April 20 when two males appeared. These were killed and with the female were sent to Dr. H. G. Dyar, of the United States National Museum at Washington where Dr. Busck kindly identified them as *Meskea dyspteraria* Grote.

On April 23 three more moths emerged. One of these, was a male. The gall from which it emerged is shown in figure 1a. Photographic work was done under great difficulties as the

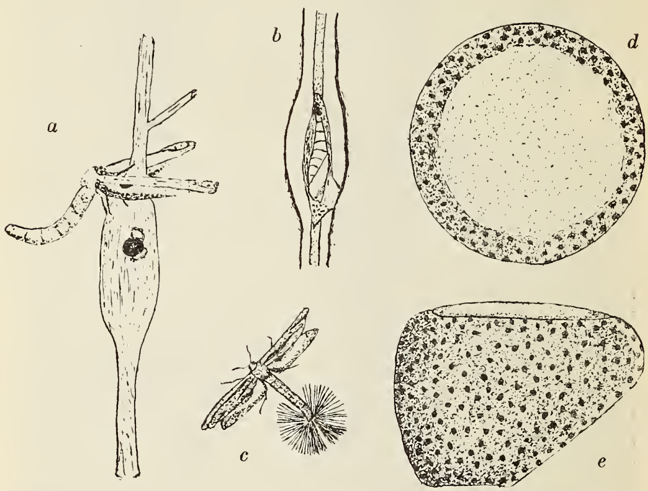


Fig. 2. *Meskea dyspteraria* Grote. *a*, Female moth resting on gall; *b*, section of gall showing position of pupa; *c*, male with copulatory tuft extended; *d*, egg seen from the top; *e*, same from side.

strong light necessary for the camera disturbed the moths. This difficulty was later overcome in studying the moths at night by the use of a red light which did not seem to disturb them. After April 23 several moths emerged each warm night, although six was the greatest number of living moths under observation at any one time. On June 6, when the author left Austin, several of the moths had not yet appeared.

Some very interesting and hitherto unobserved details of the habits of the moths in mating were observed with the use of the red light mentioned above. Soon after darkness, the male moths extrude from the posterior tip of the abdomen an elongated tuft of hairs which we may call the copulatory tuft. After this tuft is extruded, it is spread out much in the manner in which a peacock or turkey spreads its tail. This spreading is dorso-ventral as well as lateral, and the tuft is vibrated if the moth is disturbed. Though the presence of the female in the same breeding cage is not necessary to induce this behavior, there every indication that the tuft functions in mating. Unfortunately the author was not able to observe the moths at the moment in which the final stages of courtship took place and a more thorough study would probably bring out other details of interest. In this species the wings and body of the two sexes are identical in color pattern.

Attempts to photograph the copulatory tuft when spread were rather unsuccessful, as the moth usually vibrated the tuft when disturbed or retracted it entirely, and the feathery nature of the tuft makes it a hard object to photograph even when expanded. Its form is however shown in a sketch reproduced as Fig. 2c. Fig. 1d, is an excellent photograph of the contracted position of the tuft in copulation. The tuft is drawn into the abdomen and remains completely concealed in the daytime.

Several females deposited eggs after copulation; but no larvæ were hatched. The odd shaped egg is shown in top and side view in figures 2, d and 2, e.

Young galls found on Abutilon May 24, 1924 showed the first larval instar. The life history has thus been traced except the larval molts.

Meskea dyspteraria was described in 1877 by Grote in the Canadian Entomologist. A very brief and utilitarian life history is given by Heinrich in the Journal of Agricultural Research and his plates give only drawings of the head of the larvæ, the pupæ, and the arrangement of the larval setæ.

Some of the observations made in this paper are not new; but those describing the copulatory tuft in the male are, as far as I have been able to find, original and unique. I intend to make some further study of this species before discussing it in relation to other know phases of insect courtship.

In the photographic work on this paper I owe much to Reginald Painter, formerly tutor in Zoology at the University

of Texas and now assistant in entomology at the University of Ohio.

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GROWTH OF ANT MOUNDS.

By E. A. Andrews.
Johns Hopkins University.

It is well known that many sorts of ants dig into the ground and carrying out mouthfuls of earth soon make conspicuous ant hills above their subterranean dwellings. In some, these mounds are of considerable size and of long duration and serve as nests or places for rearing the young.

The best known mound builder in America is the rather large red and black *Formica exsectoides*, the mound builder of the Alleghanies, whose mounds are seen here and there in Nova Scotia, Ontario, Maine, New Hampshire, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Maryland, North Carolina, Georgia, Wisconsin, Illinois, and Colorado. As one of these mounds may contain more than a ton of earth it becomes of interest to find out how long the ants must labor to accumulate so relatively vast masses of material. One of these ants, alive, weighed 10 milligrams.

When the Rev. H. McCook in 1876 studied the "ant city" of local fame near Holidaysburg in Pennsylvania where this ant, which he called the wood or fallow ant (locally called pismires) had built up as many as 1700 mounds, he soon decided, from the occurrence of the very largest mounds on old charcoal hearths, that even the mounds that might contain 300 cu. ft. of earth were not of any very great age. He also recorded that a field plowed in September 1875 showed new mounds in February 1877; one ten inches high and 35 in diameter; a second 14 by 48. As the work of the ants stops in November these mounds were made, he thinks, in a little over one season of work. Again in a corn field in July 1876 were two new mounds, each made in two months, or one third of a working year, and each measured 8 inches in height and 18 in diameter. The first hill was, he points out, built up at the rate of 1¼ cu. ft. per annum, the second at the rate of 3, and the other two at the rate of 1. The second hill arrived in about one year to above the average size of the mounds of that region, and its very great rapidity of growth may have been due, McCook supposes, to the fact that it was not a new colony but was reconstruction work built up on the ruins of an old mound.

McCook inferred that mounds might require five to seven years to be built up to average size and that once full grown they do but hold their own. He says there were good reasons to suppose that some of the large mounds might be thirty years old but no evidence that any of them last through great periods of time. McCook states that the two small mounds in the corn field were probably new communities and it is evident that only such new communities should be considered in reckoning the initial rate of construction. Each mound is the communal work of a family and grows as the family prospers and multiplies year by year since its individuals escape death in the winter by withdrawing deep under ground in subterranean tunnels and are known to be able to live in captivity as much as seven years. The very rapidly rebuilt mounds on the other hand are the reconstruction work of prosperous communities that are able to repair even great amounts of destruction and removal of old mound materials.

As these estimates of McCook on the rate of building mounds by *Formica exsectoides* seem to be the only ones printed, the following data collected near Baltimore, Md., may be worthy of record.

Near Lutherville and Timonium in Baltimore County there is a settlement of these ants embracing some two hundred mounds and measurements made at irregular intervals from 1905-1924 furnish added means for judging of the rate of growth and the age of the mounds of these ants. During this period some of the mounds have remained in existence; either growing or remaining stationary in size; others have disintegrated; and others have sprung up anew. Parts of the entire area have been largely abandoned and other parts have been invaded by new mounds. In one of these newly populated areas measurements have been made of a certain new mound and incipient community which has grown to maturity along with many others established during this period in the same area, which was a very sterile flat of several acres covered with reddish-iron-ore earth: refuse removed formerly from large adjacent bog-iron-ore pits.

When first seen July 7, 1906, this new nest was conspicuous amidst the sparse grass as being a few handfuls of light yellow and white pellets of irregular size brought up from the subsoil and piled up amidst the grass in an irregular mass three inches high and nine inches wide. There were no holes into the middle of the nest, but large irregular entrances about the base on the N. W. S. and E. sides. It was about 150 feet from an old nest, No. 59 of a survey in 1905, that has remained there since despite the encroaching Japanese honeysuckle and has grown from five, to six by eight feet in diameter, and from 2 to nearly three feet in height, with a circumference of 22 feet. Possibly from this large nest came the female that started the incipient nest. When disturbed the ants in this incipient nest swarmed out and made a rustling sound running over the dead leaves near the nest, but they were but few in number though so rapidly covering all the surroundings.

When next measured, November 13, 1906, this incipient nest had grown to be a considerable mass fifteen inches across and four to five in height. This, then, was the maximum of the first year's building.

After another year, October 24, 1907, this incipient nest measured 6 by 18 inches. The ground on which it was placed was an artificial ridge falling off to the East as a shallow depression and from now on it became evident that the earth placed by the ants tended to spread unequally and the measurements from the ground level were greater on the east and less on the west. Thus June 12, 1908, the mass of earth was 21 inches from NW-SE, 18 inches wide from NE-SW, while the height was 8 inches from the ground on the west and 12 from the level on the east. More ants were now busy over the mound, but grass blades and small shoots of honeysuckle were growing up in the midst of the nest. In the fall of that year, October 18, the mound measured 9 by 26 inches and was quite conspicuous and well covered with small sticks and minute pebbles as well as several snail shells, flat and several millimeters in diameter; thus showing that much material had been added to the mound from surface collections, while originally all the material had come from subterranean excavations. At that date, though there had been frosts, the temperature was 70° F. and yet only one or two ants were to be seen on the mound. No more measurements were made till August 7, 1914. It had then become a noticeable mound arising abruptly on the west where bordering an obscure path apparently used by dogs, and sloping gradually on the east down to the lower level. The top of the mound was bald, covered with small sticks and stones, but about the middle height was a tonsure of straggling grass stems. The "stones" were such as ants collect; some may be 7 x 5 mm. and weigh 200 milligrams. Many ants were active about the base, but none up on the mound. A similar nest stood some 80 feet to the North. The measurements taken were: height 12 on west; 19.5 on east; diameters 42 east and west, 38.5 north and south.

September 19 of the following year, 1915, it measured 16 on west, 24 on the east, 47 north and south, and 52 east and west. It seemed well cared for with large fragments of stick and stone recently added to the dome to build up after heavy rains and was covered with very active ants. Both base and summit were bare with the sparse grass growing out from the sides of the mound in a zone.

After more than a week of rain in a cold wet season, the nest, June 18, 1916, was still in good form with much fine sand newly applied and swarming with actively working ants. The measurements were: west 16, east 21 in height; north and south 50, east and west 53 in width. Thus the mound had not gained, but apparently lost somewhat of its greatest height since the previous autumn, though its increased diameters suggested winter denudation had spread the material and as yet the loss of height had not been made good.

No measurements followed till the spring of 1919, April 13, when on account of cold few ants were working, though in the immediate neighborhood some dozen fine new nests of this same general age all showed much recent activity by presence of fresh earth over the domes. Then as in 1916, the incipient nest remained very much steeper on the north slope and still had an irregular band of green grass in tufts from half way up the slopes to near the base. The surface was covered about an inch deep with fine pellets and dried earth apparently brought out this spring to replace denudation and a series of partly open tunnels and pits across the apex of the mound showed that the interior had been exposed by destruction and removal of the roof in that part. The measurements were: west 15, east 24, north-south 58, east-west 54. Later, October 18, the grass around the middle zone had grown tall but the honeysuckle that surrounded the nest stopped abruptly, leaving a bare narrow yard all about the base of the mound, no spray or stem of the honeysuckle reaching over this dead space to the base of the mound. The bald top with bits of stick and gravel extended down farther on the southerly exposure. The measurements were: west 18, east 28, east-west 60, north-south 63. Thus in this single season of building the ant's mound had risen three to four inches and spread out five to six in diameter.

July 25, 1920 the mound swarmed with ants but some other mounds near by were more populous. The bald top of the mound was in sharp contrast to the sides grown up with tall grass amidst which the ants had accumulated heaps of earth pellets that formed a spongy mass with irregular cavities. The grass holds the sides in very steep slopes. The moat-like encircling dead space on the level without the base of the mound was strewn with dead leaves but the honeysuckle stopped short at its outer edge. The mound had grown so that the North-west-South-east diameter much exceeded the shortest diameter. The measurements were then: West 18-20, East 24-30, North-South 57, East-west 54. By the 19th of September the mound had increased somewhat; the height being West 21, East 28, the width North-south 60, East-west 57. Very few ants were to be seen at this time of year and the nest had been got into fine condition for the winter, being covered with fresh roofing of whitish clay pellets as if from deep subsoil, along with many bits of grass stems, one to one and a half inches long, dispersed through with scattered black, dried, excreta of some large caterpillar. At the end of its fifteenth year the mound was rather imposing, being 16 feet about the base, with abrupt slope on the north 30 inches up the steep to the summit, and 48 from the summit down to the ground to the South, while the west slope was 33 and the east 44 inches from summit to ground level.

August 21, 1921, the mound was in fine condition with newly capped dome, but owing to cool weather and time of day, 6.30 p. m., but few ants were slowly going over the dome and about the neighborhood of the nest. The measurements were: West 21, East 30, North-south 72, and East-west 72. The greatest North-west-South-east diameter was 76 inches. The surface distances over the top were: East-west 82, North-south 85 and greatest North-west, South-east 88. The circumference of base was 18 feet. In general appearance the mound presented a high state of differentiation. The surrounding bare space or moat strewn with dead leaves and twigs of vine that stops in growth at its outer edge, makes more striking the sudden rise of the mound from the level of the ground. The lower parts of the slopes of the mound are covered with talus of loose mouthfuls of earth rolled down from upper levels. Higher up is a faint zone of scattered grass, and still higher up a higher zone of still more sparse grass. The rounded dome is free from grass and covered with fresh light-colored subsoil and bits of dead twigs deposited to form a sort of rudely thatched roof. Near the summit of the north a minute crater seemed possibly still open to the interior. The north face remains much the steepest and the summit is nearer the north and far from the southerly limits of the mound. At this period of great development of the mound a new incipient nest was being constructed 42 inches to the North-west from the adult mound and if this may be regarded as an offspring from the large community, it may indicate its maturity and a successful effort at colonization of the neighborhood.

July 20, 1922, with temperature of 93, after many rains, the mound was swarming with very active ants that also spread many feet from the nest amidst the honeysuckle and grass. The mound presented several open holes of exit near the top but no ants were working near the top. The growth of grass on the sides of the mound was sparse and sickly, the honeysuckle dead in a broad band of a foot width about the base. The elongation of the mound to the South-east was very evident as well as the great steepness of the north slope. The measurements were: West 23, East 30, North-south 81, East-west 79, as computed from surface measurements of East-west 91½ and North-west, South-east 99. Measured again in the fall, September 10, 1922, it was: West 20½, East 32, width North-south 87, East-west 73. The distance around the base of this seventeen year old mound was 20 ft. 6 in., the distance up the north slope 3 feet and up the long south slope 5 ft. 22 in. The tape over the surface showed a distance of 8 feet 4 in. in the North-south direction and 7 ft. 4 in. East-west. This being a clear warm day ants were abundant upon the mound carrying up and dragging earth pellets toward the summit which was conical and closed, in spite of heavy recent showers. The mound was recently covered with fresh light earth with very many light fluffy cast-off pupa cases lying about as if brought up by ants from within the nest. In some parts of the circumference of the base there was more than a foot in width of dead honeysuckle. Large streams of ants ran to and from a tulip tree about twenty feet distant and many up and down the tree. Fifty feet to the east were evident several new young nests.

In the next year, 1923, measurements were made July 8, when the heighth had fallen, west 19, east 29, east-west 76, north-south 84 corresponding to surface distances of 89 and 98 inches. Apparently the lessened height might have come from denudation which added to the diameters. The mound was in fine state of preservation, not injured at the top and the ants were bringing out earth through holes near the top. The sparse grass still present about the upper reaches of the mound did not prevent much fine clean earth from rolling down and spreading to the south-east.

The next measurements, January 27, 1924, showed a greater depression of the summit, west 16, east 27, north-west-south-east 86, north-east-south-west 75. For the first time the angles of slope were measured as follows: North 45°, West 45°, East 40°-38°, longest South-east slope 35°. Other measurements were: circumference 20 ft. 2 in., distance over top North-west-south-east 98, northeast-south-west 89. An evident cause for the diminished height was the crushed in state of the top of the dome which was flattened and marked as if by human footprints partly filled in by the ant's work. No actual break into the interior remained. A large human footprint on the north-east slope near the top indicated disturbance with the normal surface. The entire mound was frozen stiff, smooth on the surface with some of the small tufts of grass still green about the lower parts of the slopes.

July 20, 1924, after several days clear and dry, in a very rainy season, the ants were very active over the surface of the mound at four to five p. m. Mound in a fine state of repair with four holes near the top on the north and one at the summit nearly, from which ants emerged; other holes concealed by talus except on the base of the north where talus was absent and old holes of egress show plainly, so that the north side seemed inactive and dead in comparison with the very long talus of fresh mouthfuls running far down to the south-east. Grass about eight inches high but not very flourishing made a ring about the bare summit. The moat or bare space about the base of the mound was very conspicuous from dead defoliated honeysuckle and stone or gravel made clean by the ants having removed the earth. Two dead branches projected from south-east part of east side near the base. Measurements as made with the aid of a level and angle, tape and yard-stick were: height, west 19¾ inches, east 33 inches, diameter east-west 88 inches, north-south 85 inches, north-west-south-east 96 inches, width of moat: north 12, west 19, south 16, east 14, circumference at base: 22 ft. 6 in., circumference of moat 29 ft. 8 in. Angle of slope: north 35°, but at base 45° where dead and full of holes; south-east 28°, west 35°, east 35°. Distance by tape up west side: 3 ft. 4 in., up north 3 ft. 4 in., up east 4 ft. 4 in., up south-east 5 ft. 11 in.

The final measurements made at the end of the year 1924, December 20, showed the mound as it then appeared at the height of its recovered maximum, after the previous period of depression but they are not added to the following table since

MEASUREMENTS									CALCULATIONS				
Dates	Height	W.	E.	Width	N. S.	E. W.	Circumference in inches	Contents cu. ft.	Increment cu. ft.	Duration months.	Increment per month.	Increment per working month.	Increment per working day in cu. in.
1906-7-7	3			9				.012	.012	7	.001	.006	.345
1906-11-13	4-5			15				.151	.139	4	.034	.046	2.699
1907-10-24	6			18				.291	.013	11	.001	.028	1.636
1908-6-12		8	12		18	21		.564	.273	7	.039	.136	7.733
1908-10-18	9			26				.912	.348	4	.087	.087	5.011
1909-12-31									.518	14	.037	.103	5.922
1910-12-31									.444	12	.037	.088	5.068
1911-12-31									.444	12	.037	.088	5.068
1912-12-31									.444	12	.037	.088	5.068
1913-12-31									.444	12	.037	.088	5.068
1914-8-7		12	19		38	42		3.72	.296	8	.037	.095	5.472
1915-9-19		16	24		47	52		7.35	3.63	13	.279	.726	41.817
1916-6-18		16	21		50	53		7.359	.009	9	.001	.004	.230
1917-12-31									.874	18	.048	.006	.345
1918-12-31									.586	12	.048	.009	.518
1919-4-13		15	24		58	54		9.012	.193	4	.048	.193	11.116
1919-10-18		18	28		63	60		13.048	4.036	6	.672	.800	46.03
1920-7-25		$\begin{cases}18\\20\end{cases}$	$\begin{rcases}24\\30\end{rcases}$		57	54		10.029	-3.019	9	-.35	-.115	-6.624
1920-9-19		21	28		60	57	192	12.009	1.980	2	.990	.990	57.024
1921-8-21		21	30		76	72	216	20.945	8.936	11	.812	1.789	102.846
1922-7-20		23	30		81	79		25.44	4.495	11	.408	1.124	64.742
1922-9-10		20½	32		87	73	246	25.44	0.000	2	.000	0.000	00.000
1923-7-8		19	29		84	76		23.04	-2.40	10	-.240	-.800	-46.08
1924-1-27		16	27		86	75	242	20.988	-2.042	6	-.340	-1.021	-58.809
1924-7-20		19¾	33		85 (96)	88	270	29.813	8.825	6	1.470	2.941	169.401

they so closely agree with those of July, some slight falling off being due to a defect near the north summit caused by human feet. This table shows all the measurements taken in the years 1906-1924 inclusive, as well as some calculations of bulk reckoned on the assumption that the mound may be a conical figure. Graphs have been made to illustrate the main facts of the table. They show that the growth in height and in diameter taken from the measurements of the last part of each year, rises steadily for a few years as two nearly parallel curves and then the heighth curve becomes more flat and with indented summit while the width curve continues to a much greater heighth and with no flattening, yet with depressions and recoveries. In a drawing showing the projections of the circumference of the mound as measured or calculated each year the circles enlarge concentrically and rather uniformly at first and then, in this special case of the mound being erected upon unlevel base, the north-west-south-east diameter elongates and the outlines become more elliptical with the axis shifted to west of north.

The curve of the bulk, as plotted from the calculated bulks at ends of years, shows steady rise for the first years; a depression in 1920 followed by greatly increased acceleration with a second set back in 1923 followed by a sharp rise above all previous heights. All these plotted results show irregularities which suggest complex factors acting upon the growth of the mound. The very slow growth the first years is striking as well as the very rapid growth in some later years correlated with the small numbers of ants in the incipient colony at first and the immense numbers in the old successful community. The ants work but half of the year at most, lying dormant in November to March inclusive.

It is to be emphasized that the growth is very irregular, the only constant numbers in the table are the interpolated figures in the seven years when measurements were not actually made. While some of these irregularities are due to crude measurements many seem to be the results of complex factors and they actually may express the resultant of causes of success or failure in the community. Thus in the years of no progress and of actual diminution, the loss of height is sometimes compensated by increase in width since the materials are spread out laterally in place of being accumulated at the apex; but there is sometimes an actual dimunition in bulk. As the interior of the mound is spongy and readily compressed by large animals walking on the mound it sometimes happens that the measured bulk may diminish when the mass is the same or greater. Possibly some storms may actually carry material in some quantities away from the nest so far that it is not soon returned by the ants and thus the mound may be washed away if the ants are not very successful some seasons in combatting this constant denudation. When a mound is deserted it slowly dwindles through some years but eventually is all washed away. This particular colony of ants had a very difficult soil to deal with and the progress made at first was much behind that reported by McCook in a region of sandy wood soil. Like all loosely piled earth, the nest must suffer shrinking and condensation from settling when this is not actively counteracted by ant work.

During the years that this mound had been forming others were made in the same soil nearby and these had grown to about the same dimensions. Two little mounds were started near the above mound and may well have been colonial offspring from it. As far as measured they have the same very slow rate of starting and are in the same soil. The following table shows these young mounds starting on their long period of trial, at the same cautious pace:

	Nest No. 2	Width	Contents cu. ft.	Material
1921-8-26	4-5	8-10	.054	Subsoil, clay
1922-7-22	3	11	.054	Subsoil, clay
1922-9-10	3	11 x 14	.070	Earth
1923-7-8	4	14 x 14	.117	Earth and sticks
1924-1-27	3	15 x 15	.101	Earth and sticks
1924-7-20	4-5	29 x 17	.421	Subsoil
1924-12-20	5.5	18 x 18	.267	Coarse particles and sticks
	Nest No. 3			
1921-9-9	2	13 x 7	.030	Subsoil, Sandy
1922				
1923-7-8	2	11 x 5	.019	Subsoil, sandy
1924-7-20	6.5	19 x 16	.045	Clay, subsoil, sticks
1924-12-20	6	20 x 18	.328	Very coarse particles and sticks

The rate of growth under the natural conditions prevailing is but slow, yet when injury is done to the mound the repair work and reconstruction results in very rapid new formation. Thus the little mound No. 2 was cut into two with a saw when frozen, January 27, 1924, and the half carried away, yet by the following July the ants had made good the loss and added to the former height, width and bulk as shown in the table. In the same way a full grown or adult mound cut into two when frozen at the same date and one-half removed for study, was found in July completely regenerated and perfect. The ants can thus accomplish much more work in a given time than they would without the stimulus of destructive injury to the mound.

The actual bulk of the mound at the end of nineteen years of work by the ants of this community is about 30 cu. ft., and was thus accumulated at the average rate of about 2 cu. ft. per year. The table shows the actual slow growth of the first years and the rapid growth of some of the later years. The number of ants is unfortunately not known, but they were very few in the first years and very many indeed in the later years. The nascent community accumulated but few cubic inches per day, the mature colony fifty to one hundred or more. As the single ant is but 1-630 part of a cubic inch the labor done is relatively very great and all the work seemed to be done by individuals without aid of fellows. Such facts led McCook to the estimation that considering the bulk and the speed of construction of the ant mound as compared with the bulk and supposed speed of construction of the pyramids of Egypt, the ant may be much more efficient than man, in fact nearly 700 times as powerful a laborer.

In the building of the mound the first two or three years seem to be exclusively years of mining operations, bringing up the earth from the shafts below ground; but after that period the ants begin to construct the mound from two classes of materials. Not only is the excavation process continued and the removed material added to the pile, but there is more and more bringing in of surface material, both surface soil and bits of organic matter such as sticks, straws, leaves and other light particles. In the early stages of mound growth the cast up mouthfuls of subsoil merely accumulate in a loose pile, but the weather compacts them and a denser mass results within which the ants begin to excavate their tunnels above the natural surface of the ground. Thus mound No. 2 had, when four years old, but few internal tunnels merely suggesting the complex labyrinth of the mature mound.

Incidentally it may be noted that in this region no trees seem to be killed by the ants, though that has been described in New England; but the ants keep the Japanese ivy from growing over the mound and even climb up and kill branches of this vine and of catbriar that may project over the mound though some feet above its surface.

Summary.

In a mound of *Formica excestoides* measured at intervals during nineteen years the growth was not constant but fluctuating in rate. In the earlier years increase was very slow, in the later years very fast. Interruptions in growth and diminution in proportions may to some extent be referred to external interferences, but probably in part to lack of steady success of the community. Other small incipient mounds start at the same slow rate. Mature mounds require many years for completion to full size.

In the first two or three years the material of the mound is mined from the subsoil, but later more surface soil and collected fragments of vegetable matter are added to the pile.

The rate of growth in reconstruction after injury to, or removal of part of, the mound is much greater than the usual rate of growth. Comparison with other mounds suggests the rate of growth to be strongly an individual character of each community under its own complex environment.

NOTES ON THE GIANT WATER BUGS

(Lethocerus and Benacus—Belostomatidæ Hemiptera)

By H. B. Hungerford,
University of Kansas.

Two papers have appeared recently on *Lethocerus americanus* Leidy. One by W. E. Hoffman[1] and the other by J. R. de la Torre-Bueno.[2] These remind me of some notes that were taken several years ago and may be of interest. In view of the rather wide popular interest in these huge "electric light bugs" it is strange that no one has given us a monograph of even the American forms. *Benacus griseus* Say and species of Lethocerus often attract attention as they fly about street lights and are sent to the entomologist for determination. A good key for the identification of these forms would be most acceptable.

These notes concern the flight of giant water bugs at Lawrence, Kansas, in May 1920, and some notes on the hatching process in one species. We had occasion to use a large number of these bugs in our studies and, therefore, made some effort to collect them. The notes on the collection of insects about the street lights in May 1920 show periods when the Giant Water Bugs were most abundant in flight.

Most of the collecting was done about two street lights. At 8th and Maine Streets 50 *Benacus griseus* Say were taken during the evening of May 5th. The bugs were brought to the laboratory alive in a cloth bag. They made a wheezing noise when disturbed and emitted a decidedly fishy odor. It will be noted below that *Benacus griseus* Say was much more abundant than *Lethocerus americanus* Leidy.

[1]W. E. Hoffman, Biological Notes on *Lethocerus americanus*, Psyche XXXI, pp. 175-183, 1924.

[2]J. R. de la Torre-Bueno, The Last Moult in *Lethocerus americanus* Say Entom. News, Vol. XXXV, p. 369-370, 1924.

Collections of Belostomatidæ at street lights in Lawrence, Kansas, May 1920:

	Benacus griseus		*Lethocerus americanus*	
Date	Male	Female	Male	Female
May 5th	44	57		
May 8th	9	7	1	
May 9th	22	29		
May 21st	9	12	5	
May 22nd	29	16	4	1
Total	113	121	10	1

Some of these bugs were paired and placed in aquaria and numerous egg batches secured. The number of eggs in a mass ranged from 8 to 17 and were placed on supports above the water. In one instance a female laid 17 eggs upon the back of the male. These were attached to the right wing cover near its tip and the male, when discovered, was resting high and dry above the water on the screening of the cage. Most of the egg masses were attacked and sucked dry by the bugs themselves. The eggs when protected from their forebearers have the appearance of those photographed by Dr. J. G. Needham.[3] They undergo an astonishing increase in size as they develop. One egg, measured the day it was laid (May 10th), was 4.5 mm. long by 2.25 mm. in diameter. Shortly before it hatched (May 22nd) it measured 6.57 mm. long and 2.87 mm. in diameter. The newly deposited egg has the same color as I have noted for *Lethocerus uhleri* and, if left in the water, does not color up very well. If placed in the air, it becomes longitudinally striped with brown as described by Doctor Needham. The surface is irregularly hexagonally reticulate, the gray and brown being laid down as units. Each hexagonal figure is of a single color, reminding one of the mosaic of a tile floor.

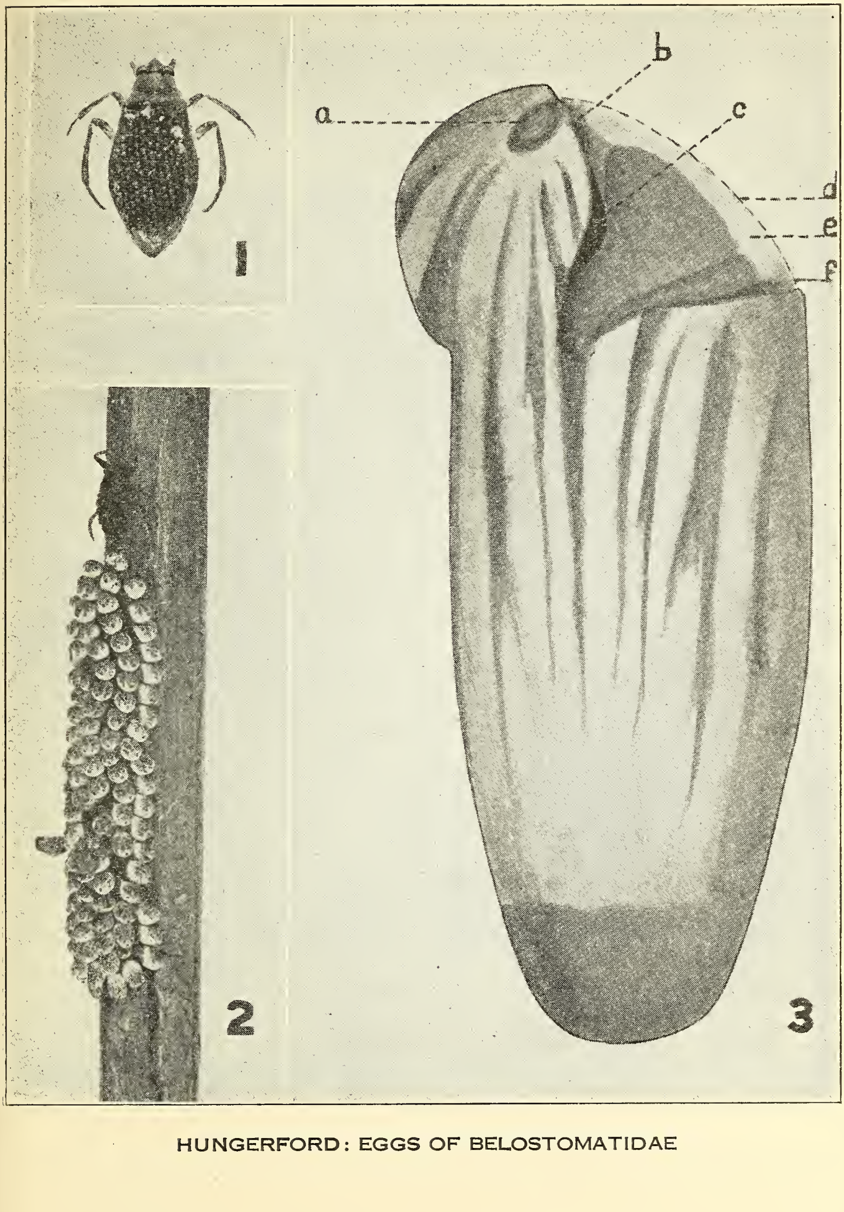
The hatching process is very interesting. I was fortunate

[3]J. G. Needham, The Eggs of Benacus and Their Hatching, Entom. News, Vol. XVII, p. 113, 1907.

enough to be watching an egg through the binocular when the cap at the cephalic end of the egg popped loose and the nymph began its emergence.[4] The cap was forced up by a bubble confined by a delicate transparent membrane. After the cap was raised by the bubble-like device the head of the bug slowly advanced into the space delimited by the membrane of the bubble which then burst and rumpled up about the opening of the egg shell. This was not the post-natal molt, for when the bug was nearly out of the shell it was still enshrouded by a delicate garment that embraced each limb separately and was shed as the last rite in the hatching process.

Mr. Hoffman, who studied *Lethocerus americanus* Leidy in Minnesota, failed to find the eggs in two seasons' search. On July 20, 1921, at Como Park, St. Paul, Minnesota, I found an egg mass on a dried cattail stalk. The stalk was inclined a few degrees from the perpendicular and on the lower side about six inches above the water surface was found the egg cluster. It consisted of 119 eggs arranged in 6 longitudinal rows and measureed 2 inches long and ½ inch wide. The cattail stalk was brought to the laboratory and placed in an aquarium jar. The following morning several eggs had hatched and some were in the process of hatching. At this stage the photograph submitted herewith was made. The nymphs had the groove in the anterior femora which is characteristic of the genus *Lethocerus* and in all probability they belonged to the species *L. americanus* Leidy.

[4]J. H. Fabre, Etudes sur l'instinct et les moeurs des insectes, *Souvenirs Entomologiques*, 18 serie, p. 99, 1903. Gives charming account of emerging of *Reduvius personatus.*



HUNGERFORD: EGGS OF BELOSTOMATIDAE

Explanation of Plate II.

Eggs of Belostomatidæ.

Fig. 1. Dorsal view of male of *Belostoma flumineum* Say bearing eggs.

Fig. 2. Egg cluster of *Lethocerus americanus* Leidy a little enlarged. Note the hatching bug not yet out of its postnatal molt and the one that has completely emerged. There were 119 eggs in this cluster, arranged roughly in 6 rows. Each egg measured 4.5 mm. long and 2.25 mm. in diameter. The eggs are gray with the free or cephalic end blotched with brown, more especially on the exposed side of the egg which is on the ventral side of the embryo as it emerges. The micropylar area is elongate, light in color and surrounded by a brown band. Pale streaks radiate from this area arranging the irregular brown spots in more or less definite rows. Compare the markings of these eggs with that of the one on the right.

Fig. 3. Hatching egg of *Benacus griseus* Say: (a) The micropylar area. (b) Indicates the space on the head between the eyes that pulsates sharply and at irregular intervals. Appears to have something to do with the inflation of the bubble which lifts the egg cap. (c) The eye. (d) The thin transparent membrane that confines the bubble. (e) The space not yet filled by the advancing embryo. Soon the bug occupies this space and disrupts the membrane (d) which crumples about the egg shell at (f). Copied by Miss Kathleen Doering from a pencil sketch by the writer.

INSECT FOOD HABIT RATIOS ON QUELPART ISLAND[1]

By Harry B. Weiss.
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The following notes represent an attempt to reduce the activities of the insects on Quelpart Island to certain food-habit types and to express the relative importance of these types in terms of parts of the whole, thus establishing a series of ratios. A list of the insects of this island was published recently by Hanjiro Okamoto as Volume 1, No. 2, Bulletin of the Agricultural Experiment Station, Government-General of Chosen, Suigen, Corea, Japan, March, 1924, and the species in this list were arranged and tabulated in accordance with the predominating larval habits of their families.

According to Mr. Okamoto, Quelpart Island is the most southern point in Corea, being the largest island adjacent to that part of the mainland. Its total area is given as about 718 square miles. The highest point is Mt. Kanra with an elevation of 2056 m., and the island consists mainly of tertiary volcanic peaks surrounding Mt. Kanra with a gradual slope to the sea. Mr. Okamoto quotes Dr. Nakai concerning the native plants which number about 1300 species and it is possible to separate the island into seven zones, "of which the southern limit of each is much higher in elevation than the northern, except at the top, where no relation exists with respect to the ocean current, and the seventh zone is consequently level on all sides." The flora of the four lower zones is temperate while a more northern flora is found in the three upper ones. The island therefore has a flora of a wide range. A more detailed description of the area can be found in Mr. Okamoto's paper.

Some 527 species are listed and although this figure does not represent a "complete count," from the information given as to the routes and times of the collecting trips, it does appear as if it might be considered as a representative sample. Even

[1]Former papers on the ratios of insect food habits were published in the Ohio Journal of Science, vol. xxiv, pp. 100-106, Entomological News, vol. xxxv, pp. 362-364 and the Proceedings of the Biological Society of Washington, vol. 38, pp. 1-4.

though not strictly representative, it is the nearest approach to it that is available at this time.

In accordance with their family food habits, the 527 species can be grouped approximately as follows:

	No. species	Phyto-phagous	Sapro-phagous	Harpac-to-phagous	Parasitic	Pollen feeders, misc. sp.
Quelpart Island	527	60%	16%	20.8%	1.5%	1.7%

A comparison of the above ratios with the ratios for other sections which have been collected over more thoroughly and which have been treated in a similar way, shows that the parasitic figure for Quelpart Island is too low, due to the fact that the parasitic Hymenoptera are not represented as they should be. From studies of "samples" in other areas, it appears that the parasitic figure should be about 10 and in view of this, 50 species have been provisionally added to the parasitic group making the total number of species 577 and resulting in the adjusted set of ratios found below.

	No. species	Phyto-phagous	Sapro-phagous	Harpac-to-phagous	Parasitic	Pollen feeders, misc. sp.
Quelpart Island	577	55%	15%	19%	10%	1%

It is now possible to compare these ratios with those of other areas and this has been done in the following table I. It will be noted that the figures in each column do not differ widely and suggest a fixed relationship or at least a close resemblance. The same relationships are brought out in a slightly different manner in table II wherein the comparisons are made with the parasitic food habit as a base. For example, if the adjusted parasitic food habit in Quelpart Island is represented by 1, then the relative importance of the other types is, phytophagous 5.5, saprophagous 1.5, etc.

TABLE I

	No. species	Phyto-phagous	Sapro-phagous	Harpac-to-phagous	Parasitic	Pollen feeders, misc. sp.
Quelpart Island	577	55%	15%	19%	10%	1%
Western Arctic Coast of N. A.	400	47%	27%	14%	10%	2%
State of N. J.	10,500	49%	19%	16%	12%	4%
State of Conn.	6,781	52%	19%	16%	10%	3%

TABLE II

Quelpart Island	577	5.5%	1.5%	1.9%	1.0%	0.10%
Western Arctic Coast of N. A.	400	4.7%	2.7%	1.4%	1.0%	0.20%
State of N. J.	10,500	4.1%	1.6%	1.3%	1.0%	0.33%
State of Conn.	6,781	5.2%	1.9%	1.6%	1.0%	0.30%

The adjusted figures for Quelpart Island, with its varied flora, tend to support the suggestion advanced in previous papers, that the ratios between the various types of food habits, based on the species present, vary but little when large areas, each embodying different types of vegetation are considered *in toto* and when the numerical ratios between the species present and the factors tending to reduce or change their numbers are considered as constant.

NOTES AND DESCRIPTIONS OF THE CERCOPIDÆ OF CUBA.

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This is the first of a series of papers on the Homoptera of Cuba which have been collected by the junior author during the past eight years. For some unknown reason the homopterous fauna of Cuba has been neglected since the publication of de la Sagra's "Historia.................de Cuba," in 1856, which contained a list of the Homoptera of Cuba by Guerin-Meneville, with descriptions of new species, but he did not include a single Cercopid. In 1864, Uhler, (Proc. Ent. Soc. Philadelphia II: 155-162) described some new species of Hemiptera including three new species of Cecropidæ, *Clastoptera stolida, Clastoptera undulata,* and *Tomapsis* (*Monecphora*) *fraterna,* from Cuba. Again in 1876, (Bul. U. S. Geol. Survey I: 348) he described, *Lepyronia angulifera,* from Florida and stated that he had specimens from Cuba. The present list records fifteen species and one variety; twelve species appear to be new to science, indicating very clearly how much the Cercopid fauna of Cuba has been neglected. One new genus is also described, indicating that Cuba may be an important center for the development of this group. No less than five new species of the genus *Leocomia* Ball are recognized, indicating that Cuba may be an important center for the development of this genus, which was described from Hayti. The genus *Monecphora* is very poorly represented in our collections, only two species, *M. bicincta* Say, and its variety *fraterna* Uhler and *flavifascia* n. sp. *Monecphora bicincta* Say variety *fraterna* Uhler equals *Monecphora fraterna* Uhler.

Monecphora bicincta fraterna Uhler.

Monecphora fraterna Uhler is certainly very close to the common North American *M. bicincta* Say and we believe that the two species are identical. The following points are evident in a comparison of *M. bicincta* from North Carolina, with *M.*

fraterna, from Cuba: Transverse bands on the wings irregular but complete in *bicincta,* usually broken into two or three elongate spots in *fraterna.* Vertex broadly rounded with median carina rather indistinct or not indicated on the pronotum in *bicincta,* vertex rather acutely angled with the median carina distinct, and usually strongly indicated on the pronotum in *fraterna.* Genital styles of the male rather acute at the apex, not strongly recurved, in *bicincta,* rather obtuse and strongly recurved, in *fraterna.*

This common species is a pest of "Parana" (*Panicum numidianum*) in Cuba and occasionally attacks sugar cane. It has been collected in the following localities: Manzanillo, July 31, 1922, S. C. B. and C. H. B.; Nagua, Oriente, July 7, 1922, S. C. B. and C. H. B.; Santiago de las Vegas, Sept. 2, 1915, S. C. B.; Baracoa, April 19, 1916, P. C.; Camaguey, Oct. 10, 1911, P. C.

We also have a single specimen from Manzanillo, July 21, 1922, S. C. B. and C. H. B., which is nearly uniform dull black above with pale golden pile. Transverse band narrowly indicated on the pronotum, dark red; transverse bands on the fore-wings indicated by a series of narrow elongate spots; face and eyes shining black. Legs and venter more or less washed with red; abdomen black with the borders of the segments and lateral pieces narrowly bright red. Otherwise this specimen seems to be identical with *M. bicincta ignipecta* Fitch.

Monecphora flavifascia n. sp.

This species is very close if not identical with the dark form of *Monecphora saccharina* Dist. as illustrated by Williams (Memoir no. 1, Dept. Agr. Trinidad and Tobago.), but this species differs in several essential details from typical *M. saccharina* in our collections from Trinidad. We believe therefore that it should be described as a new species, especially since it may prove to be of economic importance as a sugar cane pest.

Vertex about one half as long as width between the eyes, anterior margin rather pointed; discal area strongly elevated; ocelli separated from each other by about the diameter of a single ocellus; face strongly inflated, transverse ridges conspicuous, median carina well elevated. Pronotum nearly twice as broad as long. Spine near base of hind tibia short, weak, spine near apex long stout. Male genitalia with the ventral gonapophyses short and stout, contiguous to their apices which are obliquely truncate; lateral gonapophyses elongate, widely separated basally, contiguous apically, the apices claw-shaped with the two claws inclosing a nearly circular area; œdagus slender, inclosed in an evident sheath basally; tenth and eleventh segments sub equal.

In *saccharina* the ventral gonapophyses are elongate, contiguous to the apical third, then curvingly separated ending in short blunt processes; the lateral gonapophyses are elongate well separated basally then contiguous in the middle of their length and then widely divergent, the claws inclosing a long oval area.

Holotype, male, Perico, Matanzas, September 30, 1910.

Allotype, female, same locality.

Paratypes, 3 males, 12 females, same locality.

Leocomia Ball.

The genus Leocomia was described by Ball in 1919 (Proc. Iowa Acad. XXVI: 143-150) from a single specimen from Hayti. We describe below six new species of this interesting genus which seems to be West Indian in its distribution. Our species differ from the generic description as given by Ball in having a prominent spine in the middle of the hind tibiæ, and in other minor points, but we do not think that they are generically distinct. One of these forms was collected from *Pilia sp.* but the food plants of the others are not known.

Leocomia grisea, n. sp.

A uniform grayish species, the largest of the genus from Cuba, with a well produced vertex and strongly sloping wings.

Vertex flat, strongly produced in front of the eyes, gradually narrowed to the apex; ocelli slightly nearer each other than the eyes; eyes moderately large, not prominent; frons flat; pronotum but little longer than the produced vertex; anterior margin broadly rounded, posterior margin shallowly excavated; mesonotum about twice as long as broad equaling the pronotum. Venation of fore wing weak; venation of hind wing typical. Hind tibiæ with two spines both stout, the one at the middle twice as long as the one at the base.

Color above and below, nearly uniform grayish tawny, eyes, median area of the frons, tip of the rostrum, spines, claws and ovipositor, blackish.

Length, 5.10 mm.; width across prothorax, 2.10 mm.

Holotype, female Sierra Maestra, 3000-3500 ft., July 10-20, 1922, S. C. B. and C. H. B.

Leocomia balloui n. sp.

This is another species with a strongly produced vertex, dull black to piceous variegated with creamy white and tawny.

Vertex foliaceous, flat, strongly produced about two-thirds the length of the pronotum; ocelli rather close together; eyes rather prominent; frons very flat; pronotum rather strongly arched; mesonotum about as long as vertex, apical portion rather slender. Fore wings nearly vertical, strongly roughened, venation prominent; venation of hind wing typical. Middle spine of hind leg large, basal spine small.

General color dull blackish or piceous; anterior margin of vertex, tawny; fore wings with a narrow creamy white band extending irregularly from the claval margin near the middle of the mesonotum to the middle of the costal margin, apical third creamy white to tawny with veins black.

Length, 4.90 mm.; width across prothorax, 1.80 mm.

Holotype male, Pico Turquino, July 20, 1922, S. C. B. and C. H. B., 5000 ft.

Allotype female, Pico Turquino, July 20, 1922, S. C. B. and C. H. B. 5000 ft.

Leocomia nagua n. sp.

A short robust species with short wings and a short vertex.

Vertex rather short parabolic, ocelli equidistant from each other, and the eyes; frons slightly produced, but flat on the disc; pronotum about twice as broad as long broadly curved and somewhat angled anteriorly, deeply angulate posteriorly; mesonotum nearly as long as pronotum sides slightly arcuated. Fore wings rather broad, short, rounded posteriorly; venation distinct apically. Middle spine of hind tibiæ long, basal spine small.

Color, dull piceous brown with golden yellow pile; fore wings with a diagonal band from the middle of the clavus to the middle of the corium, and two small transparent spots on the costal margin, one near the middle and one near the apex of the wing. Sometimes two large greenish white spots on middle of pronotum.

Length 3.90 mm.; width across prothorax 1.80 mm.

Holotype male, Nagua, Oriente, July 1922, S. C. B. and C. H. B., 850 ft.

Allotype female, Nagua, Oriente, July 1922, S. C. B. and C. H. B. 850 ft.

Paratypes 2 males and 1 female Nagua, Oriente, July 1922, S. C. B. and C. H. B., 850 ft.

Leocomia maestralis n. sp.

This is a dull tawny species with a rather short acute vertex.

Head as wide as the pronotum; vertex produced, narrowed anteriorly, rather acute; ocelli nearer each other than the eyes; frons flat; pronotum nearly twice as broad as long, not much curved anteriorly, excavated as a right angle posteriorly; mesonotum as long as the median length of the pronotum, sides lightly arcuated. Fore wings elongate, somewhat expanded on the costal margin, somewhat rugose, veins narrow but rather distinct; spines on the hind tibiæ stout.

Color, dull tawny clothed with golden pile; face and abdomen brown; apex of fore wings shading to brown; eyes dull black, claws and spines black.

Length 4.50 mm.; width across prothorax 1.60 mm.

Holotype male Sierra Maestra, July 10-20, 1922, S. C. B. and C. H. B., 3500-4200 ft.

Paratype male, Sierra Maestra, July 10-20, 1922, S. C. B. and C. H. B., 3500-4200 ft.

Leocomia pileae, n. sp.

A medium large species for the genus, dull black, with very short vertex.

Head slightly narrower than the pronotum, vertex short, rather acute anteriorly; frons strongly produced, the disc flattened, the lateral margins slightly inflated, faintly transversely striated; pronotum nearly twice as broad as long, sloping anteriorly; mesonotum elongate, the lateral margins strongly sinuated, the apex rather acute. Fore wings strongly sloping, rather rugose. Legs short and slender, the middle spine of the hind tibia elongate, stout.

Color black, anterior margin of vertex broadly dull yellow, sometimes entire vertex and anterior margins of prothorax dull yellow.

Length 4.90 mm.; width across prothorax 1.70 mm.

Holotype male Pico Turquino, July 20, 1922, S. C. B. and C. H. B., 5500 ft.

Allotype female Pico Turquino, July 20, 1922, S. C. B. and C. H. B., 5500 ft.

Paratypes 1 female and 2 males Pico Turquino, July 20, 1922, S. C. B. and C. H. B., 5500 ft.

Leocomia fulva, n. sp.

This species may be recognized by its large size, pale golden yellow color and triangularly produced vertex.

Head rather narrow, pointed, the anterior margin nearly a right angle with the margins nearly straight lines; pronotum elongate, its length nearly two-thirds the width, the lateral margins strongly contracted and the posterior margin deeply indented by the mesonotum, with a distinct percurrent median carina; mesonotum broad, the lateral margins strongly sinuate, tip narrow.

General color golden yellow, the eyes and the tips of the fore wings shading to deep brown; legs and beneath, golden brown, the spines and tips of the tarsi and claws black.

Length 5.2 mm.; width across prothorax 2.1 mm.

Holotype female Pico Turquino, Cuba. July 20, 1922, 5000 ft. S. C. B. and C. H. B.

Enocomia maestralis, n. sp.

This species is placed in the genus *Enocomia* Ball with great hesitancy as it does not agree in all points with the description of that genus.

Vertex narrow, transverse, somewhat rounded anteriorly, its median length greater than the length next the eyes; ocelli closer to each other than to the eyes; frons inflated, the median area with a prominent circular impression; pronotum broad nearly twice as broad as median length, lateral margins strongly converging posteriorly; mesonotum shorter than the pronotum. Wings short, broad, strongly inflated without an appendix, venation fairly distinct. Posterior tibia with a short stout spine beyond the middle, a very small spine at base.

General color, blackish brown shading to lighter on the apex of the vertex and the apex of the wings, with conspicuous pale yellow c-shaped marks on either wing. Vertex brownish, shading to pale yellow anteriorly; face black, dorsally pale yellow with four short dark arcs broken on the median line; eyes dark gray; pro- and mesonotum brownish uniformly covered with pale yellow pile. Fore wings blackish brown shading to paler apically, where the veins are blackish and conspicuous, uniformly coarsely punctured and covered with pale yellow pile. Base of the clavus with a broad pale yellow stripe which curves across the claval suture, then anteriorly to the costal margin, this stripe is more or less broken on the middle of the corium; apex of the clavus pale yellow, tibiæ and tarsi pale brownish yellow with the claws and tips of the spines black. Abdomen dull black.

Length 3.9 mm.; width across the prothorax 1.9 mm.

Holotype male Sierra Maestra 10-20 July. 1922, C. H. B. and S. C. B., 3250-4400 ft.

Allotype female, Pico Turquino, 20, July 1922, S. C. B. and C. H. B. 5000 ft.

Paratype 1 male and 1 female Pico Turquino, 20 July, 1922, S. C. B. and C. H. B. 5000 ft.

Dasyoptera, gen. n.

In general appearance the members of this genus suggest a small species of *Aphrophora Germ.* and the venation of the fore and hind wings is quite similar. They differ however, in many important points.

Head narrower than the prothorax, somewhat angulate anteriorly; anterior disc of the vertex horizontal, posterior disc sloping; face elongate, flat, the disc flat giving the appearance of an elongate oval impression; pronotum broad nearly twice as broad as long, and the anterior margin distinctly broadly angulate, the lateral margins distinctly produced into shoulders; mesonotum nearly as long as the pronotum, broad anteriorly with the lateral margins concave, the apex attenuate. Fore wings long and narrow, the venation strongly elevated giving a very rugose appearance; venation about as in *Aphrophora* Germ., hind wings long and narrow, venation as in *Aphrophora*. Legs short, hind tibia with a long stout spine beyond the middle, and very short obtuse spine near the base.

Type: *D. variegata*, n. sp.

Dasyoptera variegata, n. sp.

This species may be recognized by its general golden brown color, with the vertex and pronotum strongly marked with black.

Vertex broad, short, somewhat angularly produced anteriorly about half again as long on the median line as next the eye; face nearly twice as long as broad, faintly ovally impressed on the median line; pronotum viewed laterally broadly arched.

General color golden brown with golden yellow pile, this pile much paler in definite areas giving a spotted appearance; face with two large black spots apically, these spots continued over the apical margin as two black dashes on the vertex; posterior margin of vertex with two large black spots which are twice as far from each other as from the eyes; pronotum with a row of six small black spots near the anterior margin. Fore wings with many spots of pale pile; hind wings transparent with brown veins. Legs and beneath, golden brown, the hind tibia darker.

Length 6 mm.

Holotype female Pico Turquino, Cuba, July 22, 1922, S. and C. H. B., 6770 ft.

Lepyronia robusta n. sp.

A short robust species similar to *Lepyronia gibbosa* Ball but shorter, more robust and darker.

Vertex about half as long as its basal width; tylus triangular, deeply impressed; ocelli twice as far from each other as from the eyes; face moderately convex. Pronotum twice as broad as its median length, broadly incised posteriorly. Mesonotum lozenge-shaped. Fore wings short, broad, inflated; venation fairly distinct, typical; hind tibia robust, with two lateral spines about equidistant from each other and the base and apex of the tibia, the apical spine stouter. Male genital plates inflated, about three times as long as broad, together elongate oval.

Ashy gray above, darker on the vertex, pro- and mesonotum and clavus; the fore wings with a diagonal dark band from apex of clavus to middle of costal margin, and another band at apex of wings; the whole upper surface densely covered with short golden pile. Whole ventral surface, including eyes, legs and abdomen blackish.

Length male, 4.3 mm., length female, 5.6 mm.

This is apparently a very variable species and we are by no means sure that the two specimens listed under this name really belong together, but until more specimens are at hand, they may as well be listed thus.

Holotype male, Santiago de las Vegas, Jan. 9, 1922, S. C. B.

Allotype female, Manzanillo, July 31, 1922, S. C. B. and C. H. B.

Clastoptera undulata Uhler.

This species may be recognized by its pale face with a broad brown band below the middle, and a series of seven to nine interrupted arcs above; vertex pale, crossed by an irregular brown band; pronotum pale with two brown arcs across the middle, interrupted on the median line, and the posterior third clouded with brown; mesonotum dark, lateral margins pale. Fore wings dark with an irregular pale band across the middle, and the apex transparent.

We have a single typical specimen from Taco Taco, April 1-6, 1922, C. H. B. and S. C. B. and two paler females, one from Taco Taco and the other labeled Santiago de las Vegas.

Clastoptera stolida Uhler.

This is a dark species with a series of three pale greenish yellow spots across the middle of the wings; vertex and pronotum more or less bordered with pale tawny yellow; face about as in C. *undulata* Uhler; legs pale.

Three specimens from Manzanillo, July 31, 1922, C. H. B. and S. C. B.

Clastoptera flavidorsa, n. sp.

This species may be recognized by its broad short form, and distinctive yellow and black coloration.

Vertex rather short with the vertical part of the frons nearly parallel margined; frons strongly inflated; pronotum about twice as broad as long, broadly curved anteriorly; mesonotum large. Wings short and broad. Legs short and stout.

Head entirely shining black; anterior margin of pronotum bordered with shining black, this border wider on the median line and then narrowed until nearly concealed by the eyes laterad, rest of the pronotum and anterior half of the mesotonum bright yellow; apex of the mesonotum black. Wings nearly uniform brown, apical cell black. Face, venter and legs black, the tarsi shading to brown.

Length 2.75 mm.; width across the prothorax 1.50 mm.

Holotype female, Sierra Maestra, July 10-20, 1922, C. H. B. and S. C. B., 3500-4200 ft.

Clastoptera cuba, n. sp.

This species is nearly uniform brown above, with the face twice banded with black.

Short robust; vertex rather deeply excavated posteriorly together with the vertical part of the frons obtusely rounded anteriorly; frons moderately flat, not inflated; pronotum not twice as wide as long; mesonotum elongate, very acute posteriorly, side margins feebly arcuated. Wings broad, short and somewhat inflated.

General color above tawny brown, corium shading to darker; face crossed by two black bands the area between, pale yellow, dorsal area uniform brown with dark arcs faintly indicated. Legs dull black, knees paler, and the hind tibia ringed with paler near the apex.

Length 2.75 mm.; width acorss the prothorax 1.74 mm.

Holotype female Palma Mocha Mt., Sierra Maestra 10-20 July 1922, C. H. B. and S. C. B., 3250-4200 ft.

PECTINATE ANTENNÆ IN THE GEOMETRIDÆ (LEPIDOPTERA).

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The present note is the summary of an analysis of antennal characters in the Ennomid Geometridæ, for which there seems to be no present hope of publication.

The Geometridæ and especially the Ennomid (Boarmine) series, have always been notorious for the plasticity of their characters and the difficulty of their classification. The present study of antennal characters has developed out of Bodine's work (Trans. Am. Ent. Soc. 23, 1, 1896) on the Lepidopterous antenna, and has, I believe brought some significant and useful characters to light.

This discussion includes only the genera with pectinate male antennæ. In the Geometridæ the simple antenna is not primitive, but has been several times produced by reduction. For the present it is not possible to place all these genera, but pupal and other characters will throw light on their relationships.

Bodine recognizes five types of antennal organs: three lengths of setæ, cones, and pit-organs. In the Ennomids the pit-organs seem of little use in classification, and the two types of generally distributed setæ (his types 1 and 3) are not easily distinguished; the presence and arrangement of the long single setæ which he calls type 2, and the thin-walled sensory cones—type 5,—give good characters.

The following grouping may be made:

Series I: Pectinations naked; cones on shaft.

There are three subdivisions of this type, corresponding to two natural groups, and a somewhat heterogeneous remainder.

1. Pectinations each with a single distinct seta of type 2, not obscured by long setæ of type 3; pupa with two strong spines on the cremaster, with dorsal groove (between abdominal segments 9 and 10) well developed; moth slender, wing normally with fovea. Antenna usually with a long simple apex.

Protoboarmia (indicataria), Parexcelsa (inconspicuaria), Eufidonia, Neoalcis (californiaria), Melanolophia, Vinemina (opacaria), Paraphia, Epimecis, Elphos, Boarmia, (e. g. rhomboidaria), Amraica. In Amraica the antenna is unipectinate, with a superficial likeness to Arichanna. The others form a homogeneous group.

2. Pectinations very short, gradually running out to base and apex, slender, central on segments, not clubbed, with long sparse bristles, the apical one not distinct; segments lightly chitinized, with fine striations, transverse on outer part of segments, as in Melanolophia.

Bapta (?) *virginalis.* The remaining Baptas have simple antennæ, and resemble Cabera (Deilinea). This species has no likeness to Cabera and has no visible connection with any other.

3. Pectinations more or less clubbed, with a terminal tuft of long curved setæ, burying the single short apical or sub-apical seta of type 2. Body stout, mouth parts normally reduced; sculpture normally not unlike group 1, which also has a similar pupa.

Biston (ursaria), Amphidasys (cognataria, robusta), Erannis (segments sometimes 4-pectinate, sometimes merely serrate), *Artiora (Therapis), Coniodes, Cochisea.* This is a homogeneous group. Artiora has usually been widely separated from Erannis but hardly differs save in wing-form.

4. Pectinations with at least two strong setæ of type 2, which are typically apical and strongly divergent; and are frequently supplemented by one or more such setæ on the outer sides of the pectinations. A miscellaneous group, held together mainly by the survival of a primitive condition.

A. Three nearly apical setae of type 2.

Prosopolopha.

B. A dorsal seta (or more) on pectinations.

Euchlœna (including *irraria*), *Lytrosis, Stenotrachelys, Angerona (prunaria, œxaria), Xanthotype, Metarrhanthis, Cepphis (Priocycla).*

c. Only two setae of type 2.

Gonodontis (*bidentata, formosa, ocellaria*), *Abbotana, Himera, Campœa* (*Metrocampa*), *Ellopia* (not *Therina*), *Selenia, Hygrochroa, Stenaspilates, Hypoplectis, Scodiona, Hulstina, Amblychia* (*angeronaria*), *Xandrames* (*dholiaria*), *Arichanna* (transitional to Melanolophia group), *Sarcinodes* (unipectinate), *Achlora* (4-pectinate).

Series II: Pectinations naked, cones at their apex.

This series like the first is composed of three main groups, of which two are more like each other than to the third, and has some anomalous genera of uncertain position. Nacophora makes a group by itself, much like the Biston group, but differing in egg-type as well as antenna.

1. Basal segment of antennal shaft with well-marked pectinations; posterior series of longer pectinations than anterior, especially toward apex; cones very few, sometimes irregular in position and deformed. Apical setæ of pectinations strong, strictly apical, and not obscured by setæ of type 3; sub-apical seta strong, often arising well back from apex. Pectinations stout and long, tapering, with tips turned distad; strongly chitinized, especially at base, and longitudinally striate; shaft smooth or slightly granular.

Nacophora (including "*Amphidasys*" *arnobia*), *Phœoura.*

2. Cones numerous, normally on both series of pectinations; apical setæ usually two, and well-marked. Tropical species frequently very heavily chitinized. American genera.

Therina (including *quercivoraria* and *lœta*), *Nepytia, Zerene, Sicya, Philtrœa, Philedia, Nipteria* (in part), *Lissochares* (*nigrovenata*), *Deutophlebia* (*radiata*), *Emplocia* (*bupaloides*), *Leucula* (*cillenaria*), *Carpella* (*districta*), *Sangalopsis* (*beata*),—also "*Dioptis*" *hesperioides*, for which I have not happened to see a valid generic name,—*Metanema* (*inatomaria* and *determinata*, transitional to group IIc).

3. Cones numerous on one series of pectinations, normally the posterior, usually absent on the other series, but present

on both series on Bupalus, Crocallis and Euctenurapteryx. Old-world genera.

Chemerina, Cleogene, Dasydia, Epione, Bupalus, Euctenurapteryx (*maculicaudaria*), *Crocallis.* The last genus on most characters is an outlier of series I.

Series III. Pectinations scaled, cones apical.

This is far the smallest, and in antennal structure the most homogeneous of the four series, but the genitalic structure as well as the appearance seems to indicate it is not homogeneous. Gnophos is particularly troublesome, as with a great variety of antennal type the genitalia are homogeneous, while Platæa, which has practically the antenna of G. dilucidaria, has wholly different genitalia.

Bases of pectinations conspicuously transversely rugose, and often swollen.
  Pectinations basal on segments.
    Over 40 segments. . . . . *Gnophos, Patœa, Pherne*
    Under 40 segments. . . . . *Glaucina, Cœnocharis*
  Pectinations subapical.
    Segments under 40, pectinations short. *Carphoides, Barnesia*
    Segments over 40, pectinations long. . . . . *Pterotœa*
Bases of pectinations smooth or nearly so.
  Antenna pectinate to apex.
    Lightly chitinized; segments stout. . . . . *Ennomos*
    Heavily chitinized; segments very slender. . . . . . . *Aspilates*
  Antenna with a long simple apex. . . . (a few aberrant Nipterias)

Series IV: Pectinations scaled, cones basal.

There are two main types involved in this group, one represented by Cabera and Apicia (Caberodes), in which the cremaster of the pupa has eight hooks, and the other by the Cleora group with a bifid cremaster. There is a corresponding difference in the appearance of the moth and of the antennæ, and the groups are no doubt natural, although at present impossible to define. Ametris, commonly put with the Œnochrominæ, seems to belong here, while the true Œnochromids fall in series I; Cleora and Ripula have doubly pectinate antennæ, the pectinations alternately scaled and naked. Cleora may be ancestral both to the Cleora group of this series and the Melanolophia group of the first, the inner pectinations having disappeared in one case and the outer in the other. Ripula has no obvious affinities. The diurnal forms Epelis and Ematurga seem to be separately derived from something near Itame, and should not be combined in a single genus, as has been commonly done, following Hulst in Dyar's list. The following grouping is largely artificial and for the convenient tabulating of some characters only.

Synopsis of groups.

Pectinations basal
- Sculpture strong on pectinations, setæ of type 2 apical, not strong. . . . . Group *A*
- Sculpture weak on pectinations; setæ subapical and obsolescent, lost among the setæ of type 3. . . . . Group *B*

Pectinations central or apical
- Strongest seta of type 2 subapical, short and weak as a rule, when near the apex lost among a mass of longer setæ of type 3.
  - Subapical seta strong, comparable with the apical. Group *C*
  - Subapical seta less than half as long as the apical and weak, but distinct. . . . . Group *D*
  - Subapical seta not recognizable, lost in the setæ of type 3 or (more probably) absent. . . . . Group *E*
- Pectinations ending in a strong and conspicuous apical seta
  - No subapical or dorsal seta, only the apical type-2 seta present. . . . . Group *F*
  - Subapical seta well-marked, no dorsal seta
    - Pectinations apical. . . . . Group *G*
    - Pectinations central. . . . . Group *H*
  - Subapical seta strong; a few, at least, of anterior pectinations with a third dorsal seta at about a third their length. . . . . Group *I*

Pectinations with apical seta more or less distinct, but not fully apical, at least on some segments; subapical strong; sculpture of shaft weaker than in group D Group *J*

A: *Selidosema* (*ericetaria*, *ambustaria* but not the American species sometimes included).

B: *Lychnosea* (*helviolaria* only), *L.* (?"*Hyperitis*") *trianguliferaria*, *Stegania* (*trimaculata*), *Ripula.*

C: *Caripeta*, *Hemerophila* (*abruptaria*). A wholly artificial pairing, I suspect. Caripeta has a pupa similar to Cabera and Apicia, Hemerophila is much more suggestive in all ways of Lytrosis in series I.

D: *Vitrinella* (*pampinaria*).

E: *Itame* (*Diastichtis*, *Cymatophora*), *Physostegania*, *Elpiste*, *Macaria* (species with more or less pectinate antennæ), *Mericisca*, *Buzura* (*suppressaria*), *Eubolia*, *Enconista*, *Epelis*, *Exelis*, *Eumacaria*, *Parapheromia* (*lichenaria*), *Tracheops*, *Merisme* (*spododea*), *Fidonia* (*limbaria*), *Euaspilates*, The South American "*Alcis*" *salmonearia*, and "*Ectropis*" *anaisaria* also belong to this group, but not the genera in which they now stand.

F: *Glena* (*insaria*, *quinquelinearia*), *Anacamptodes*, *Ematurga* (*faxonii*, *atomaria*), *Hyposidra* (*talara*), *Gynopteryx* (*seriaria*), *Hymenomima* (*tharpa*), *Ametris.*

G: *Pseudoboarmia* (*umbrosaria*, *punctinalis*), *Stenoporpia* (*polygrammaria*), *Tornos*, *Hesperumia*, *Chloraspilates*, *Somatolophia*, *Halesa* (*œnitusalis*), *Erebomorpha*, *Aplogompha* (*riofrio*), *Molybdogompha* (*biseriata*,) "*Lychnosea*" *intermicata*, *Neoterpes*, *Epiplatymetra.*

H: *Ixala*, *Pterospoda*, *Enemera.*

I: *Cabera*, *Drepanulatrix*, *Catopyrrha*, *Apicia* (*Caberodes*, without C. irraria).

J: *Plagodis*, *Anagoga*, *Hyperitis.* This is a homogeneous group on venation as well as antenna.

In the following genera I have been unable to find any trace of cones, or at most a few on the simple terminal segments, so that it is impossible to group them unambiguously. I divide them into artificial groups to call attention to some of their characters.

Group I: Pectinations naked, basal on segments, apical setae normally distinct

Heliothea, Egea (no terminal setæ), *Nychiodes, Eurrhanthis,*

Group II: Pectinations naked, apical, no setae of type 2.

Acalia, Brephos

Group III: Pectinations scaled.

Nepterotœa (compare *Cœnocharis* and *Gnophos*), *Eucaterva* (compare IV B or IV G) *Narraga* (compare *Epelis*), *Fernaldella* (very near Narraga), *Melanchroia* (Compare IV F).

STERRHINÆ and HYDRIOMENINÆ

Pectinations slender, basal, naked with stiff, sparse and rather evenly distributed setæ, and a minute apical seta of type 2 or none. Cones rare on the pectinate segments; on the shaft in *Xanthorhoe ferrugata,* rudimentary on apices of pectinations in the *Sterrhinæ.*

HEMITHEINÆ

Pectinations naked, with cones usually on the simple apical segments only, but sometimes also on the apices of some pectinations.

NOTE ON PANURGIDÆ (BEES)

By Charles Robertson.
Carlinville, Illinois.

That the cubital cells in Perditinæ are the first and third, as stated in my Synopsis of Panurgidæ, Psyche, vol. 29, p. 195, was pointed out by Cockerell (Proc. Acad. Sci. Phil. Jan. 1896, p. 30) who says that on one side of the type ♀ of *obscurata* a petiolate second cell shows. A male taken by me at Orlando, Florida, shows this second cell in both wings. In a recent paper I notice that the third cell is called "second." The relative size of the two cells would be different, when the two veins coalesce, from what it would be if one were obliterated.

On page 161 of my paper it is stated that *Zaperdita maura* is an oligolege of *Physalis*. In the Canadian Entomologist vol. 35, p. 334, Crawford says that Graenicher regards it as an oligotropic visitor of *Physalis*. Graenicher used the term oligotropic in the sense in which I have used it, but that term is used in so many senses that I have adopted oligolege, or oligolectic bee, as more precise.

Another Instance of the Northward Migration of Odonata in the Spring.

Mr. John B. Paine has informed me that on either May 25th., or 26th., 1923 as he crossed the street from a store to the Custom House in Boston, he noticed on the side walk over a dozen dead dragon-flies. He attached no particular interest to their presence but noted that they were of medium size and dark colored. In questioning Mr. Paine about the matter he told me that the area he crossed was very limited and therefore the large number of the insects and their presence on a city side-walk attracted his notice. Evidently, I believe, they were casualities from a migrating horde such as has been described by Bradford Torrey as seen twice in the city of Boston on a spring northward migration.

R. Heber Howe, Jr.

The David Mason Little Memorial
Museum of Natural History.

THE NORTH AMERICAN VARIETIES OF *VOLUCELLA BOMBYLANS* LINN.

By Charles W. Johnson.

Boston Society of Natural History.

My paper entitled, "The *Volucella bombylans* Group in America" (Psyche, 1916, vol. 23, p. 159-163), was written primarily to encourage a study of this group and of their relation to the various species of Bombus or Bremus. My system of naming in the above paper might deserve some criticism from a strictly nomenclatorial standpoint. I have therefore in the following table and notes endeavored to correct an error and to make more clear my views on the relationship of these various forms.

Volucella facialis Will. cannot be satisfactorily separated from the var. *plumata* of Europe, but as the typical *bombylans* is absent in America, it seems best to recognize *facialis* as a subspecies. I am also considering the eastern *evecta* and the Labrador *arctica* as subspecies, and the other forms as varieties of these subspecies.

The question naturally arises, are these variations worthy of distinct names, especially when European authors have placed twenty-four names (including the American *evecta, sanguinea* and *facialis*) in the synonomy under *bombylans*? Ignoring variation, when it exists in such a widely distributed species, does little to encourage a study of this most interesting syrphid. If certain forms do actually resemble the species of *Bombus* in whose nests it is commensal, then a knowledge of the possible limits and distribution of these variations is essential for a biological study,

Table of subspecies and varieties.

1. Face yellow, with yellow pile.............................2
   Face black or dark brown, with yellow pile................3
2. Dorsum of the thorax and the pleura black pilose, third abdominal segment black pilose (Calif. to Alaska).........
   subsp. *facialis* Will.

Dorsum of thorax black pilose, pleura yellow pilose, third abdominal segment black pilose (N. H. to Newfoundland.. . var. *lateralis* Johns.

Dorsum of thorax black pilose, pleura yellow pilose, posterior margin of the second and a large dorsal spot on the third abdominal segment red, bearing reddish pile (Col., Utah, N. M.). . . . . var. *rufomaculata* Jones.

3. Antennæ dark brown, thorax with the pile in front of a line between the base of the wings black in the ♂ and mixed with yellow in the ♀, abdomen entirely yellow pilose (Labrador). . . . . subsp. *arctica* Johns.

Antennæ red, pile of the thorax and pleura entirely yellow, first and second and the fourth and fifth segments of the abdomen with yellow or red pile (Eastern U. S.). . . . . subsp. *evecta* Walker.

Abdomen with the pile of the first and second segments yellow, the others entirely black. . . . var. *americana* Johns.

Abdomen with pile on the first and second yellow, a portion of the third segment reddish pilose, and the remaining segments with either red or yellow pile. . . . . var. *sanguinea* Will.

Volucella bombylans facialis var. **lateralis** Johnson.

V. plumata Macq., Dipt. Exot., 4, Suppl. p. 131, 1844.

V. bombylans form *lateralis* Johns., Psyche, vol. 23, p. 161, 1916.

This is the eastern representative of *facialis* distinguished chiefly by having the pile of the pleura yellow. The variety is quite common at Mt. Desert and the only form I have taken on the island. It belongs to the Canadian zone.

Volucella bombylans facialis var. **rufomaculata** Jones.

V. bombylans form *sanguinea* Johnson (*non* Williston), Psyche, vol. 23, p. 162, 1916.

V. rufomaculata Jones, Ann. Ent. Soc. Amer., vol. 10, p. 227, 1917.

This was referred to *sanguinea* in my previous paper, on the strength of the reddish pile on the abdomen. Since then I have received a specimen from Pennsylvania referable to *evecta* with reddish pile on the third segment, which indicates that Williston probably had eastern specimens before him. *Rufomaculata* seems to be peculiar to the more elevated portions of the Rocky Mountains.

Volucella bombylans arctica Johnson.

V. bombylans from *arctica* Johns., Psyche, vol. 23, p. 163, 1916.

With only the American forms for comparison I would have considered this a distinct species, but it resembles so closely specimens in my collection from the Alai Mountains, Turkestan, received under the name *V. hæmorrhoidalis* Zett., that it seems best to consider it an arctic subspecies of this circumboreal species. Types from Rama and Nain, Labrador.

Volucella bombylans evecta Walker.

V. evecta Walker, Ins. Saund. Dipt., p. 251, 1856.

Walker's description calls for a form with—head black, antennæ reddish, thorax thickly clothed with "tawny hairs," abdomen with black hairs, with two bands of "tawny hairs, one band at base paler than the other which is near the tip." Walker does not clearly define the difference between a light yellow and a reddish yellow so that the pile on the posterior segments of *evecta* may be either yellow or reddish. In actual use the word tawny covers many shades of color from pale ochre to swarthy brown. *Evecta* is the upper austral form extending through the transition zone.

Volucella bombylans evecta var. **americana** Johnson.

V. bombylans form *americana* Johns., Psyche, vol. 23, p. 162, 1916.

This is the more common form, the typical *evecta* being less frequently taken in New England.

Volucella bombylans evecta var. **sanguinea** Will.

V. evecta var. *sanguinea* Will., Synop. N. A. Syrphidæ, p. 186, 1886.

Specimens of *evecta* referable to this variety are rare. A specimen received from Mr. A. B. Champlain, taken at Charter Oak, Pa., July 11, 1917 (H. B. Kirk), has a dorsal patch in the third and the greater portion of the fourth segment with red pile. A specimen from Sherborn, Mass., June 13, 1913 (E. J. Smith), has a large patch of red pile on the third segment while the pile on the fourth and fifth segments is yellow. This variety will have to be restricted to those with red pile on the third segment. It represents—in a way—a parallel variation to that of *rufomaculata* in the subspecies *facialis*, but lacks the red ground color.

International Entomological Congress.

The *III. International Congress of Entomology* will take place at Zurich from July 19th to 26th, 1925. President: Dr. A. von Schulthess-Schindler.

Informal reception on Sunday evening July 19th; distribution of programmes, etc.

Membership 25 Swiss francs, associates accompanying members \$12.50, Life-membership \$250.00.

Entomological Societies, Institutions and Departments of Zoology, Forestry, Agriculture, Horticulture and Hygiene are invited to send Delegates.

Notifications of papers and exhibits should reach the General Secretary before July 12th. Applications for accomodation in Hotels, etc., should be sent as early as possible. All communications to be addressed to the General Secretary, Dr. Leuzinger, Gloria-Str. 72, Zurich 7, Switzerland.

The New York State List of Insects.

It is expected that the proposed List of the Insects of New York State will soon be issued by the State College of Agriculture of Cornell University, Ithaca, N. Y.

It is estimated that over 15,000 species will be listed as definitely occurring in New York, together with the complete distribution data within the state as known for each species. The lists for several orders are already practically completed. Dr. M. D. Leonard, the editor of the list will greatly appreciate definite New York State records in all groups and will see that full credit is given to every cooperator. All records should be sent to him before June 1, 1925.

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THE MYSTERY OF THE SO CALLED "TRILOBITE LARVAE" OR "PERTY'S LARVAE" DEFINITELY SOLVED.[1]

By Eric Mjöberg.

CONTENTS.

I. Introduction

Among the many remarkable forms of insect life to be met with in the Oriental region none have aroused the interest of entomologists more than certain strange looking uncouth creatures, showing a great resemblance to the extinct trilobites in possessing protruding lateral processes on the abdominal segments. From time to time various "trilobite-larvæ" as they have been termed by English entomologists, have been figured and more or less superficially described. Although the first one was made known in 1831 by Perty no one has been able to breed them and state what they really are. They have been a standing

[1]Contributions from the Entomological Laboratory, of the Bussey Institution, Harvard University, No. 249.

puzzle to entomologists and for nearly a hundred years their systematic position, method of propagation, food, etc., have remained a mystery.

II. Historical

In the year 1831 Perty described a peculiar beetle-larva which he called "*Larva singularis*" or "*Larva quœdam et Java.*" He seemed to be inclined to regard it as the larva of a necrophagous rather than of a malacoderm insect and adds: "*Vi determinandum est cujus imaginis haec larva sit.*"

In his "Introduction to the classification of Insects" (1839) Westwood mentions the same larva and refers it preliminarily to the Lycids. Furthermore he describes and figures a smaller larva with more nearly parallel-sided body, which he also considers to be a Lycid larva.

Some years later (1841) Erichson refers to a similar larva and believes it to be a Lampyrid. This opinion was shared 20 years later on (1861) by Candèze.

In 1887 or some 26 years later Kolbe discusses the "trilobite-larvæ "and inclines to Westwood's opinion that they are Lycids.

A larva referred to in 1887 by Lucas with "mandibules grands, arquée robustes" and with "plaques lumineuses" from Siam is apparently a Lampyrid-larva of some kind.

In 1899 Bolivar describes and figures two "trilobite-larvæ" of the broader type, one from Borneo and another one from the Philippines under the title "Dos formas larvarias de lampirides." Concerning their systematic position he seems to be in doubt. A figure of one was sent by Bolivar to Bourgeois, who in reply makes the following statements: "Quant á cette de Philippines elle est tout autre et je ne serais pas étonné qu'elle n'appartient pas au genre *Lycus.* Quoi qu'il en soit, cette larve de Philippines est de plus intéressante et il serait fort a souhaiter que nous puissions être édifiés bientôt sur les métamorphoses á quelle espèce nous devons la rapporter."

An examination of Bolivar's figures makes it clear that both larvæ are of the "trilobite" type. The one from Borneo is obviously the most common lowland form, which has repeatedly been figured or described by various authors.

The same year (1899) Dr. Sharp describes and figures a peculiar larva from New Britain in the following words: "There have long been known to entomologists some extremely remarkable larvæ, that probably are Lampyrides or Lycides, though none of them have been satisfactorily identified. Dr. Willey procured a most remarkable form of this kind, bearing long abdominal processes that are segmented or articulated at the base (Pl. XXXV, Fig. 7). "I take the opportunity", he adds, "of drawing attention to these forms with the hope that someone may soon be able to give us further information about them."

There can be hardly any doubt that the larva referred to is a Lampyrid larva, though of a very aberrant and extraordinary type.

In an article in the Sarawak Museum Journal (No. 3, 1913, pp. 61-65) Mr. Gahan deals in detail with the mysterious "trilobite-larvæ" and discusses the future possibilities of solving the problem which they present. He recommends strongly that tropical entomologists attack the problem in the field and make renewed attempts to rear them, pointing out, however, that larvæ have been kept alive a long time, extending up to two years, but so far without success.

The late Curator of the Sarawak Museum, Dr. R. Shelford, in his posthumous work "A Naturalist in Borneo" edited by Prof. Poulton, has dealt at length with the "trilobite-larvæ." He devotes several pages to these mysterious creatures, from which I extract the following:

Page 172: "If, then the adult male of the 'trilobite-larvæ' is provided with wings and wing cases, then the larva should possess imaginal rudiments, but a careful microscopical examination of male larvæ ranging from a comparatively small size to nearly the largest has failed to reveal the slightest trace of these organs. I can therefore declare with some degree of confidence that if an adult male of this larva be eventually found differing in its external anatomy from the larva, then it must be apterous. In spite of the abundance of these larvæ, in spite of the fact that they have been known to collectors for many years, a male of this description has never been found. I will venture to prophesy, moreover, that it never will be found, but that some day a larva with completely developed internal generative organs communicating with the exterior by ducts will be found and such a "larva" will be to all intents and purposes an adult. If this is ever established, we shall have a gradual transition from species exhibiting complete metamorphoses to species without any metamorphoses at all as thus:

Males and females undergoing complete metamorphoses. . . . . *Lycidæ* etc.

Males and females undergoing complete metamorphoses but female larviform. . . . . *Lampyris noctiluca.*

Males undergoing complete metamorphoses; females not metamorphosing. . . . . Phengodes

Males and females undergoing no metamorphoses, both indistinguishable from larvæ. . . . . "Trilobite-larvæ".

What Shelford means by "having examined male-larvæ ranging from comparatively small size to nearly the largest is certainly very difficult to explain. Obviously he presumes that some of the "trilobite-larvæ" commonly met with in the nature must be male-larvæ and therefore all his conclusions based upon this wrong supposition are wrong. For all "trilobite-larvæ" reared by me—and they number more than 50 and belong to three different species—have turned into females and we can therefore safely conclude that all the common "trilobite-larvæ" we find crawling about in the jungle are female-larvæ.

What furthermore seems to have puzzled Shelford is the extraordinary size of the larvæ. He states that "neither in Kina Balu nor in the neighborhood of Kuching, where 'trilobite-larvæ' also occur does there exist, so far as known a Malacoderm beetle that could possibly be regarded as the adult in either of these families and this in spite of the fact that in the one place the larvæ are extraordinarily abundant and in the other common enough."

It deserves furthermore to be pointed out that Shelford's above quoted statement about *Phengodes* is misleading. As we shall see later on, the members of the peculiar American group Phengodini pass through a long pupal stage and the larviform female shows certain distinctive features in comparison with the larva.

The latest author to deal with the "trilobite-larvæ" is Gravely in his paper "The Larvæ and Pupæ of some Beetles from Cochin" (Records of the Indian Museum, Vol. XI, part V, No. 20, 1925). He describes and figures the larva of *Lyropœus biguttatus*, which in general type resembles the "trilobite-larvæ" although it is considerably smaller in size. The larva developed normally into a pupa and imago. Gravely states that "the larvæ which give rise to these winged insects are, however, not particularly large and throw no certain light on the status of the much larger insects with which the name "trilobite-larvæ is more particularily associated."

Gravely also refers to two large insects of the "trilobite-type" which were found in the Cochin forests. They are figured on plate XX and measure about 28 mim. He also mentions another larva of much smaller size also from Cochin, which has more elaborate tubercles and papillæ and differently constructed mouthparts. He suggests that these former larvæ may prove to be immature females of the Lycid genus *Lyropœus*, but leaves the question open as nobody has been able to trace their life-history.

III. New Investigations.

On arriving in Borneo in May 1922 I made up my mind to have the problem of the "trilobite-larvæ" of Borneo definitely solved more especially as my interest for these peculiar forms of life had been already aroused during my sojourn in Sumatra in 1919-21, when I came across a single representative of "Perty's larva" in the jungles of Siantar.

It has long been known that these peculiar larvæ reach their maximum of size in Borneo. So far as I have been able to ascertain at present two distinct types have been recorded from there and superficially described. To this I am glad to add four more, making a total of six species. One of them is a very striking form, measuring nearly 70 cm., quite black with a serie of sealing-wax red tubercules on the dorsal side. It is figure on Plate III fig. 1 and is the largest and most conspicuous form known so far.

Since 1922 I had a large number of the larvæ under close observation and have made every effort to rear them. The first species that came in my way was the large attractive larva just referred to above. It was found quite commonly on the higher slopes of the unknown Mt. Murad, a high mountain situated in the North of Sarawak not very far from the Dutch boundary. Over 200 specimens in different stages were secured and kept alive in suitable cages, but none of them underwent any metamorphoses. Most of them were brought along six weeks later on when I returned from Mt. Murad on my way back to the Baram Station on the lower Baram River. Owing to the awkward conditions of transportation where everything had to be carried on the natives' backs, many of the larvæ died.

The sudden change in temperature from the cold mountain regions down to the steaming hot lowland naturally aided in reducing the number.

In January 1923 I undertook an expedition to Mt. Dulit (4000-5000 ft.). The number of surviving larvæ, about 30, were taken along, but soon died. Out of more than 200 larvæ only a single one developed into an adult female, distinguished from the full-grown larva only by possessing a sexual opening in front of the anal disc, surrounded by two simple genital valves. It lived for some days but owing to some difficulties in casting the skin on the apical segments it soon shriveled, became discolored from a black secretion and died.

A dissection showed the ovaries full of small whitish eggs, convincing me that I had to do with a sexually mature, fully developed female for the first time.

When arriving at Mt. Dulit on the Tinjar River, a large tributary to the Baram River, I found to my great surprise that another "trilobite-larva" of large size and of apparently unknown type was fairly common on the higher slopes from 3500-4500 feet. It is the big black larva of the type shown in Plate III fig. 2.

On returning to my headquarters in Kuching in March I brought more than a dozen very large larvæ with me. These were fed on decaying jungle wood, which was changed daily.

After some weeks of captivity one of the larvæ rolled itself up and was lying on the surface as though dead for several days. One morning I found that it had cast the larval skin and appeared quite whitish. It remained in that position for another five days whereupon the color changed into a dull yellowish-white. It soon started to crawl slowly about. A close examination revealed the interesting fact that it had developed a sexual opening on the eighth sternite surrounded by two small valves immediately in front of the anal suction disc.

Some days later on it started to lay eggs. These were small, whitish, perfectly round, measuring about one millimeter in diameter. They were deposited in small groups here and there or simply dropped wherever the female was crawling, sometimes as many as 15-20 at the same place. Egg-laying went on for about two weeks until over 300 eggs had been deposited. Every morning, when opening the door to the cage I found the female turning the top of the abdomen upwards in order to expose the sexual opening from which a clear drop of liquid was secreted.

Three more larvæ cast skins after a similar period of rest and turned into sexually mature females behaving in exactly the same way as the first one described above. They all died after having deposited from 300-400 eggs. Some months later more females developed, but no signs of any males could be seen.

In October I undertook a new expedition to Mt. Poi in Southern Sarawak. There I came across the very same big black larva just referred to. They were found at an altitude ranging from 3000-5000 feet and were quite numerous. Several developed into females and were exposed at suitable places in the jungle in hopes of attracting the males, but without success. The females were tied up with a string long enough to allow them to move about in a circle and were protected by a cage of wire netting with meshes more than an inch wide. Thus the males could easily gain access to the cages and the females were comparatively free but at the same time well protected.

All efforts were, however, in vain. I had to return again to my headquarters. During the following month (December) my native collectors brought me more than 200 big larvæ of the same type from another mountain, Batu Gadin, in the Lundu district, where they had been despatched exclusively for the purpose of collecting "trilobite-larvæ." Of these more than 20 developed into adult females in quite the same way as the ones previously referred to. As no signs of males could be detected it became now more clear to me that the "trilobite-larvæ" commonly met with in the various localities must all be female larvæ.

In January 1924 I set out for a third expedition, this time to the second highest mountain in South Sarawak, Mt. Penrissen (4000 feet). The main object was to follow up the search for the males of the mysterious larvæ, all the available female material was brought along in two big cages. My supposition that the same type of larvæ probably would be found also on Penrissen turned out to be quite correct, for several larvæ of the same or at least very similar kind though not quite so big were found in close vicinity of my camp.

A number of newly developed females were immediately exposed in the same way as described before. As many as 18 cages were kept going. They were carefully examined three times a day, the first time always at sunrise. But although over a month was spent on the big mountain, covered with a luxuriant jungle, no traces of any males could be found.

It deserves to be mentioned that all "trilobite-larvæ" found on Mt. Penrissen were only half grown and showed more pronounced light markings between the dorsal rows of tubercules than the form from Mt. Dulit, Mt. Poi and Mt. Batu Gadin. It is therefore possible that it might have represented another species or sub-species and that both these facts may have been reasons why I did not meet with any success in capturing the males.

I returned to Kuching, determined not to give up my efforts to secure the males. As all the larvæ of the developed females had been collected on Batu Gadin, this place could be regarded as their true home and I therefore decided to move my base of operations there. In April 1924 I proceeded to Lundu and from there directly to Batu Gadin where my headquarters were erected at an altitude of 2500 feet.

During two weeks I supervised the experiments myself. Females of the ordinary types as well as of the smaller more parallel-bodied kind which I had also been successful in breeding, were exposed at selected places but all in vain. As other duties called me to Kuching I had to return leaving my collectors behind with instructions to report immediately if any males should appear in the cages.

During more than two months this tedious work was kept going without the slightest results. In the meantime I visited the place twice making some slight alterations. The native collectors lost all hope, complained about the cold weather and wanted a change.

I gave, however, orders to move the experimental base 1000 feet higher up, where big larvæ seemed to be more plentiful, as the attempt to get the males had to be continued. A reward of $10.00 for the first male stimulated the collectors very much in their efforts.

I returned again to Kuching but heard nothing from my collectors during the following weeks. I visited the place again and made several alterations placing the cages in more open places, exposed to the weather and wind, here and there clearing patches of the dense jungle vegetation.

This proved ultimately to be successful for one morning a male was caught in copula with a female. (Plate IV fig. 1). I was just on my way back, when one of my collectors came running after me with the copulating pair wrapped up in a banana leaf. At the ventral side of the big female a small black beetle was seen firmly attached and with his tip of the abdomen deeply inserted in the female's sexual opening.

It soon detached itself from the female and was preserved in alcohol. The female was brought back to Kuching where it soon started to deposit a large number of eggs, but unfortunately they never hatched out. Probably the male had been too much disturbed and the eggs had not been properly fertilized.

My collectors received strict orders to carry on the experiments in order to secure as many males as possible and to watch carefully the eggs deposited by the females. Four more weeks' work yielded a dozen more males of exactly the same type as the first one. It was therefore evident that I had, after all my trouble and effort, secured the proper male

All deposited eggs were brought down to Kuching by the returning collectors, but for some unaccountable reason, not a single one hatched. Evidently the sudden change in altitude and temperature between the cold mountains and the hot lowland must be responsible for their failure to hatch.

As already stated females of the smaller and more narrow type of "trilobite-larva" had also been exposed, but no males were ever found. The females deposited about 100 eggs each. In spite of the female of this type being much smaller than the first one its eggs, as seen on Plate IV fig 2, are curiously enough twice as large.

Thus nearly two years of more or less continuous field work had resulted in rearing three species of "trilobite-larvæ" to egg-producing adult females and in the capturing of several males of the second largest species.

All my attempts to rear the very common, flat, leaf-like lowland species figured in Plate III Fig. 5, had been a failure. Although the larvæ were kept by me in hundreds in cages not a single one turned into a female. When attaining their maximum of size they were all attacked by a whitish mould which killed them in great numbers.

The only way to rear this species seems to be to build big cages in the forest and to keep some hundred of the largest ones in captivity under conditions as natural as possible until the females develop like the other species. The larvæ feed on decaying old wood. This type of larva is extremely abundant and it would be more interesting to get its male which, for reasons given below, probably represents a new genus.

IV. Neoteinic Females.

A closer examination of the "trilobite-larvæ" from Borneo thus reveals the interesting fact, that the "trilobite-larvæ" so commonly met with are the female-larvæ of Lycid beetles of various genera and that the females undergo, practically speaking, no metamorphoses at all. They attain sexual maturity as complete larvæ and differ in their organization only by possessing developed ovaries and a sexual duct and opening. They are adults retaining infantile characters and can therefore be termed neoteinic in the definition of Giard (1905). The males on the other hand are well developed beetles probably hitherto undescribed but in all essential characters normally developed Lycids.

The female has so completely reduced her metamorphoses that in her external features, she is perfectly larviform. No marked pupa or imago-stage exists. As a worm-like creature she crawls sluggishly about on the ground and dies after having deposited her numerous eggs. Copulation and oviposition take place in a quite normal way. The female has specialized in the direction of larger size, premature development of the sexual organs and in reducing the normal metamorphoses to an absolute minimum.

It seems certainly strange that the female after the last ecdysis remains whitish and unpigmented. A close examination, however, shows that a diffuse casting of skin takes place after the development of the sexual organs, or in most cases after oviposition, when the body shrinks together and therefore the thin transparent skin becomes more conspicuous. (Plate III Fig. 2a). This partial casting of the skin seems to be more or less confined to the dorsal side and is probably the last reminiscence of a former regular pupal stage, which we must suppose the female to have possessed during earlier geological periods when it was more similar to the male and not yet so highly differentiated in the way of retrograde development.

It deserves in this connection to be mentioned that many, if not all of the normally developed Lycids show a distinct tendency to retain the last larval skin when pupating. When in Borneo I bred hundreds of the gregarious larvæ of *Lycostomus gestroi* Bourg. They all kept their skin when pupating. The advantages of this are apparent. The larvæ are black with bright yellow markings, which serve as warning colors. Their principal enemies, birds, reptiles and carnivorous insects know by experience their nauseous properties and a *Lycostomus* larva is therefore never attacked. The insect makes use of the well-known warning coloration to protect the whitish-yellowish pupa, by keeping the larval skin as a cover. The larval skin bursts on the sides and the dorsal as well as the ventral sides remain covered by the brightly colored larval skin.

It is therefore possible that the diffuse casting of a thin skin in the female of the "trilobite-larvæ" after the oviposition or after the development of the sexual organs is to be explained as a reminiscence of the habits of its ancestors to pupate within the larval skin.

Strictly speaking the present day female of the "trilobite-larvæ" represents nothing more than a strongly condensed form of a larva and pupa and imago of a Lycid-female.

The larva is clearly indicated by the larva-like organization in general, simple eyes and mouth parts, one clawed-tarsi and 9 abdominal segments; the pupa by the general lack of pigment and probably by the diffuse casting of a thin postlarval skin; the imago finally by its sexual maturity.

The discovery of egg-laying larva-like females and the first male of the "trilobite-larvæ" of large size from Borneo makes it highly probable also that the other large "trilobite-larvæ" from Borneo and other parts of the Oriental Region are nothing but female-larvæ of Lycid beetles. When the male of the second largest species from Borneo has proved to be such a small Lycid it is probable that the males of the other smaller species belong to the smaller forms of the Lycidæ. The characters of the first male known point decidedly towards a fairly close relationship with the genus Dihammatus of which so far as I am aware only three species are recorded from Borneo (*D. pallens*, *D. abditus*, *D. bornëensis*), some few other ones from Java, (*D. cribripenuis*) Sumatra, (*D. atriceps*) and Formosa (*D. atricolor*).

That our knowledge of the Lycid beetles is, indeed, only in its infancy is clearly shown by the large number of new genera and species described by the well-known German entomologist, the indefatigable Mr. R. Kleine. My own material from my expedition to the unknown Mt. Murad has already been worked by Mr. Kleine and his results will be published in the next number of the Sarawak Museum Journal. More than 66% of the forms are unknown and there are many new genera. Professor C. F. Baker of Manila, who so keenly and in a most admirable way has devoted his time and efforts to the exploration of the insect-fauna of the Philippines, informs me that Kleine recently has doubled the number of Philippine Lycids.

Unfortunately I was not able to study the development of the eggs which may prove to be of extraordinary interest. When the male and the female are so extremely different not only in size but in their whole organization, it is highly probable that the male-larva is very different from that of the female, *i. e.*, the "trilobite-larva" we find crawling on the ground. Are the male larvæ already "*ab ovo*" different to the female-larvæ and of what shape and form are they? And how large a percentage of a female's 300-400 eggs turn into males, how many into females? Where and how do the male-larvæ live and where the males, both being obviously extremely hard to find?

All these interesting questions remain to be settled!

Methods Of Securing Males Of The "Trilobite-Larvæ."

It is certainly strange that the "trilobite-larvæ" have for so long frustrated the efforts of the entomologists to solve their mystery. I am quite sure that if I had not been so persistent in my searches and during so long a time devoted special attention to the problem in the field, I also should have failed.

My experience clearly shows that the males of the "trilobite-larvæ" can be got only by bringing together a large number of the larvæ and keeping them under conditions as natural as possible until they turn into egg-laying forms. These have to be exposed at suitable places where the larvæ are abundant and during the wet season, when the males seem to have developed into winged beetles. Change in temperature and altitude should be avoided so much as possible. Finally the hunter should arm himself with great patience!

Such exposure at the right place remains to be done with five more Bornean forms and with the various larvæ found in Java, Sumatra, Malay Peninsula, Cambodja, Indo-China and the Philippines, from which latter faunistic region Professor C. F. Baker with usual generosity and kindness has sent me a couple of species from the Island of Mindanao.

Supposed Luminosity Of The "Trilobite-Larvæ."

It has been stated from time to time that some of the "trilobite-larvæ" are luminous.

The first entomologist to make such a statement was Kolbe (Ent. Nachr., No. 3, 1887, page 38). He states that "Das Königl. Museum bekam wieder um eine Anzahl dieser Larven von Hr. von Faber, die derselbe in Padang an der Westküste von Sumatra gefunden hat und welche anscheinend übereinstimmen mit den schon seit langer Zeit in Besitz des Königl. Museums befindlichen Exemplare aus Java. Nach Angabe der dortigen Bewohners sollen sie im Dunkeln leuchten, aber ich habe keine Gelegenheit gehabt es selbst zu sehen. . . . . Man sieht daher dass nicht nur die Larven der Lampyriden und einiger Telephoriden (Phengodes) sondern auch von Lyciden leuchten."

As seen this statement is entirely based upon the natives' vague information. It is more than credible that a confusion with *Lampyrid* larvæ has taken place for no other reliable entomologist, who has handled "trilobite-larvæ"—with one exception, which will directly be dealt with—has been able to observe any luminosity. Kolbe's conclusion that certain Lycids show luminosity is certainly very rash and can hardly be taken seriously.

The only white observer who mentions something about personal experience with luminous "trilobite-larvæ" is Shelford (Rep. Brit. Assoc. 1901, page 690). In a short note he refers to: "Some other Malacoderm larvæ of considerable size (50-80 mm.) were frequently met with, but their life-histories were not traced; in fact these larvæ have long been a complete puzzle to entomologists, since no adults of corresponding size are known. The external features of one form has recently been described by Bourgeois (Bull. Soc. Ent. Fr. 1899 page 58-63); the head is extremely like that of the Lycid larvæ noted above and in other points of its anatomy it agrees with those forms. . . . . In another form with a pair of phosphorescent organs in the penultimate segment of the abdomen the cuticle is glandular."

To what larva the latter statement refers, we get no further information. I have carefully examined all the "trilobite-larvæ" in the Sarawak Museum, but fail to find even the slightest trace of luminous spots or organs in any of them. The very same thing applies to all the various "trilobite-larvæ" I have handled in a living state.

As it is hardly credible that Shelford had access to any other "trilobite-larvæ" than those that I have seen, I think we can safely conclude that he has based his statement on a Lampyrid larva, many of which occur in Borneo, some reaching a fair size.

I therefore maintain that so far no definite and convincing statement about luminous Lycids exists.

The First Known Male And Female Of The "Trilobite-Larvæ."

Duliticola gen. nov.

♂: Somewhat allied to the genus Dihammatus but differing by having more strongly developed and more curved mandibles, the 2nd and 3rd joint of antennæ more sharply set off from the

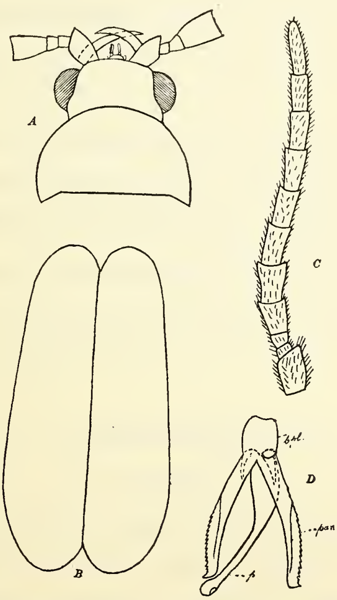

Fig. 1. Male of *Duliticola paradoxa* op. nov. *A*, head and prothorax from above; *B*, outline of elytra; *C*, antenna; *D*, genitalia.

others, the joints more transverse, slightly emarginate at the dorsal end, laterally more compressed and more strongly hairy; prothorax more semicircular with the sides more plainly set off and more rounded, stronger and more robust; legs and the genital apparatus in the male of much more slender and much different type.

Head broad, transverse; antennæ distant, long and slender, second and third joints much shorter than the others; eyes large, prominent, coarsely facetted. Prothorax semicircular, lateral parts flattened and plainly set off by a deep impression. Elytra showing signs of indistinct ribs, interstices slightly rugose, increasing considerably in width backwards, richly hairy; wings of the ordinary Lycid-type, but membrane strongly infuscate giving the whole wing a blackish appearance. Legs richly hairy; tarsi long and slender. Abdomen showing eight transverse segments, all finely hairy, the eighth tergite at the anterior margin deeply excised; genital segment consisting of a dorsal elongate lamella and a much shorter ventral one; penis and paramera of a slender type as shown in text fig 1, D; paramera hooked at the apex, distinctly serrated at the lower margin, apparently forming an effective clasping-apparatus during copulation.

♀: In everything like the female larva (*vide* description below) but yellowish white; the row of tubercules on the sternites placed on more distinctly set off parts of the segments; the eighth sternite very much emarginated at the hind margin and here the sexual duct, surrounded by genital valves, opens (Plate III fig. 2a).

Size slightly smaller than in the full grown larva, ranging from 65-75 min.

Duliticola paradoxa sp. nov.

Imago.

♂: Entire body with the exception of the somewhat lighter colored sides of prothorax black, depressed, broader behind.

Antennæ long, laterally compressed, densely hairy, basal joint robust, partly receiving the base of the second, which is short and cylindrical; third much broader than long, tapering toward the base, fourth to sixth about one and one-half times longer than broad; slightly emarginate at the apex, seventh to tenth gradually becoming longer and more slender, apical joint the longest, being fully four times longer than broad, at the apex rounded. Frons vertical, labrum thin, membranaceous, tapering anteriorly, slightly emarginate in front and here transparent; mandibles very strongly developed, perhaps serving some purpose in copulation, maxillæ and labium of the normal type; sides of head behind the eyes strongly converging backwards. Prothorax more than twice broader than long, nearly semicircular, disc with a slight transverse basal impression, shining, hind margin emarginate, hind angles slightly protruding, obtuse; scutellum fairly big, triangular, rounded at the tip. Elytra showing a tendency to develop faint longitudinal costæ, widened towards the tips, posteriorly rounded; tibiæ long and slender; claws with a small tooth-like dilatation at the base. Abdomen narrow, the first seven segments fairly equal in size, hairy. Measurements: Total length 7 mm. greatest width 2.7 mm.

Habits: Nocturnal.

Locality: Mt. Batu Gading near Lundu, altitude 1500-3000 feet, Sarawak. Probably distributed over a wide area. Its ♀ larvæ found by me (1 spec.) near Lio Matu on the Baram River and on Mt. Dulit on the Tinjar River, North Sarawak, altitude 2000-4000 feet.

♀ (Plate III fig. 2a): Of very large size, in general shape and appearance like the female-larva, but yellowish-white.

Measurements: Slightly smaller than the full grown larva, ranging from 65-75 min.

Adult-Larva

♀: Body black, except a small median patch at the posterior margin of all thoracic and the first eight tergites, which is yellowish; abdominal processes and lateral margin of thoracic segments whitish; the whole upper surface finely shagreened and punctured. Head small, completely retractile within the prothorax; antennæ retractile, two-jointed, terminal joint hairy, provided with several holes in the chitin where probably sense organs of some kind are placed; mouthparts very incompletely developed, mandibles curved, more or less membranaceous and folded horizontally, maxillæ small, maxillary palpi three-jointed the second joint only half the size of the basal one, the apical joint very small, weakly pointed. Labium anteriorly forming a small chitinous ring on which the small 2 jointed labial palpi are inserted, the terminal joint pointed; head forming a solid chitinous case, sides from the base of the antennæ to the small simple eyes parallel, from these converging backwards; eyes in the living animal marked by a small pigmented spot. Prothorax forming a large triangular shield, in the middle of the front margin with two small tubercles and two corresponding ones on the ventral side, hind angles obtuse, at the posterior margin in the middle with two small black shining tubercles; meso- and metathorax broader, more rounded at the sides, both with a pair of small black tubercles separated by a yellowish patch at the hind margin, both segments with a pair of extraordinary large spiracles. Legs consisting of a long and robust coxal part, a trochanter-like one, a tibial and a tarsal one which is hairy below and bears at the end a single strong and sharp claw. Abdominal tergites nine in number, the first seven fairly equal in size, the eighth and ninth gradually becoming smaller, the hind angles of all segments protruding as a backwardly bent process of lighter color and with a pair of black tubercles separated by a yellow patch, except on the apical segment, where the tubercles are missing; posterior margin of last segment slightly sinuate; the corresponding sternites show the lateral parts set off by a deep furrow, in the middle with two rows of protruding spines, which at the top carry a tuft of dirty white bristles. On the distinctly set off lateral portions of the segments there are two rows of tubercles, one interior consisting of small black tubercles and one exterior row of large slightly curved processes which become lighter colored towards the tips; obviously these rows of ventral tubercles serve for locomotory purposes, enabling the larva to move about on the loose jungle soil; the terminal segment with a large circular round whitish suction disc.

Measurements: Total length 75-80 mm. Greatest width of metathorax 25-30 min.

THE SYSTEMATIC POSITION OF THE GENUS DULITICOLA.

From what has been said above the genus Duliticola possesses all the essential characters of the family Lycidæ and should therefore be placed there.

When still in Borneo I tried hard to identify the first known male of the well-known "trilobite-larvæ". Owing to lack of access to literature I could not settle the question locally. I therefore sent a specimen to the well-known entomologist Mr. C. F. Gahan of the British Museum asking him for his opinion. Mr. Gahan informed me that he considered the beetle to be a Lycid and belonging to a genus related to or perhaps identical with Dihammatus.

Later on I sent also a specimen to the well-known German entomologist and Lycid specialist, Mr. R. Kleine of Stettin, who declared that no Lycid of any similar type was known to him and that he thought the beetle to be a Drilid.

Before leaving Borneo I was kindly offered an opportunity by Professor W. M. Wheeler to come to America and to take up some research work at the Bussey Institution. I gladly accepted his invitation and had there an excellent opportunity to go into the question in detail myself.

There can in my mind hardly be any doubt that Gahan's statement that the beetle is a Lycid is correct. My close examination, however, shows that it can under no circumstances be placed in the genus Dihammatus. It differs distinctly in the shape and build of the antennæ, the shape of the prothorax and above all in the male genital apparatus, from a specimen of *Dihammatus abditus* Kleine which Mr. Kleine has been kind enough to send me for comparison.

The reasons why Kleine seems to favor a position in the Drilidæ are partly because the middle-coxæ of my beetle are not quite so distant as in most Lycids, and partly because normally developed females of all known Lycid-genera are known.

With reference to Kleine's first objection, I find that the characters "coxæ contiguous" and "coxæ distant" are fairly relative ones, different degrees of both being traceable within the family Lycidæ. The male-specimen of *Dihammatus abitus* Kleine from Sandakan in North Borneo, treated with caustic potash shows the middle-coxæ more nearly contiguous (less distant) than in the males of *Duliticola paradoxa* Mjöb, treated in the same way. I therefore consider that not too great stress should be laid upon this character.

It is certainly a strange fact that not a single of the many known Lycid-genera known up to now are characterized by larviform females, normally developed females of all described genera according to Kleine being known.

As I find that my beetle can not be received in any of the known genera I have been forced to create a new one. The fact that no similar beetle is represented in the rich collections of the Sarawak Museum and in no other collections I have seen (Singapore, Java, Manila) would certainly point to the belief that the male of *Duliticola paradoxa* Mjöb. as well as of the other "trilobite-larvæ" must be extremely hard to get. It took me fully two years of more or less continuous field work to procure the first male and it was only thanks to the numbers of sexually mature females exposed and to my persistent attempts that I was successful in securing it. Obviously the males must live in such a hidden way that they do not fall in the hands of the chiefly diurnal entomologists and collectors. The circumstances that they are exclusively nocturnal and non-luminous have also much weight. Also the fact that the males are not attracted by strong light helps to explain why they have so far escaped all entomologists. During my long and tedious nights in the Bornean jungle I kept permanently two big light traps going, consisting of a big basin in four sections filled with water and measuring about a meter in diameter with a 250-candle power lamp ("Storm King") hanging immediately above the water. Every night thousands of smaller creatures were attracted and caught on the water. Among the victims were several male lampyrids of the genera Lamprophorus, Lucernuta, and Luciola but not a single male of *Duliticola paradoxa* Mjöb.

As all observed males of Duliticola seem to die directly after the copulation it is probable that they fertilize only one female. That they are not so scarce at the right place and at the right time is evidenced by the fact that my collectors managed to catch over a dozen specimens at the very same place, after I had found out the right way to expose the females.

As full grown female-larvæ can be collected in great numbers, sometimes in hundreds within a shorter time than a week, and at almost any time of the year, it is only logical to conclude that males also must be developed fairly regularily, since parthenogenesis does not seem to occur. That there is no standstill in the tropics is a well-known fact and it is indeed corroborated by the fact that larvæ kept in captivity by me continuously developed into mature females the whole year round.

It seems therefore probable that the males, guided by their senses, find their way directly to the hidden females and die on the spot immediately after copulation. This may be the explanation why they are so rare in nature and have so far escaped entomologists and collectors. The same obviously applies to the females which can be said to be still more scarce, as in no single instance has a mature female yet been found in the field. The life history of the imagines of both sexes is therefore still wrapped in mystery.

The type of antennæ and the general structure do not permit me to place the genus Duliticola within the family Drilidæ, all known females of which are carnivorous. This applies also to the Drilid larvæ known up to now, which are very different from the "trilobite larvæ" in all more important features, while these latter undoubtedly remind one strongly of certain Lycid larvæ, for instance, the larva of the genus Lyropæus as described by Gravely.

It is, however, a noteworthy fact that Duliticola and in all probability also the other genera of "trilobite-larvæ" which undoubtedly soon will be discovered, differ strongly from the ordinary Lycids in following striking features:

1. Neoteinic larviform females.
2. No externally visible metamorphoses in the female sex.
3. Female larvæ reaching a gigantic size, with reduced mouthparts.

4. Non-carnivorous, non-gregarious, feeding on decaying damp wood.

As pointed out previously the "trilobite-larvæ" must belong to different genera. As normally developed females are known of all described Lycid genera and as it is utterly incredible that one and the same species should possess both winged and larviform females normally as Gravely suggests (*l. c.* p. 362) I venture to prophesy that several new genera of "trilobite-larvæ" will be described in the future. If these should possess more strange characters than does Duliticola, compared with normal Lycids (*viz.*, Dihammatus) it would perhaps be justifiable to separate the group of "trilobite-larvæ", characterized by so many strange features and habits, as an offshot of primitive Lycoid beetles and give them the rank of a family or sub-family of their own (Duliticolidæ of Duliticolinæ) related to the other four groups of malacodermata and *via* Duliticola more so to the Lycids than to the Lampyrids and Drilids.

But at the present moment our knowledge of these queer creatures is too scanty to justify such a step.

Food And Habits Of The "Tribolite-Larvæ."

The "trilobite-larvæ" are chiefly found on or in the vicinity of big rotten logs, sometimes several near the same spot, but as a rule they do not show any tendency of being gregarious, odd larvæ often being found crawling about anywhere in the jungle. They like rainy weather and are mostly found crawling around after heavy showers.

The larvæ feed on the juice of decaying wood, as clearly evidenced not only by the contents of the stomach but also by direct observations. But they seem to be very particular in getting the right kind of wood. When changing food every day I had many opportunities to study their behavior. Often they crawled over the new pieces of wood put in the cage until they came to the proper kind. There they used to accumulate and I could plainly see by aid of a powerful magnifying glass that they actually were sucking the juice from the wet pieces of wood. Larvæ killed and examined some hours afterwards were found to have the stomach and intestines full of a dark mass of decayed woody products, reminding one of the material found in longicorn larvæ.

When touched the larva withdraws its head very quickly and remains still for a time. Slowly the head is again thrust out and the larva continues its slow crawling.

When taken between the fingers the larvæ secrete a kind of mikly white substance between the segments and the joints of the legs, which apparently serves some protective purpose. No living being in the jungles seems to be inclined to attack or feed upon the larvæ on account of their nauseating properties. In the numerous stomachs of birds which I purposely examined in search of parasites, I have failed to discover any remains of "trilobite-larvæ."

Peculiarly enough I have never been able to find larvæ of smaller size than 15 min. Probably the female deposits her eggs in the interior of big hollow decaying logs and the young larvæ remain in their birth place until they have cast the skin several times.

The larvæ grow very slowly, as many of them kept by me in captivity have remained unchanged and cast no skins during more than six months. In all probability the larva requires several years to become full grown.

It is equally strange that one never finds the adult females in nature. Although having for years hunted through the jungles in search of other invertebrates, both myself and my trained collectors, and having turned every stone and split up thousands of pieces of decaying wood or heavy logs I have never been able to find a single fully developed female, in spite of the fact that full grown larvæ were abundantly common thereabouts. Where she undergoes her last ecdysis still remains a mystery. As the larvæ are very feeble, helpless creatures they can neither live a subterranean life by digging themselves down into the ground nor by boring themselves into the wood. It is, however, possible that the female manages to reach the interior hollow parts of a big heavy log, which is comparatively sound and where entomologists do not gain access.

Different Species Of "Trilobite-Larvæ" Found In Borneo.

The following types of "trilobite-larvæ" are known to me from Borneo:

No. 1. (Plate III fig. 1)

♀ : *Larva*: A very large remarkable form, shining black with a row of four bright sealing-wax red tubercles at the hind margin of the thoracic segments and two rows of median sealing wax red tubercles on the hind margin of the first eight abdominal segments. Also the margins of the thoracic segments of the abdominal segments are of the same bright color. The anterior prothoracic margins show two small tubercles or processes just behind the head; the prothorax is of a triangular shape, with rounded, obtuse hind angles, the sides of the meso- and metathorax are more parallel; all three segments are distinctly punctured and with a slight median, smoother elevation.

Measurements: Greatest length 92 mm., greatest width 20 mm.

Locality: Mt. Murad, N. Sarawak.
Altitude 4000-7000 feet.

Adult ♀ : In everything similar to the above described larva, but with a sexual opening, surrounded by genital valves on the eighth sternite. Color yellowish-white. Size slightly smaller than the larva. ♂ unknown!

No. 2. (Plate III fig. 2)

♀ : *larva*: *Duliticola paradoxa* sp. nov. *vide* description above.
Adult ♀ : *vide* description above.

No. 3. (Plate III fig. 3)

Cinnamon colored, with two black shining tubercles on the thoracic and the first eight abdominal segments; the abdominal lateral processes dark colored. Prothorax more rounded behind than in larva No. 1 and the hind angles smaller, metathorax with more protruding hind angles.

Closely related to No. 1 and probably belonging to the same genus.

Measurements: Greatest length 80 min.
Greatest width 18 min.
Locality: Mt. Murad, N. Sarawak. Altitude 6500 feet.
Adult ♀ and ♂ unknown!

No. 4. (Plate III Fig. 4).

Resembling No. 3; cinnamon colored like it, but the posterior prothoracic angles more rounded and the meso- and metathorax differently shaped, the rows of tubercles not so pronounced and between them a dark colored fascia. Otherwise like No. 3 and probably a species of the same genus.

Measurements: Greatest length 45 min. (if full grown?)
Greatest width 16 min.
Locality: Mt. Dulit, N. Sarawak.
Altitude 3500-4000 feet.
Adult ♀ and ♂ unknown!

No. 5. (Plate III Fig. 5).

The ordinary common type from the lowland frequently mentioned and figured by various authors.

Body strongly depressed, thin as a leaf, light brown, thoracic segments strongly dilated, with a streak-like mark on each side.

Measurements: Greatest length 40 min.
Greatest width 25 min.
Locality: Kuching and surroundings, Ramboengan, Lundu, South Sarawak. Especially common during the rainy season (Nov.-March).
Adult ♀ and ♂ unknown!
Represents another distinct genus!

No. 6. (Plate III Fig. 6).

The type figured and briefly described by Westwood. Of much more elongate and parallel-sided type than the previous ones.

Measurements: Greatest length 50-55 min.
Greatest width 13 min.

Distribution: Kuching, Lundu, and some other lowland localities, South Sawawak.

Larva of very similar or identical type occurs also in the Malay Penninsular and Sumatra.

Represents a distinct genus!

♀ *Adult*: In everything similar to the ♀ larva and like it colored dark brown although a diffuse casting of the pupal skin seems to take place.

♀ :-Unknown!

The above mentioned larvæ represent, to judge from their external appearance, the following genera:

I. A probably unknown genus with No. 1, No. 3 and No. 4 as species. (All mountain-forms!)—Borneo.

II. A new genus related to Dihammatus and described above as Duliticola. The larva of the only known species represents a type of its own quite unlike the other ones.—Borneo.

III. A genus of its own and on account of the abundance of the larva probably of an already described genus, but which? —Borneo.

IV. A genus of its own, but not so far known. Quite a distinct type.—Malay Peninsula.

"Trilobite-Larvæ" From Other Parts Of The Oriental Region.

From time to time there have been "trilobite larvæ" specifically described and figured from Java, Sumatra, Malay Peninsula, Cambodia, Cochin, Burma, Ceylon, the Philippines, etc. How many species and genera they really represent it is impossible to state with our present scanty knowledge.

I have personally seen only the larva No. 7 of Plate III which was sent me from the Kuala Lumpur Museum and which comes from the Malay Peninsula. It is somewhat similar to larva No. 5 from Sarawak, but has more strongly and differently developed tubercles on the thoracic segments, and is surely specifically, if not also generically distinct from the Bornean one. Its body is not so flattened and its size larger (45 mm.).

Of the Philippine larvæ I have seen a collection belonging to the Bureau of Science, Manila, and think that there are at least three different fairly closely related types or species represented. They all come from the island of Mindanao. The only hope of solving the identity of the species would be to send a trained entomologist to the island with strict orders not to return before he has endeavored to breed them out.

General Discussion of the Development of Lampyridæ, Drilidæ, Telephoridæ and Lycidæ.

Of these four families, forming the group of the Malacoderms (*s. str.*) the Lampyrids show a marked tendency to develop larviform females, the retrograde development being confined chiefly to the elytra and the wings. All degrees of reduction seem to be represented, from females exactly like the males with fully developed elytra and wings down to entirely apterous larviform females.

It is of interest to note that a reduction also seems to take place in some of the males. But all males have wings except in the genus *Phosphœnus*, where the elytra are reduced to small rudimentary lobes, the wings entirely absent.

All Lampyrid-females pass through a normal pupal stage and the imagines are characterized by possessing well developed antennæ, compound eyes, two claws, etc. No traces of hypermetamorphosis can be found.

In the family Drilidæ conditions are practically the same, though slightly more complicated. The larva in its first stage is quite different from the so called "inactive form" or second stage, which is more like the pupa and therefore has been termed "pseudopupa."

According to Grawshay (Trans. Ent. Soc. Lond. 1903., pp. 39-51.) "the winter form into which the undeveloped larva changes about the middle of September, or often earlier, as stated, is incapable of feeding or of more than a heavy grub-like motion, when disturbed. In general outlines it much resembles the ordinary form of larva but it rather perhaps deserves the term "false pupa." The setæ are absent, the body being almost entirely soft, of whitish color and except on the last three or four segments, almost hairless. The head is small and pale with the mouth parts rudimentary and the antennæ very short, modified. The legs are soft and short with the claws absent and replaced by a small prominence. The processes of the body are much smaller and less distinct, with only a few white hairs, until the last three or four segments where they become rather thickly hairy, but with the hairs shorter than in the larva. The terminal processes are likewise shorter but with the spines long (Plate III. Fig. 2a). This skin is cast about the middle of May and the larva then reappears from the shell in its ordinary form continuing its life as before, until it is full fed in the second or probably in most cases the third summer. When full fed it changes into a second inactive winter-form which more nearly approaches the pupa and which like the other, may be aroused early or late in the year. Though this is very similar to the previous one, it differs from it especially in the much more stumpy form of the antennæ and of the processes of the last three or four segments."

Another author, Rüschkamp, (Biol. Centralbl., 1920, page 376-389) corroborates Grawshay's above quoted statements about the life history of *Drilus flavescens* and gives the interesting information that he has been able to shorten or prolong the different stages by changing the degree of humidity and food. Such change of a larva from an active to an inactive stage could be brought about after only thirteen days. The larva seems to have the ability of adapting itself to the prevailing circumstances by changing over from the active to the inactive stage, whenever necessary or "*necessitate coacta,*" an extraordinary thing showing how plastic in their habits certain members of the large and undoubtedly primitive group of malacoderms are.

The pupa of the male Drilid is a normal beetle pupa. The female pupa resembles very closely the last inactive form of lava. Thus a tendency to reduce and simplify the originally normal pupal stage is clearly distinguishable.

The females of the few Drilids, the life history of which is known are even more larviform in their general appearance than are the Lampyrid females. A distinct resting period is undergone and the female is in all essential characters an imago, possessing many-jointed (10-11) antennæ, compound eyes and two claws, but lacking all traces of elytra and wings and therefore extremely larviform.

It is in this connection of interest to note that in the female also a reduction of the antennæ is noticeable. These show only ten joints, the apical one being reduced to a small appendage only, reminding of the small accessory appendage often found in the larval antennæ.

In some cases even a further reduction seems to take place. According to Grawshay "the antennæ of the female are normally composed of 10 joints (omitting the supplement) but the ninth joint is often imperfectly formed being sometimes confounded with the preceding one so as to be scarcely visible, and sometimes entirely absent." This deformity may even appear in different degrees in the two antennæ of the same insect. The Drilids therefore show a much greater degree of retrograde development than the Lampyrids.

The extensive group of the Telephorids shows as a rule quite normal conditions. Both sexes are equally well developed and typically predaceous, in this latter respect agreeing with the larvæ of the two previously mentioned groups. A strikingly exceptional type, however, is the remarkable American group Phengodini, where the sexes differ greatly from each other.

Thanks to Haase's excellent paper (Zur Kenntnis von *Phengodes*, Deutch. Entom. Zeits. 1888) we know that the Phengodes female has developed in a retrograde direction to an extremely larva-like creature. The male on the other hand is an elaborately developed beetle with highly specialized antennæ. According to Haase and Riley the female differs from the larva only by having "more feeble mandibles and tarsi" than the larva. It passes, however, a distinct pupal stage as is also corroborated by Mr. H. S. Barber in a letter to me.

In Sharp's "Insects" of the "Cambridge Natural History" the following startling statement about Phengodes is found: "There is no reason to doubt that Haase was correct in treating the insects we figure as a perfect insect; he is, indeed corroborated by Riley. The distinctions between the larva and female imago are that the latter has two claws on the feet instead of one, a greater number of joints in the antennæ and less imperfect eyes."

The source of this error of Sharp's is difficult to find. As stated previously no such distinctions do exist as already pointed out by Haase and Riley and furthermore corroborated by Mr. Barber in a letter to me of recent date.

Through the kindness of Mr. Nathan Banks I have had the opportunity of examining two larvæ and a female of *Phengodes*. There can be no doubt about the error of Sharp's statement. No such differences as pointed out by him exist. But on the other hand the differences between the female and the larva seems to be great. Whereas the fully grown larva is a pale-looking soft-bodied creature with a comparatively small head, the adult female in general appearance more suggestive of an Elaterid-larva, shows strongly chitinized, dark brown tergites with large, yellow, more or less square patches indicating the site of the luminous spots. The head in general and the mandibles are much more strongly developed, as well as the legs. In many ways the female really conveys the impression of an imago. When preparing for pupation the Phengodes larva burrows itself down in the ground and rests for a period of several weeks.

Like the Lampyrid Drilid and Telephorid larva the Phengodes-larva is carnivorous, and according to observations feeds upon myriopoda of the family Julidæ, which are often subterranean in their habits.

The specialization *via* retrograde development in the Phengodes female is thus carried to an extreme, the female being more vermiform than in the three previously mentioned groups, but still showing certain distinctions from the larva and still undergoing a pupal stage.

Finally, in the fourth group, the Lycidæ, both males and females are normally developed beetle imagines. Their larvæ so far as known, are Lampyrid-like, carnivorous and in some cases at least gregarious.

The only genus showing a tendency to develop reduced females seems to be Homalisus, the systematic position of which, however, does not seem to be definitely settled. Thus according to Fowler (The Coleoptera of the British Islands, p. 126) "the synthetic genus Homalisus ought perhaps to be removed from the family (Lycidæ) and regarded as is done by some authors as a separate family in itself."

In his splendid work, "Fauna germanica" Reitter keeps the position of the genus Homalisus in the Lycidæ and adds with reference to *H. frontes bellaquei* Geoffr: "Das sehr seltene ♀ hat nur ganz kurze klaffende Flügeldecken und die Tergiten liegen frei."

I have not been able to find any more recent references to the germs Homalisus. But in all other respects the female is a normally developed beetle.

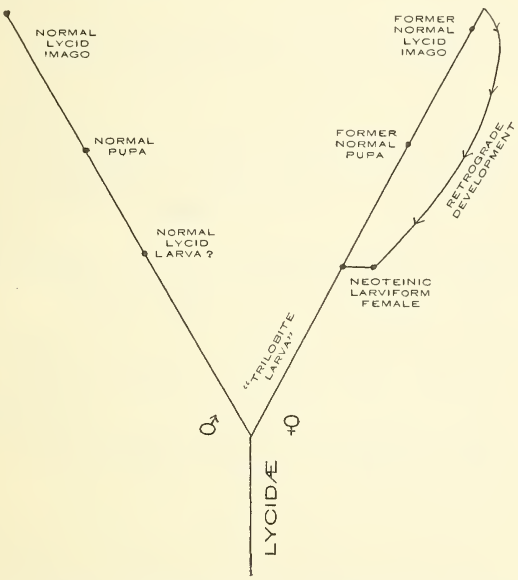

Fig. 2. Diagram illustrating the types of metamorphosis in the Lycidæ.

As a very striking example of retrograde development among the Lycid females we must now add the females of the Bornean "trilobite-larvæ". All the three vermiform females I have been successful in breeding (*Duliticola paradoxa* and the females marked as No. 1 and No. 6 (Plate III) show no differences whatsoever from the larvæ except in color and in possessing sexual organs, ovaries, duct and aperture; and pass through no marked pupal state. The full grown larva simply rolls up openly for some days as does the larva when casting its skin, sheds the larval skin and turns into an adult female with the same head, simple eyes and one clawed tarsi as the larva. The two females bred without any complications (which as stated before happened to No. 1) behaved in exactly the same way, kept still for some days and started to deposit eggs and to expose the sexual opening by turning upwards the tip of the abdomen and secreting from the sexual aperture a drop of clear liquid.

The small group of Lycids which has developed in this queer direction, of which the larvæ up to now have been known as "trilobite-larvæ" is confined to the Oriental region. They belong undoubtedly to several genera and represent the most degraded forms known among the non-parasitic beetles. Judging from the abundance of the larvæ in the field, their peculiar regressive development seems to be a successful specialization. They differ also from normal Lycids by being non-carnivorous, with their mouthparts very much reduced, enabling them only to suck the juice of decaying wood. Their larvæ are further more non-gregarious and typical jungle insects, whereas most Lycids are gregarious and love sunny open places.

The group apparently reaches its maximum of size and variety in Borneo. Up to now six distinct forms are known from there, but future investigations will undoubtedly show that the "trilobite-larvæ" are richly represented in the central mountain chains of Borneo, a region which, however, still falls outside the beaten track.

It has long been established that the Malacoderms have to be placed among the more primitive forms of beetles. This explains partly why the members of this group which is in many ways undifferentiated display great plasticity in various directions. In all four families we find steps towards higher specialization mostly in retrograde direction, this applying chiefly to the females. In the Drilids a kind of hypermetamorphosis is found. Some of the Lampyrids show prothetely (*vide* Williams, Psyche, Vol. XXI. No. 4, pp. 126-129).

The most degraded forms are undoubtedly the females of the "trilobite-larvæ" which have reduced the metamorphosis to an absolute minimum and are practically larvæ with full possibility of propagation.

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EXPLANATION OF PLATES.

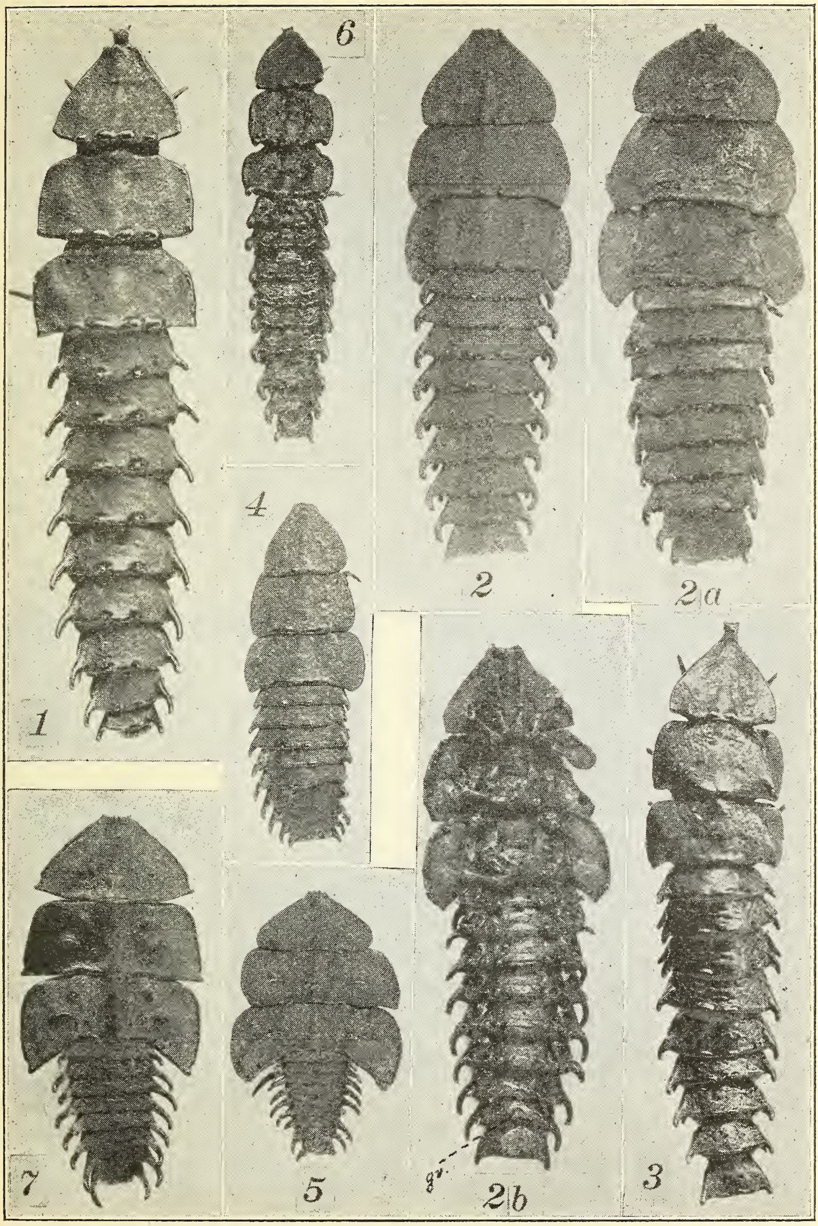
Plate III

1. "Trilobite larva" No. 1, Borneo.
2. Larva of female of *Duliticola paradoxa* gen. nov. and sp. nov.
2a. Adult female of *Duliticola paradoxa* gen. nov. and sp. nov.
2b. Ventral view of same.
3. "Trilobite larva" No. 3, Borneo.
4. "Trilobite larva" No. 4, Borneo.
5. "Trilobite larva" No. 5, Borneo.
6. "Trilobite larva" No. 6, Borneo.
7. "Trilobite larva" No. 7, Malay Peninsula.

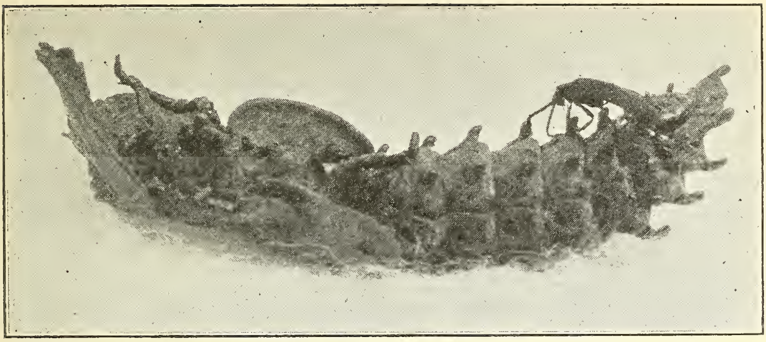
Plate IV

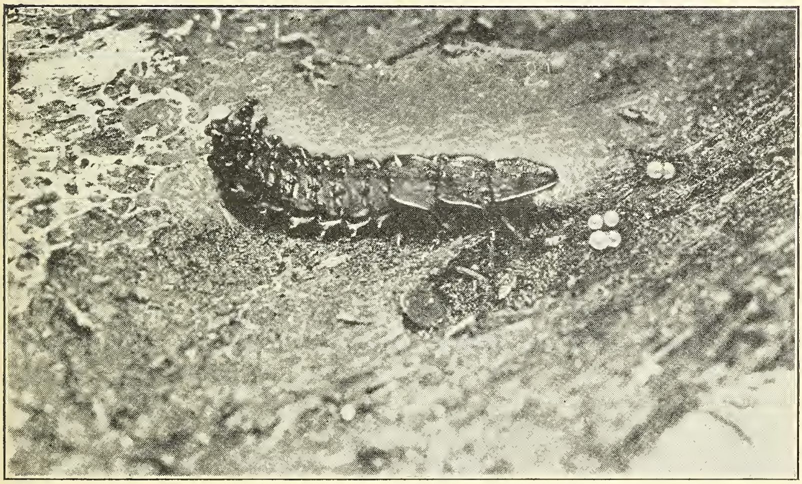
Above: Male and female of *Duliticola paradoxa* gen. nov. and sp nov. *in copula capta* (Twice natural size).

Below: Female of another species with eggs which she has deposited (natural size).



MJÖBERG—"TRILOBITE LARVAE"





MJÖBERG—"TRILOBITE LARVAE"

NOTES ON NEOTROPICAL ONYCOPHORA[1]

By Charles T. Brues.

During the course of the past year I have received for identification several lots of Onycophora collected in Panama, Colombia, British Guiana and the West Indies. These have come from several sources; from the University of Michigan Museum collected by F. M. Gaige, from the U. S. National Museum collected by W. M. Mann and T. E. Snyder, and one from the American Museum of Natural History collected by F. E. Lutz. Other examples were obtained by W. M. Wheeler, T. Barbour and J. B. Shropshire.

This material adds considerably to our knowledge of the distribution of the group in the American tropics and it contains one well marked variety from Panama which has not hitherto been described.

Oroperipatus corradoi Camerano

Boll. Mus. Zool. Anat. Torino, vol. 13, No. 316, p. 2 (1898).
Bouvier, Monog. Onycophores, Ann. Sci. Nat. (9), vol. 2, p. 120 (1905).

There are two females in the collection of the Museum of Comparative Zoology, obtained by Dr. Thomas Barbour in the Canal Zone, Panama. The species was known by Bouvier from Ecuador where it ranges from the sea-coast into the high mountains at Quito, and has since been reported by Clark from Ancon, Canal Zone, Panama.

The present specimens seem to be referable to *O. corradoi* although as Bouvier has already indicated this species is very similar to *O. eiseni* Wheeler described from Tepic, Mexico and since reported from Rio Purus in the Amazon basin in Brazil. He even suspected that intermediate forms might be found in the intervening territory from Mexico to Ecuador. These examples fall much closer to *corradoi* as the nephridial tubercles of the fourth and fifth pairs of legs are completely fused with the larger portion of the third creeping pad and the smaller part of

[1]Contributions from the Entomological Labratory of the Bussey Institution, Harvard University, No. 250.

the pad is distinctly larger than the tubercle. The width of the creeping pads is used by Bouvier as a diagnostic character for the separation of the two species but the form of these in the present specimens do not appear to indicate a clear relationship in either direction. Both females measure about 60 mm. in length in a fully expanded condition and have 28 pairs of legs, a typical number for either species.

Peripatus (Macroperipatus) geayi Bouvier.

R. Acad. Sci. Paris, vol. 128, p. 1345 (1900)

Bouvier, Monog, Onycophores, Ann. Sci. Nat. (9), vol. 2, p. 200 (1905)

Clark, Smithsonian Misc. Coll., vol. 60, No. 17, p. 2 (1913).

Two large females from the Santa Marta Mountains, Colombia, June 6 and 22, 1920 (F. M. Gaige.)

Both measure fully 60 mm. in length and have 31 pairs of legs. They agree well with Bouvier's description of the single type from French Guiana in all details, except in color. The type was evidently completely decolored as the present specimens show distinct indications of a series of lozenge-shaped markings along each side of the median line and a very distinct interrupted dorsal transverse pale band behind the head almost exactly similar to the band of *P. torquatus.* Possibly this collar may indicate a color variety as it is described by Clark (1913) as present in a specimen from La Chorrera, Panama which examined and referred to this species. The head and antennæ are extremely dark in the present examples and the band so much lighter than the body behind it that one would not expect it to disappear entirely even in specimens so completely decolored that the lozenge-shaped markings are practically faded out. Nevertheless, Bouvier makes no mention of such a band and speaks of the antennæ as darker than the head, which suggests strongly that the western form may be distinguishable on this color character. On the other hand there is with one of the Colombian examples, a very poorly preserved specimen quite possibly of this species which shows no indication of any pale band; it appears also to be a female.

Another very large female with 31 pairs of legs from the Cincinnata Coffee Plantation near Santa Marta, Colombia collected by Dr. Wm. M. Mann may be referable to this species. It measures fully 90 mm. in length, with dark beaded median dorsal line and clearly marked lateral broad dark wavy band, dark head and antennæ and narrowly interrupted pale collar. The integumentary papillæ are not separated by clearly marked grooves as in the other examples although these show in some places.

Four other specimens (three collected by F. M. Gaige and one by W. M. Mann) are by no means typical in the arrangement of the integumentary papillæ, but they show the characteristic pale collar and as they are also from the Santa Marta Mountains, Colombia are probably referable to this species. The papillæ are very indistinctly or not at all separated by transverse grooves and the integumentary folds thus resemble those of *P.* (*Epiperipatus*) *edwardsii* and related forms. Most of these specimens are strongly contracted which probably accounts to some extent for their different appearance and a larger series of well expanded examples will be necessary to determine to what extent the character separating Macroperipatus and Epiperipatus may be relied upon in the classification of the species referred to these two groups.

Peripatus juliformis Guilding, var **danicus** Bouvier.

This form was based on a male and female from the Island of St. Thomas which Bouvier regarded as a variety of *P. juliformis*. Later Clark (Smithsonian Misc. Coll., vol. 60, No. 17, p. 4) has elevated this to specific rank, apparently for geographic reasons.

In the present material there is a female from St. Croix, Virgin Islands collected by Dr. F. E. Lutz, bearing the label "Under rotten log, March 2, 1925." It is now in the collection of the American Museum of Natural History. It agrees well with Bouvier's description except that there are 32 instead of 33 pairs of legs, a common number for Jamaican examples of the typical *juliformis*. The body color is very dark, a rich brownish purple with the papillæ much lighter, due probably to the decolorizing effect of the alcohol used for preservation.

The distribution of *P. juliformis* and *P. dominicæ* and their varieties overlap in this region as the former extends eastward from Jamaica through St. Croix to St. Thomas while the latter extends westward from Dominica through Antigua to Porto Rico and to Haiti. So far as I know this is the first specimen of Peripatus to be taken on St. Croix.

Peripatus (Epiperipatus) brasiliensis Bouvier.

C. R. Acad. Sci. Paris. vol. 129, p. 1031 (1899)

Bouvier, Monog. Onycophores, Ann. Sci. Nat. (9), vol. 2, p. 269 (1905)

The types and nearly all of the material of this species seen by Bouvier were from Santarem in the lower Amazon area of Brazil, but he referred a single specimen from Panama to this species with some doubt. Since then the species has been reported from Merida in the interior of western Venezuela.

Recently a number of specimens have come into my hands as the result of collecting by several naturalists at and near the Barro Colorado laboratory in the Canal Zone. A prolonged and careful examination of these has led me to the conclusion that they may be more or less clearly distinguished from the Amazonian representatives of *P. brasiliensis*. Unfortunately no examples of the latter are available for comparison, and it has been necessary to rely upon Bouvier's extended description of the latter for comparison. As will be shown later, the Panamanian form seems to approach *P. imthurmi* in some respects although it could not possibly be referred to this common Colombian species. Certainly it cannot be regarded as a distinct species, but as it seems to represent a well marked geographical race common in a district far removed from the type locality of *P. brasiliensis* it may be best known by a distinctive name.

Peripatus (Epiperipatus) brasiliensis Bouvier, var **vagans,** var. nov.

♀. Length when well extended 65 mm. and probably considerably more to judge from one large contracted specimen.

Tegumentary folds complete on the anterior and middle part of the body, except that there may be very rarely an incomplete fold which bears no relation to the insertion of the legs; posterior third or quarter of body with an incomplete fold more or less regularly on the flank about halfway between each leg and the median line. Anteriorly there is commonly a fusion of two ridges above the leg but in such cases one of the adjacent ridges bifurcates downwards at this point and the number of ridges is not decreased. The primary papillæ vary markedly in size, frequently but not always there is one or there may be two smaller ones between two adjacent large ones. The accessory papillæ are quite numerous, more so in larger specimens and they frequently ascend well on to the ridges often in a pair (one anterior and one posterior) between two primary papillæ. On very large specimens there are occasional groups of three or even four accessory papillæ in groups between adjacent primary ones in addition to a scattering of accessory ones along the edges of the fold. In the largest specimens the primary papillæ are of nearly equal size. Nephridial tubercle on fourth and fifth legs lying in a distinct but not deep emargination of the third creeping pad, the fourth pad usually but little shorter than the third, but much narrower and deeply emarginate next to the tubercle which, however, does not divide the pad. The number of legs varies from 33 to 30 pairs, 32 in the type and 32, 32, 33, 33, 30 and 30 in the paratypes.

♂. The male measures 25-50 mm. in length, with 29 pairs of legs. It is essentially similar to the female although one is evidently not fully grown as the form and arrangement of the papillæ resemble those of the smaller females. The larger specimen shows three small primary papillæ between the larger ones.

There are in all eight specimens as follows: Barro Colorado Island, Canal Zone, Feb. 6, 1924 (T. E. Snyder) (type); Barro Colorado Island, Canal Zone, Feb. 26, 1924 (T. E. Snyder); Rio Tapia, Panama, Feb. 7, 1924 (T. E. Snyder); two from Las Cascadas, Canal Zone, Feb. 12, 1924 (T. E. Snyder); two from Fort Sherman, Canal Zone, February 1924 (J. B. Shropshire); Rio Chinilla, Canal Zone, Feb. 22, 1924 (T. E. Snyder); Barro

Colorado Island, Canal Zone, Feb. 22, 1924 (W. M. Wheeler). The last two are males.

The variety *vagans* may be distinguished from the typical *P. brasiliensis* first by the tendency for pairs of the transverse integumentary folds to fuse above the base of the legs on the posterior part of the body, a condition that has not been found in the typical form where the rare cases of fusion or incomplete folds are irrespective of the bodily segmentation. It differs also in the much greater development of the accessory papillæ which approach the condition found in *P. imthurmi*. The latter form has however, incomplete folds regularly on each segment.

Epiperipatus (Peripatus) inthurmi Sclater.

Quart. Journ. Micros. Soc., vol. 28, p. 343 (1888)
Bouvier, Monog. Onycophores, Ann. Sci. Nat. Zool., (9) vol. 2, p. 275 (1905)

One female from the Cincinnati Coffee Plantation, Santa Marta Mts. Colombia (F. M. Gaige).

Six females from Dunoon, British Guiana (F. M. Gaige, obtained by the Walker Expedition in 1914. These range in size from 25-65 mm. in length; five have 31 pairs of legs and one 29 pairs.

Peripatus (Epiperipatus) edwardsii Blanchard

Ann. Sci. Nat. Zool. (3) vol. 8, p. 140 (1847)
Bouvier, Monog. Onycophores, Ann. Sci. Nat. Zool. (9) vol. 2, p. 301 (1905).

One large and one very small female from the Santa Marta Mountains, Colombia (F. M. Gaige).

Peripatus (Epiperipatus) isthmicola Bouvier.

Monog. Onycophores, Ann. Sci. Nat. (9) vol. 2, p. 329 (1905).
Clark. Smithsonian Misc. Coll., vol. 65, No. 1, p. 24 (1915).

This form was regarded as a variety of *P. nicaraguensis* Bouvier by Bouvier, but has since been listed as a distinct species by Clark (*loc. cit.*)

Four females collected by Dr. Wm. M. Mann at Columbiana Farm, Santa Clara, Costa Rica and a male sent later collected by Mr. P. Siggas at the same place.

These specimens agree well with Bouvier's description based upon five specimens obtained at three localities in Costa Rica. The females have 30, 30, 29 and 29 pairs of legs respectively and the male 27. All are of large size and well expanded, the females ranging from 65-73 mm. in length and the male is considerably smaller (48 mm.). The inner lamella of the mandible bears only one accessory tooth or may show the trace of a second very small one. In Bouvier's material most of the specimens showed a well developed accessory tooth but there seems to be no constant difference. The creeping pads on all the legs are rather narrow and the fourth is very small. On the fourth and fifth pairs of legs the fourth pad is always very much reduced and pushed to one side by the nephridial tubercle. Sometimes it is band-shaped, again rounded and no larger than the tubercle, and again has practically disappeared.

Peripatus (Epiperipatus) biolleyi Bouvier, var. **betheli** Cockerell.

Proc. Biol. Soc. Washington, vol. 26, p. 87 (1913.

This species was described from a single female from the Atlantic seaboard of Guatemala at Puerto Barrios. Five specimens were obtained by Dr. Wm. M. Mann at San Juan Pueblo, Honduras and have been sent for study from the U. S. National Museum.

There are three females, each with 30 pairs of legs; they are in various stages of contraction and measure from 38-55 mm. in length. Two males are much smaller, 22-25 mm. and bear each 25 pairs of legs. All are considerably bleached by the alcohol in which they are preserved and in none are there any traces of a color pattern. The darkest specimen is distinctly brown and thus similar to the "dark wood brown" of the type as described by Cockerell. In the arrangement of the integumentary papillæ, nephridial tubercles, creeping pads and mandibular teeth all agree closely with Cockerell's description, except that in two specimens there are only eight minute teeth on the inner blade of the mandible.

GUESTS OF *ECITON HAMATUM* (FAB.) COLLECTED BY PROFESSOR W. M. WHEELER.

By W. M. Mann,

Entomologist, Taxonomic Investigations, U. S. Bureau of Entomology, Washington, D. C.

Through the kindness of Dr. Wheeler I have been able to examine the inquilines which he collected when he discovered a cluster of the army ant, *Eciton hamatum*, on Barro Colorado Island, Panama. A description by Dr. Wheeler of the cluster and of the hitherto unknown female is now in press.

There were among the ants a number of beetles, one *Staphylinus* (*sens. lat.*) *sp.*, two species of Erchomus and an Endomychid, Rhymbus sp., which were probably merely resting among the branches that held the cluster, as well as the new forms described herein which were evidently true guests.

Though *Eciton hamatum* is one of the commonest of the army ants, this is, as far as I know, the first record of a cluster being examined. The actual files of *hamatum*, numbers of which I have watched, contain few guests compared with the files of of the equally common *E. burchelli*, and it is curious that the genus Ecitophya, so common with the latter, is very rare with *hamatum*.

I have included the description of a new species of Tylois from Guatemala, long in the National collection.

The holotypes of the new species are in the National Museum.

STAPHYLINIDÆ.

Xenocephalus panamensis, sp. nov.

Length 7.5 mm.

Very near *X. clypeatus* Wasm.

Castaneous, shining; microscopic pubescence lacking on pronotum, finest and very sparse on elytra, more abundant on abdomen, ventral surface, and legs; first ventral sclerite of abdomen with coarse, elongate foveolate punctures and semi-recumbent short setæ; second with a row of separated setigerous punctures near posterior border and third segment with a much sparser row; legs with long and fine hairs mixed at apices of tibiæ with setæ; coxæ and femora distinctly and regularly punctate.

Head, seen from beneath, about as long as broad, vertex moderately convex, front strongly convex, subcarinate at middle; clypeus submembraneous at anterior border, the border broadly arcuate. Labrum transverse, broadest in front, convex, anterior border broadly and feebly concave. Antennæ compressed, basal joint longer than the following two, second joint longer than broad and longer than the third, joints three to ten transverse, terminal ovate, narrow at tip, shorter than two preceding joints together. Pronotum transverse, behind as broad as base of elytra, sides arcuately narrowed to front border, which is shallowly and rather narrowly concave at middle; surface convex. Elytra convex, sides very feebly arcuate in front, more strongly behind middle, posterior corners only slightly projecting, subangulate, border concave at sides, then nearly straight. First three abdominal segments with spinose processes at sides, apex with four teeth visible from above, the two at middle conspicuously larger than the others and rounded at tip.

Type locality.—Barro Colorado, Canal Zone, Panama.
August 1, 1924, W. M. Wheeler.

Host.—*Eciton hamatum* (Fab.)

Described from two specimens.

This is close to *X. clypeatus* Wasm., which lives with the same species of Eciton in Santa Catherina, Brazil, but differs from Wasmann's description and figures of that species in having the front of head narrower, the clypeus less emarginate at border, the labrum broader and not narrowed apically, the antennal joints broader and the sides of elytra less convex in outline.

Leptonia (*s. l.*) **hospes** sp. nov.

Length 1.75 to 2 mm.

Form elongate, moderately shining, except posterior half of abdomen, which is strongly shining above; head, thorax, and elytra coriaceous, abdomen microscopically punctate. Head, prothorax, elytra, mesosternum, apical four abdominal segments and antennal joints except the three basal and the terminal, dark fuscous, remainder ferrugineous. Head, thorax, and elytra very finely, and ventral surface more noticeably, pubescent; stiff erect hairs sparse on margins of head and more abundant on body; fine and silky recumbent hairs in thin rows at margins of abdominal segments above.

Head, excluding labrum, about as broad as long, vertex moderately convex, occipital border and sides behind eyes broadly rounded. Clypeus truncate anteriorly. Labrum transverse, broadly emarginate in front. Eyes longer than their distance to occipital border. Antennæ extending a little beyond posterior border of pronotum; basal joint as long as the second and third together, second joint two-thirds as long as the third; joints four to ten transverse, the last two very strongly so, terminal joint conical and longer than the preceding two together. Pronotum broader than long, broadest in front of middle, with feebly arcuate sides and posterior border, nearly straight anterior border and rounded anterior and posterior angles; surface evenly convex. Elytra at base a little broader than pronotum and at suture about as long as middle of pronotum; sides and posterior border nearly straight, posterior corners subangulate. Abdomen about as broad as elytra, sides nearly parallel to near tip. All joints of subequal length except the terminal of each tarsus.

Type locality.—Barro Colorado, Canal Zone, Panama. August 1, 1924, W. M. Wheeler.
Host.—*Eciton hamatum* (Fab.)

Described from a small series taken with the host ant.

This species has the middle coxæ rather widely separated and the mesosternal lobe short and broad; the first four joints of the posterior tarsi are subequal, the first scarcely longer than the second and the fifth twice as long as the fourth, for which reasons I am placing it in Leptonia. *L. picta* Sharp, also known from Panama, is much larger with more elongate thorax and elytra and is quite differently colored.

Zyras (*sens. lat.*) **ecitonis** sp. nov.

Length 5 mm.

Head, pronotum, antennæ, except first two joints, abdomen except margins of dorsal and lateral sclerites, black; remainder of body dark red-brown, legs yellow. Moderately shining.

Head with a few distinct punctures in occipital region, about as long as broad, arcuate behind eyes and nearly straight at occipital border, at middle with a carina that commences very indistinctly on the vertex and becomes stronger anteriorly, especially on the clypeus. Clypeus nearly straight at anterior border. Labrum five times as broad as long. Eyes very large and convex, more than twice as long as their distance to occipital border. Antennæ stout, basal joint longer than second and third joints together, joints four to ten transverse, terminal connate, longer than the two preceding joints together.

Pronotum a little broader than long with moderately abundant, scattered, large and shallow punctures, each bearing a semi-recumbent hair; scattered on the disc are a few longer erect stiff hairs and the lateral margins bear a series of five long ones; anterior and posterior borders arcuate, anterior corners and front portion of sides broadly rounded, sides behind straight and convergent, posterior corners subangulate; border throughout with a distinct though fine marginal line, most conspicuous on posterior border. Scutellum rugosely punctate. Elytra broader than long, shorter than pronotum, humeri subgibbous, sides feebly arcuate, posterior corners rounded, border nearly straight; surface regularly, abundantly punctate, the punctures distinct, though very much finer than on pronotum, each bearing a fine, silky, semirecumbent yellowish hair, mixed, especially toward the sides, with very sparse, erect black hairs. Abdomen at base slightly narrower than elytra, sides feebly arcuate, segments two, three, and four subequal in length; dorsal surface glabrous, except for a pair of widely separated setigerous punctures at middle of third and fourth sclerites, two pairs of punctures on apical third of the fifth; apical margins with very sparse, black hairs. Apex and ventral surface, as well as meso- and metathorax thinly pubescent.

Type locality.—Barro Colorado, Canal Zone, Panama. August 1, 1925, W. M. Wheeler.

Host.—*Eciton hamatum* (Fab.)

Described from a single specimen.

In habitus, in the structure of the trophi, antennæ, and in the tarsal formula this species belongs in the genus Zyras, but cannot be assigned to any of the indefinite subgenera. It is related to *mimulus* Sharp, but is much longer and differently colored and the thorax is relatively longer.

In form and sculpture *Z. ecitonis* somewhat resembles species of Tetradonia, but the latter has the outer lobe of the maxillæ short (in *Z. ecitonis* they are longer than the inner lobe) and very much longer antennæ.

HISTERIDÆ

Synodites bifurcatus sp. nov.

Length 2 mm.

Broadly oval, convex above; dark brownish red, legs lighter, pronotum darker; shining.

Hairs fine and short, suberect, rather strongly bent and bifurcate for nearly half their length (those on legs straighter, simple, and more recumbent), abundant on pronotum and pleuræ, sparser on ventral surface, arranged in rows on elytra.

Head at sides with strong rounded shining margins which become obsolete anteriorly, vertex and front very shallowly concave, with coarse, shallow punctures, separated by reticulate lines; clypeus transverse, truncate, and with a thin fringe of very fine hairs at anterior border. Mandibles with moderately abundant, short, erect, stiff hairs. Pronotum transverse, sides nearly straight, anterior corners very broadly angulate, truncated margin short, feebly arcuate, anterior border concave, posterior border rather strongly arcuate at middle; sides and anterior border with a rounded margin which is thickened at posterior third of sides, and on the sides bears a feebly impressed line; surface evenly convex, with abundant coarse shallow setigerous punctures (some of them "tear shaped"). Disc of elytra with seven striæ (not counting the marginal and submarginal) formed by double rows of coarse, approximate punctures, the sutural straight, the second nearly straight and terminating at two-thirds the distance from posterior to anterior border, the third parallel to the second and a little longer, the others extending to near apical border of elytra and terminating in a punctate area; surface between striæ glabrous. Propygidium and upper portion of pygidium coarsely and shallowly punctate. Prosternum margined at sides, margins converging in front, surface flat and nearly smooth, three times as long as broad; anterior lobe and the pro pleuræ coarsely rugosely punctate. Mesosternum triangularly projected in front and finely punctate, with a marginal and submarginal line at sides, the latter strongly bent in front; surface with a nearly obsolete carina at middle, sparsely punctate anteriorly and coarsely, confluently punctate at sides between marginal lines and at corners of posterior border. Mesosternum with a basal row of eleven large punctures and a few fine scattered punctures. Lower face of anterior femora and tibiæ rugosely punctate similar to the propleuræ. Posterior tibiæ not broader than the femora, the outer border broadly rounding into the base; anterior tibiæ with a series of nine long separated spiniform teeth.

Type locality.—Barro Colorado Island, Panama (August 1, 1924.)

Host.—*Eciton hamatum* (Fab.)

Described from one specimen.

Synodites schmidti Lewis, from Bahia, is, judging from the description, close to *bifurcatus*, but has the fourth elytral striæ joined at base to the sutural (in *bifurcatus* they are separate); there is a short, curved stria between the prosternal carina and the coxæ, the mesosternum is not carinate at middle, carinæ at sides of head converge in front to form an angle, and no mention is made of the strongly bifurcate setæ. Both species are very similar in punctation (with "tear-shaped" punctures abundant on the pronotum), in striation and in the structure of the pro-and mesosterna.

Troglosternus ecitonis sp. nov.

Length 2.75 mm.

Form broadly oval, convex above; rufo-piceous, ventral surface and appendages lighter; thorax and legs shining, elytra subopaque.

Head between eyes rather strongly and broadly concave, sides coarsely bimarginate, the inner margins short, the outer convergent at middle, then divergent, forming an hour-glass outline and extending to clypeus, front with four separated foveolate punctures. Clypeus nearly flat, shining and smooth, except for a series of four very coarse punctures near anterior border, which is truncate; front coarsely punctate.

Pronotum transverse, broadest behind, anterior corners obtusely angulate, sides moderately arcuate, anterior border concave, posterior border broadly rounded, median portion of surface convex, basal portion near border with a pair of small deep pits; side portions obtusely gibbous a little behind middle, with three strong costæ, the inner of which is angulately bent near apex of gibbosity, the middle subparallel to the inner, but less sharply bent and the outer one finer, intercepted, and extending forward as a submarginal line to the anterior border; median portion with coarse, widely separated setigerous punctures and sparse very distinct though fine shining reticulate costæ, surface between punctures smooth and shining; gibbous portions of sides smooth between costæ and lateral surface, between marginal and second costæ longitudinally impressed and with a row of coarse punctures. Elytra finely, densely striate longitudinally, some of the striæ on the basal portion bifurcate; disc with four coarser striæ, conspicuous at basal third, then as fine as and continuing with the other dorsal striæ, humeral stria strongly arcuate and coarser than the three others. Propygium and upper half of pygidium rugose-punctate and reticulately striolate, lower half of pygidium with very sparse coarse punctures.

Prosternum broad, nearly flat, margined at sides with sharply impressed submarginal lines that extend on posterior half and are connected by a transverse line, enclosing with the posterior border a flat impressed surface more shining than the rest; broadly triangularly excised behind, separated from gular plate by distinct transverse line; gular plate not incised.

Mesosternum with a pair of very profound pits adjacent to and inward from the coxæ.

Legs moderately long, shining; anterior and middle tibiæ rather flat, the middle pair subangulately enlarged in front of middle of outer border, concave posterior to this, then roundly enlarged and convex to tip; hind femora about as long as tibiæ, strongly convex on outer and concave on inner surface, thickened at apex; very coarsely and sparsely punctate on outer surface; tibiæ projected and rounded at middle of outer border, the margin concave on either side, margin on basal half with a series of seven short serrate teeth, outer surface strongly convex and overlapping at basal margin, with a very strong impression parallel to the basal two-thirds of margin; inner surface broadly concave, with an impressed marginal line parallel to the lower border and one parallel to the inner border of the tarsal grooves.

Hairs erect, very stiff and abundant on dorsal surface, longer and with flexuous tips on margins of legs, the pygidium, and ventral surface. One specimen is an exception in having the hairs equally abundant, but all longer, flexuous, the others appearing as though they had been neatly trimmed.

Type locality.—Barro Colorado, Panama. August 1, 1924. W. M. Wheeler.

Host.—*Eciton hamatum* (Fab.)

Described from five specimens.

T. dasypus Bick. from Bahia, the type of the genus, lacks the distinctive punctures on the pronotum, where there are only two strong lateral impressions, and the inner is rounded instead of angulate and the sutural and approximate dorsal striæ are indicated by impressed, smooth lines. Bickhardt's specimen had sparser, very much finer pilosity than any of my series.

Euxenister wheeleri sp. nov. (fig. 1.)

Length 4.5 mm.

Form elongate, subopaque; mandibles, legs, and ventral surface moderately shining; brownish red; hairs of two kinds, one fine and silky and the other basally very coarse, acutely pointed and spinelike, the former most abundant on the dorsum (especially the pronotum) and legs, and the latter on the dorsum, but present sparsely beneath and, on the prosternum, arranged in thin fascicles and in heavy fascicles on the inner side of the apical third of middle and posterior tibiæ.

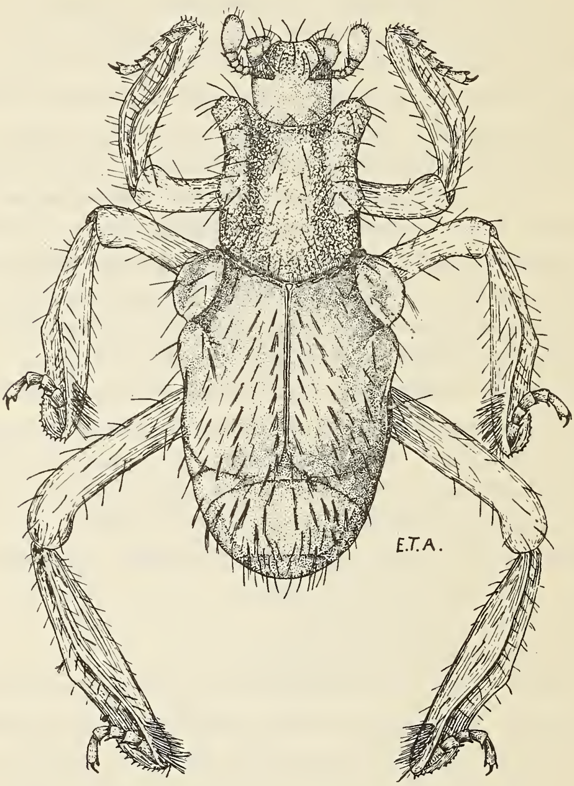


Fig. 1. *Euxenister wheeleri* sp. nov.

Head with the front and vertex feebly concave, sides in front of antennal sockets obtusely margined; clypeus three times as broad as long, anterior border concave; surface rugosely punctulate, with several very indistinct longitudinal striæ. Pronotum elongate, discal portion slightly and evenly convex, except for a pair of distinct though shallow impressions near the posterior third of sides; anterior border concave, posterior border convex; anterior three-fourths of sides elevated into an immense, rounded margin, with concave outer and convex inner sides, projecting forward and slightly outward as somewhat flattened lobes, the outer corners of which are obtusely angulate, the inner corners broadly rounded, terminating behind as thick gibbosities; in profile the dorsal portion of the margin is evenly and shallowly concave; surface rugosely punctate, the disc also with elevated reticulate lines. Elytra densely punctate, more finely than pronotum, not striate; surface at anterior margin with a series of six large, rounded, rather shallow foveæ; anterior two-thirds of sides elevated into a pair of huge marginal masses, subequal in length, the anterior (humeral) one higher and broader than the other, constricted laterally at base, broad above, strongly and broadly impressed longitudinally at middle and very roundly margined at sides; posterior lobe separated from the humeral by a lateral construction and a narrow transverse impression, broadly concave above, with the margins narrowly rounded, evenly sloping behind to the sides of disc and terminating at two thirds the distance to posterior border of elytra.

Propygidium and pygidium punctate throughout similar to the elytra. Prosternal keel narrow, strongly excised behind, surface nearly flat, sides between coxæ feebly concave, weakly margined, the marginal lines divergent in front, terminating before the middle; surface of lobe rugosely punctate, of keel more finely punctate, with a few foveæ on posterior portion. Mesosternum at sides with sharp elevated margins and at middle with a more elevated longitudinal carina, thickened posteriorly, bordered in front, the surfaces between this and the marginal carinæ strongly concave. Metasternum gibbous at middle near base, impressed in front of this, with an indistinct median longitudinal line.

Legs long, slender, outer borders of tibiæ narrowly cultrate, anterior and middle pair sinuate at outer border, posterior tibiæ feebly and roundly angulate well posterior to middle.

Type locality.—Barro Colorado Island, Panama. Aug. 1, 1925 (Wheeler).

Host.—*Eciton hamatum* (Fab.)

Described from one specimen.

Near *E. asperatus* Reich.; described from a colony of *Eciton quadriglume* (Rio Negro, Parana), but *wheeleri* is larger and lighter colored, with nonstriated elytra; the pronotal marginal swellings are shorter and distinctly terminate before posterior border, those on the sides of elytra smaller and divided by a transverse suture. Both species are remarkable not only for their elongate forms and the large pronotal and elytral marginal masses, but especially for their strong bristles, thickest at baes and pointed apically, quite spikelike. *E. caroli* Reich., the type species of the genus, was taken in a file of *Eciton burchelli* at Blumenan, Brazil, and probably *E. wheeleri* is also a file guest.

Tylois barberi sp. nov.

Length 2.5 mm.

Form broad, convex above; uniformly dark reddish brown, shining.

Vertex feebly concave, very coarsely and foveolately punctate, sides with an elevated, rounded margin, sides of front strongly and broadly elevated as thick carinæ which diverge anteriorly and enclose a narrow triangular flat median surface, separated from the clypeus by an arcuately impressed line. Clypeus three times as broad as long, strongly emarginate at anterior border.

Pronotum less than twice as broad as long, sides convex in front of middle, impressed behind anterior angles, anterior border truncate at sides, with the angles rounded, border biconcave, median portion rounded, posterior corners rounded, the border truncate at sides of impressions, feebly arcuate at middle, surface with coarse scattered punctures, variable in size and sparse on posterior portion and sides, abundant at middle of anterior fifth, sparse and irregular at lateral borders; disc convex in front of middle, flattened behind at middle and at sides with a pair of large and very profound pits, which are bordered inwardly by short, rather feeble and rounded carinæ and separated from the lateral portions by strong, moderately elevated, rounded carinæ; lateral portions not separated from the disc by suture, broad, concave, with the side margins moderately elevated; a strong impressed line extending from base to less than half the distance to anterior border.

Elytra very strongly gibbous at humeri, sides in front of middle concave, then rather strongly arcuate and margined to apex; humeral and subhumeral carinæ short, thick, and very strongly elevated, concave and with a row of coarse punctures at top; the two discal carinæ less elevated and short, thick and punctate above; surface concave at base, rather strongly convex behind; large, foveolate punctures sparse and fine punctation between more abundant. Propygidium strongly transverse, coarsely and rather densely foveolate-punctate. Pygidium very sparsely punctate. Prosternum at middle with large elongate, rounded, jet black tubercle; sides behind this margined; posterior border strongly excised; surface behind tubercle and the frontal lobe coarsely punctate. Mesosternum with three strong tubercles similar to those on prosternum, remaining surface very coarsely and densely punctate, at middle with a longitudinal sulcus. First abdominal segment with punctures smaller and more widely separated. Anterior tibiæ at margin with a series of four strong teeth widely separated; middle and posterior tibiæ roundly angulate.

Type locality.—Cacao Tres Aguas, Alta V. Paz, Guatemala (Barber and Schwarz).

The single specimen before me was collected by beating a branch. It is badly rubbed and the only pilosity remaining is at the lateral borders of the pronotum; the hairs are short, rather thick and erect.

T. mirificus Lewis from Pernambuco is closely related, but according to the description has the propygidium and pygidium both sparsely punctate, the keel of the prosternum is smooth and the first ventral abdominal segment smooth in the middle; the middle tibiæ of *barberi* are much less strongly angulate than in *trilunatus* Marseul.

This is the fourth species in the genus, and all of them, both from their systematic position and structure are evidently inquilinous, but no host has been recorded.

NEW SPECIES OF NORTH AMERICAN DOLICHOPODIDÆ (DIPTERA)

By M. C. Van Duzee.
Buffalo, N. Y.

Mesorhaga pallidicornis sp. nov.

Male: Length 3 mm. Face metallic green with abundant white pollen. Front blue-green with white pollen above the antennæ and along the orbits. Occular bristles black, bristles at upper corners of the eyes yellow. Proboscis yellow; palpi black, yellow on apical half. Antennæ with the two basal joints blackish; third joint reddish yellow, black on upper basal corner, nearly round in outline; bristles on second joint white; the basal arista brown. Orbital cilia white, becoming short above, scarcely reaching the upper orbit.

Mesonotum, base of scutellum and metanotum shining blue; remainder of scutellum, pleuræ and abdomen metallic green, pleuræ dulled with white pollen. All bristles and hairs of the thorax and abdomen yellowish. Hypopygium shining black; its appendages testæcous, somewhat oval in outline, more than half as long as the hypopygium, their hairs small and yellow.

Fore coxæ, all femora and tibiæ pale yellow; midd e and hind coxæ black; hairs and bristles on all femora, coxæ, and tibiæ yellow, there are several blackish bristles on posterior tibi æ, but these appear yellow in certain lights, the hairs on fore coxæ and lower surface of fore and middle femora are long and almost white. Tarsi longer than their tibiæ, yellow, becoming brown towards their tips. Joints of fore tarsi are as 40-11-9-7-6; those of middle ones as 54-17-13-7-7; joints of posterior tarsi as 39-30-18-9-6. Knobs of halteres yellow. Calypters yellow with a narrow brown border and long yellow cilia.

Wings a little grayish; veins brown; venation as usual in the genus.

Described from one male taken at Sandusky, Ohio, July 9, 1904, by E. P. Van Duzee. Type in the author's collection

This is the only species known as far as I can find that has the antennæ partly yellow; in all others described from North and South America and Asia (there are none in Eur pe the antennæ are wholly black.

Neurogonia minima sp. nov.

Male: Length 1.5 mm. Face wide, narrowed below, blackish. Front and occiput black with white pollen. Antennæ brown, third joint small, somewhat conical in outline, abruptly narrowed where the arista is inserted extended into an outuse point; arista pubescent, inserted near the middle of the upper edge of third joint. Orbital cilia minute, pale; bristles of the head reddish.

Thorax reddish brown, dorsum dull brown; depressed space before the scutellum large, dark brown with gray pollen; I cannot see any acrostichal bristles; dorsocentrals large, black when viewed from above, still against a dark background they appear more or less yellow. Abdomen blackish, hypopygium more reddish brown, large, somewhat pedunculate, oval, but a little narrowed towards the tip, where there are minute lamellæ and a fringe of long hairs.

Coxæ, femora, tibiæ and tarsi yellow, middle and hind tarsi a little infuscated on outer surface; fore coxæ with white hairs, legs without long hairs. Joints of fore tarsi are as 17-8-6-5-4; of middle ones as 22-11-7-5-5; those of posterior pair as 12-14-9-6-5. Calypters, their cilia and the halteres yellow.

Wings grayish; second, third and fourth veins nearly straight and a little divergent from opposite the middle of the first vein; cross-vein near the middle of the wing; first vein reaching about half the distance to the cross-vein.

Described from one male taken at Ithaca, New York, August 28, 1894. Type in the Cornell University Collection.

This differs from *nigricornis* Van Duzee in having the antennæ more pointed at tip, the thorax dull, not at all shining, the hypopygium less bulky, coxæ and legs darker, especially the middle and hind coxæ, the bristles of the head more reddish, and in being smaller in size.

Medeterus emarginatus Van Duzee.

Psyche, xxv, p. 439, 1914.

Male: like the female in size and color. The hypopygium is large, black, with apical portion shining, the hairs on basal part and its apical appendages yellowish. Joints of posterior tarsi as 33-35-32-14-9. Last section of fifth vein 26 fiftieths of a millimeter long. There are three black bristles above each fore coxa, the anterior coxæ have a row of long hairs on outer edge of the front surface, these hairs are also found in the females taken with this male.

One male and three females were taken at Peru, Clinton County, New York. The male and two females are in the Cornell University collection.

Medeterus minimus sp. nov.

Male: Length 1.6 mm. Face moderately wide, black, lower part without pollen, upper portion and the front opaque with brown pollen. Palpi and proboscis brown. Antennæ black. Lower part of occiput with a few pale hairs.

Thorax opaque with brown pollen and with a darker median stripe, which nearly reaches the scutellum, the latter with one pair of marginal bristles. Abdomen blackish with green reflections, dulled with brown pollen, its hairs pale. Hypopygium thick and obtuse at apex, shining black.

Coxæ black, extreme tip yellowish. Femora more or less blackened. Tibiæ and tarsi yellow. The joints of hind tarsi are as 15-15-9-8-6. Calypters yellowish with white cilia. Knobs of halteres whitish.

Wings grayish, venation typical of the genus, veins yellowish; last section of fifth vein 17, of cross-vein 8 fiftieths of a millimeter in length.

Described from one male, taken at Felton, St. Cruz Mts., California, May 20, 1907, by J. C. Bradley.

Type in the Cornell University collection.

Hydrophorus criddlei sp. nov.

Male: Length 3-3.2 mm.; of wing 4.2-4.7 mm. Face rather wide, silvery white, the green ground color shows through a little on upper third, lower portion a little longer than wide, evenly rounded on its lower edge. Palpi black with white pollen, which is not silvery, covered with delicate pale hairs and with several stouter, black, very short ones. Antennæ black, third joint rounded at tip. Front opaque brown. One pair of postverticals; the black orbital cilia extend down to the middle of the eye. Beard rather bright yellow, quite long, there are several black bristles under the neck.

Thorax green, dorsum nearly opaque with brownish pollen; pleuræ with thin brown pollen; propleura with one long black bristle and a few pale hairs above fore coxa; acrostichal bristles small, reaching nearly to the front of the thorax; dorsocentrals moderately large; scutellum with four marginal bristles. Abdomen green with white pollen on the sides, its hairs mostly black, only a few very small white hairs on the sides and at tip. Hypopygium mostly concealed, it has a small black appendage projecting below and the posterior edge of fourth abdominal segment also extends downward a little in the center of its ventral surface.

Coxæ black; anterior pair with white pollen and long, but not very abundant, yellow hair on the front surface, these hairs become a little shorter towards the apex, I cannot see any black spines, even at tip. Femora and tibiæ green; fore femora thickened at base, tapering to the tip, they have a row of five black spines on lower surface of basal third, three of which are as long as the thickness of the tibia, the two nearest the base shorter, there are also many long pale hairs on the lower surface, these are longer than the spines and extend from the base almost to the tip, where they are shorter and further apart. Fore tibiæ with a row of spines extending their whole length. Middle femora towards the tip and middle tibiæ with two or three very slender, but rather long bristles on the anterior surface. Tarsi black, plain. Joints of fore tarsi are as 30-16-13-9-11; those of middle pair as 41-20-15-10-12; joints of hind tarsi as 38-26-18-12-

12. Calypters yellow with yellowish cilia, halteres dark yellow, sometimes yellowish brown.

Wings dark grayish; cross-vein a little clouded; third vein only a little bent back towards the tip, nearly parallel with fourth; last section of fifth vein 14, cross-vein 19 fiftieths of a millimeter.

Female: Length 2.5-3.2 mm; of wing 3.5-4 mm. Face with grayish pollen, its lower portion about as long as wide, evenly rounded on oral edge. Fore coxæ with two very small black spines at base (I cannot see these in the male). Femora with about eight irregularly placed short spines on lower surface of basal half and several longer ones, they also have the same long pale hairs as are found in the male, but they are a little shorter. The wings are about the same as in the male, except that in two of the females there is no cloud on the cross-vein and the wings are more clear.

Described from two males and three females, all taken at Awene, Manitoba, October 7, 1924, by N. Criddle, after whom I take pleasure in naming this interesting species.

Hydrophorus fulvidorsum sp. nov.

Male: Length 4.2 mm. Face wide, only slightly narrowed above, brownish gray, wholly opaque, the lower portion not as long as wide, a very little pointed in the center. Front opaque brown. Antennæ black (only the first joint present on the type). Occiput green with brown pollen. Cheeks narrow. A row of bristles extend each way from the postverticals, joining the orbitals rather far down; the black orbital cilia extend down to the middle of the eye; beard white, not very abundant, there are a few black bristles under the neck.

Thorax green, covered with thick brown pollen, the posterior part and the scutellum more shining; humeri with gray pollen; pleuræ nearly opaque with brown pollen, which appears more gray when viewed from below; scutellum with one pair of marginal bristles; I can see no acrostichal bristles in the anterior half of the dorsum (in the type the posterior half is injured by the pin); propleuræ with a cluster of long pale hairs above each fore coxa, but without a black bristle. Abdomen blue-green with abundant brown pollen on the sides; the hairs on its dorsum short, black, on the sides the hairs are longer and white. Hypopygium mostly concealed; its appendages black, they consist of a minute pair of lamellæ fringed with hairs and a central organ extending from the base of the hypopygium, all these projecting backward.

Coxæ with brownish gray pollen; anterior pair with rather long, delicate, white hairs, without black bristles; femora and tibiæ green. Fore femora considerably thickened at base, tapering to their tips; they have two rows of short spines extending nearly their entire length, those in the anterior row are smaller and more scattering than those in the posterior row. Fore tibiæ with a small angle below at the tip projecting towards the femora; they have two rows of nearly erect spines on inner surface; those in anterior row more slender and numerous, extending the entire length of the tibia to the tip of the apical angle; those in posterior row a little stouter, about eight in number and not reaching base or tip. Tarsi blackish; joints of fore tarsi as 42-23-17-12-12; those of middle tarsi as 54-28-20-15-13; joints of posterior ones as 60-37-26-20-15; fifth joint of middle tarsus a very little widened. Calypters brown with white cilia. Knobs of halteres pale yellow.

Wings tinged with brownish gray, with a cloud on the cross-vein; third vein bent backward at tip so as to approach fourth at tip, where they are one third as far apart as at the cross-vein.

Described from one male taken at Chin, Alberta, May 3, 1923, by H. L. Seamans. Type in the Canadian National Museum.

This is very much like *intentus* Aldrich. They have the same wing characters, about the same formation of the hypopygium and the form of the fore femora are about the same. This form has no black bristles above the fore coxæ, the scucellum has only one pair of bristles, but the others may have been broken off, the first joint of the antennæ are shorter, and the spines on the fore femora seem much shorter; these variations would seem to be enough to separate the species, and I am venturing to publish it as a new species, still it may prove to be the same when we have a series of specimens from the type location.

Dolichopus maculitarsis sp. nov.

Female: Length 4-4.5 mm. Face wide with white pollen. Front green with bronze reflections. Antennæ black, lower half of first and second joints yellow. Lower orbital cilia white, upper cilia black.

Thorax, scutellum and abdomen green with bright bronze reflections; hairs of the abdomen black.

All coxæ black, their hairs short and black. Fore femora black with their tips broadly yellow. Middle and hind femora yellow, black at base for a short distance, each with one preapical bristle. Fore and middle tibiæ blackish, more or less yellow at base, middle ones sometimes yellowish on upper surface to near the tip; posterior tibiæ and anterior and posterior tarsi wholly black; middle tarsi with basal portion of each joint dull whitish, contrasting with their black tips, fifth joint wholly black, each joint a little enlarged at tip. Joints of fore tarsi are as 38-18-13-10-13; of middle ones as 56-31-23-17-17; joints of posterior tarsi as 52-55-34-24-17. Each joint of middle tarsi with a few minute spines below and a bristle or spur at tip. Calypters and halters yellow, the former with dense, deep black cilia, which is of moderate length.

Wings grayish, a little yellow at root; bend in last section of fourth vein rather abrupt and near its middle; cross-vein 22, last section of fifth vein 53 fiftieths of a millimeter; anal angle of wing prominent.

Described from two females. The holotype was taken at Baldur, Manitoba, June 23, 1924, by H. D. Bird, and is in the Canadian National Museum; the paratype was taken at the same place and time, by N. Criddle.

This is very much like the female of *appendiculatus* Van Duzee, Cole & Aldrich. The middle tarsi of both are formed and colored alike. Both have the first two antennal joints largely yellow. They differ in the amount of yellow on the antennal joints, in the new form these joints have the upper half black, while in the older species they are only narrowly black on upper edge; all femora and tibiæ are wholly black in *appendiculatus*, while in this form the middle and hind femora are almost wholly yellow, the fore and middle tibiæ are more or less yellow at base, at least above, the joints of the tarsi are of somewhat different lengths in the two species, the measurements of the new form are given above; the joints of the middle tarsi of *appendiculatus* are as 47-27-27-15-15; and those of posterior ones are as 40-48-29-17-13; the wings in the two forms are about alike.

Hercostomus purpuratus sp. nov.

Male: Length 3.5-4 mm. Face covered with white pollen, wide, concave almost to the lower edge, there not being any very distinct separation between the upper and lower parts; oral margin straight, a little projecting. Front shining blu with purple reflections. Antennæ black; first joint as long a second and third taken together, the latter two taken together nearly round in outline, the arista being inserted near the middle of their upper edge, its pubescence long. Palpi black with black hair. Orbital cilia wholly black.

Dorsum of thorax and the scutellum purple or violet, the edges more blue, the front slope and the pleuræ greenish; pollen on the dorsum brown, on the pleuræ white. Abdomen dark green with black hair. Hypopyigum black, its lamellæ large, nearly round in outline, sordid white with broad black border, which is jagged and bristly; inner appendages whitish, lamella-like, widened from the narrow base to apical margin, they have several minute hairs near the apex.

All coxæ black; anterior pair with small black hairs on the front surface and a row of bristles at tip. All femora and tibiæ yellow, upper edge of anterior femora brown, sometimes they are almost wholly yellow; posterior tibiæ a very little brownish at tip on inner side; fore and middle tibiæ with strong bristles. Posterior femora on apical half and their tibiæ on basal half with long, delicate, brown hairs on lower posterior surface; these hairs are as long as the width of the femora; posterior tibiæ with a row of four large bristles on upper posterior edge of basal half, and a ow of five on upper anterior edge, these last inserted at nearly regular intervals for their whole length, they also have a glabrous line on upper edge. Fore and middle tarsi black from the tip of the first joint, hind tarsi wholly black. Joints of fore tarsi are as 38-18-15-10-10; of middle ones as 49-23-17-14-13 those of posterior pair as 42-45-29-18-15. Calypters and halteres yellow, the former with black cilia.

Wings tinged with blackish; costa with an enlargement which fills in the space between the first vein and the costa at the tip of the first vein for a considerable distance; third vein bent backward towards the tip, nearly parallel with fourth; last section of fifth vein 42, of cross-vein 27 fiftieths of a millimeter in length; cross-vein at nearly right angles to fourth vein; anal angle prominent.

Female: Color of all parts as in the male, except that the posterior tibiæ are a little more brown at tip; antennæ as in the male; face a little wider and more convex on lower part; no cilia on the lower surface of posterior femora or tibiæ; hind tibiæ with three bristles in the row on upper posterior edge of basal half; wings without an enlargement of the costa. Otherwise about as in the male.

Described from four males and one female, all taken at Stockton, Manitoba, July 29, 1924, by N. Criddle. Holotype and allotype in the Canadian National Museum.

This is a very interesting species with a number of striking characters in the male; the female will be easily recognized by its dark wings; violet or blue front and thorax, dark upper edge of the anterior femora and the yellow hind tibiæ with their wholly black tarsi.

Gymnopternus Loew.

At present I am useing the generic name *Gymnopternus* Loew (Neue Beitr., V, 10, 1857) in the sense of a subgenus of *Hercostomus* Loew (Neue Beitr., V, 9, 1857), following Dr. Lundbeck in this (Dolichopodidæ of Denmark, 1912), however Dr. Theodore Becker unites the two genera under the name *Hercostomus*, not giving *Gymnopternus* even subgeneric value, but to me it seems best, for the present at least to follow Dr. Lundbeck and use the name *Gymnopternus* as a subgenus.

Most of our species are easily separated, especially in the male, the male hypopygial lamellæ of the Hercostomus being large and formed about as in the genus Dolichopus; while those of the forms coming under Gymnopternus are small and more or less crescent shaped; in almost all the species of *Hercostomus*, as thus separated, the last section of fourth vein is bent or it is convergent with third vein in both male and female; while in the subgenus *Gymnopternus* the third and fourth veins are almost parallel beyond the cross-vein.

As in most large genera, we have some species which are rather difficult to place if we have only the female; the exceptions that I know of among the North American species are, *Hercostomus metatarsalis* Thomson and *H. vetius* Melander, in which the bend in the last section of fourth vein is small, and *Gymnopternus convergens* Van Duzee, where these veins are decidedly convergent, but not as much so as in *Hercostomus unicolor* Loew.

Two species which I have described some time ago as *Paraclius ornatus* and *flavicornis* should be placed in the genus *Hercostomus*, as both have the third and fourth veins convergent beyond the cross-vein, as in *Hercostomus unicolor* Loew.

Gymnopternus flavitarsis sp. nov.

Male: Length 2.5 mm. Face very narrow below, blackish. Palpi black. Front green with whitish pollen. Antennæ black; third joint small, scarcely as long as wide, somewhat rounded, scarcely pointed at tip; arista basal, as long as the face.

Thorax and abdomen green with white pollen; hairs on the abdomen black. Hypopygium black; its lamellæ dark yellow with a narrow black border, fringed with rather long black hairs; inner appendages yellow with a few black hairs at tip.

All coxæ black, the hairs on anterior pair black, short on basal half, longer and with some bristles mixed with them towards the tip. All femora black with yellow tips, without longer hairs below. All tibiæ wholly yellow. All tarsi yellow, only a little darker at tip. Posterior tibiæ and tarsi not at all thickened. Joints of fore tarsi as 23-10-8-6-7; of middle ones as 28-19-12-9-8; joints of hind tarsi as 20-24-17-11-9. Calypters and halteres yellow, the former with pale cilia.

Wings grayish; third and fourth veins parallel, but both slightly bent backward at tip; last section of fifth vein 20, of cross-vein 15 fiftieths of a millimeter.

Described from one male taken at Gloversville, N. Y., by C. P. Alexander. Type in the Cornell University Collection.

Gymnopternus maculiventris sp. nov.

Male: Almost wholly yellow, with black hairs and bristles, nearly related to *flavus* Loew.

Length 3 mm. Face yellow, narrow below. Front blackish on upper half, covered with white pollen. Occiput blackish with white pollen. Antennæ yellow; third joint slightly longer than wide, pointed at tip, its apical half brown; arista black, pubescent.

Thorax and abdomen yellow, they have a slight green reflection in spots when viewed in certain lights, their hair and bristles black; abdomen with poorly defined, black spots on third and fourth segments. Hypopygium black, its lamellæ small, yellow, fringed with stiff black hairs.

Coxæ, femora, tibiæ and tarsi pale yellow; posterior tarsi slightly infuscated from the tip of first joint, which has a small bristle at tip. Joints of fore tarsi are as 28-15-12-9-8; those of middle ones as 30-19-16-12-8; joints of posterior pair as 23-24-15-15-8. Calypters, their short cilia and the halteres pale yellow.

Wings yellowish gray with yellow veins; third and fourth veins parallel; last section of fifth vein 26, cross-vein 13 fiftieths of a millimeter; sixth vein short.

Described from one male, taken at Cold Spring Harbor, New York, August 9, 1920, by Mr. Davis. Type in the author's collection.

This differs from *flavus* Loew in having the third antennal joint short, the hairs on the abdomen and those fringing the lamellæ black; the hypopygium also being black. In *flavus* the hypopygium is yellow, its lamellæ are fringed with yellow hairs and the hairs of the abdomen are also yellow, except a few long ones on the hind margins of the segments; it has the third antennal joint drawn out into a long point.

Gymnopternus robustus sp. nov.

Male: Length 4 mm. Face and front covered with grayish white pollen. Palpi black. Antennæ black, third joint slightly longer than wide somewhat conical in outline. Orbital cilia wholly black.

Thorax and abdomen blackish green, shining; pleuræ black with white pollen. Hypopygium and its lamellæ black, the latter somewhat crescent shaped with a short truncate protuberance in the middle, which makes them appear wide in the center, they are fringed with black hairs, a few of which near the middle being bent at tip.

All coxæ and femora black with black hairs and yellow tips. All tibiæ and basitarsi yellow, all tarsi being black from the tip of the first joint; posterior tibiæ with an obscure brown spot at extreme tip on posterior surface. Joints of fore tarsi as 34-15-12-8-10; of middle ones as 51-23-19-16-11; first two joints of posterior tarsi as 45-30. Calypters and halteres yellow, cilia of the former black.

Wings grayish, very slightly tinged with brown in front of second vein; costa slightly, but distinctly thickened at tip of first vein, tapering to its tip; third vein bent backward a little towards its tip, parallel with fourth at tip, but slightly approaching fourth just beyond the middle of the last section of fourth vein; length of last section of fifth vein 53, of cross-vein 25 fiftieths of a millimeter.

Described from one male, taken at Manlius, N. Y., by Mr. H. H. Smith, in 1873.

Type in the Cornell University collection.

THE BREMUS RESEMBLING MALLOPHORÆ OF THE SOUTHEASTERN UNITED STATES (DIPTERA ASILIDÆ).

By S. W. Bromley,
Amherst, Mass.

The robber-flies of the genus *Mallophora* are, for the most part, rather large and densely-pilose, and are of a more compact build than most of the other members of the Asilidæ. Nearly all of them resemble bees of one kind or another, and the species of the particular section of this genus here treated bear a marked resemblance to bumble-bees. In some cases the resemblance is actually specific. For example, *Mallophora orcina* (Wied.) is a counterpart of the worker of the bumble-bee, *Bremus pennsylvanicus.* The resemblance is, of course, most striking in the field, particularly if the flight of the asilid is directed away from the observer. The illusion is destroyed, however, when the flight of the insect is directed toward the observer, as the conspicuous yellow beard and mystax of the fly dispel all doubts as to its identity. When the robber-fly is at rest, moreover, the posture assumed is entirely different from that of any bumble-bee. In fact, it seems to the writer that the mimicry is not nearly as striking as in the case of some of the robber-flies of the genus *Dasyllis*, such as *D. thoracica*, where the imitation of a bumble-bee is so exact that even an experienced collector may be mislead when the insect is in flight.

Of the species here considered, *M. orcina* is the most abundant and has the widest geographical distribution. I have taken this species commonly in Northwestern Missouri, and have examined specimens from most of the southern states, including Florida and Texas. It is found in southern Ohio and, according to Mr. C. T. Greene of the National Museum, is very common in the neighborhood of Washington, D. C. The type-locality of Wiedeman's specimen is "Savannah." In Arizona, a very closely related species, *Mallophora fulva* Banks (Canadian Entomologist vol. 43, no. 4, 1911, p. 130), has been taken. This is so close to *orcina* that it may possibly prove to be a western variety. However, until a full series showing the merging of the characters is available, it is best to consider it a distinct species. *Mallophora faütrix* O. S. another western species, smaller than, but bearing a superficial resemblance to, *orcina*, may be easily distinguished by the reddish ground color of the femora (instead of black) and the absence of black pile on the abdomen.

Mallophora bomboides (Wied.) is abundant in some parts of Florida and has also been taken in Georgia. The type locality is "Georgia." The only records of *M. nigra* Willst. that I could obtain are from Florida. *M. rex* sp. n. I have from N. Carolina, Mississippi, and Florida; while *M. chrysomela* sp. n. is represented by specimens from Georgia and Mississippi.

All five species are quite closely related. The first species to be described was named *bomboides* by Wiedeman evidently because of its resemblance to a bumble-bee. The resemblance is not as striking, however, when the insect is observed in the field, as in the case of *orcina*.

In 1893, Coquillet devised a key to the genus Mallophora dealing with all species then known to occur in America north of Mexico (Canadian Entomologist, vol. 25, no. 5, p. 118). The key presented below does not include all of the species of this genus, but simply a natural group of five species occurring in the Southeastern United States, and is included for the purpose of bringing out clearly the differences existing between the two new species described and those most nearly resembling them.

1. Pile of abdomen wholly black. . . . . *nigra* Willst.
   Pile of abdomen partly light-colored. 2
2. Light-colored pile on basal 4 or 5 tergites. . . . *orcina* Wied.
   Light-colored pile on first 3 tergites: always black on 4th. . . . 3
3. Wings light yellowish-brown. . . . . *bomboides* Wied.
   Wings dark purplish-brown. 4
4. 3rd joint of antenna ⅓ length of arista: male genitalia with yellow hair. . . . . *chrysomela* sp. n.
   3rd joint of antenna subequal to arista in length: male genitalia with black hair. . . . . *rex* sp. n.

A table is also included, showing points of contrast in the case of the four species whose characters make them difficult to distinguish. Length measurements of the body do not mean a great deal in this genus, as the abdomen may be contracted in some individuals and distended in others. A better basis of comparison is the wing measurement.

Mallophora rex, sp. nov.

♂ ♀—Length of body, 26-33 mm. (A series of 86 *M. bomboides* from Florida gave lengths from 23-29 mm.) Similar to *bomboides* in habitus. Mystax composed of dense yellow bristles below, black above. Beard, light yellow. Palpi, black with yellow hairs and a few black ones. Antennæ dark brown.

Pile along anterior border of prescutum and lateral anterior angles of thorax, yellow. A strip of yellow pile extending from base of wings to metacoxæ. Scutellum covered with a dense mass of long yellow pile. Other hairs of thorax black.

Wings dark purplish brown. Legs dark reddish-brown, densely covered with short, stout black hairs. The hind femur with a very few inconspicuous yellow hairs intermingled. The under side of the hind tibia of the ♂ bears a small tuft of white pile.

In five specimens from N. Carolina the venter of the abdomen is covered solely with black hairs; in the five other specimens from which the description was drawn (three from Mississippi, one from N. Carolina, and one from Florida), there is a median line of light yellow pile, broadening toward the apex of the abdomen where it clothes the sixth and seventh segments. The first three tergites bear dense yellow pile. The remainder of the pile on the abdomen is black. The hairs on the male claspers are black.

Habitat. Three specimens from the collection of the Miss. Agricultural College, received from Professor Harned. Newton Co., Mississippi (Aug. 1920) (E. Blackburn); Iuka, Miss. (J. N. Miller); Leaksville, Miss. (Aug. 20) (O. Z. Smith). Four specimens from Southern Pines, N. C., three of which were taken Aug. 1907, and one 1, 7, '89 (A. H. Manee coll.) received from Mr. Nathan Banks; and two from the collection of the American Ent. Soc., courtesy of Mr. E. T. Cresson, Jr. The Data on the latter are: one from "Florida," and one from Southern Pines, N. Carolina (VIII, 26, '09) collected by A. H. Manee.

Mallophora chrysomela, sp. nov.

♂—Length of body 23-27 mm. Thick, heavy hairs of mystax, beard, palpi, occiput, genæ, and post-genæ bright yellow; a very few black hairs intermingled with the yellow on palpi.

On the meso-thorax a patch of yellow pile extends cephalad from the base of the wings to the prothorax which is also covered with yellow pile. There are a few yellow hairs along the anterior margin of the prescutum. Scutellum covered with thickly set, long yellow pile. A narrow area of long yellow hair extends from a point below and slightly posterior to the base of the wing, to the metacoxa. Wings dark purplish brown. Legs reddish-brown, densely clothed with black hairs. Some yellow pile on hind femora, and a thick patch of silver hairs on the inner side of the distal portion of the hind tibia. Pro- and meta-coxæ with yellow hairs intermingled with a few black ones.

Abdomen with first, second and third tergites with thick yellow pile. Venter with a median area of yellow pile, narrow anteriorly but widening posteriorly to cover entirely the sixth and seventh segments, where it becomes darker in color, approaching orange. Other hairs on abdomen black. Hair on male claspers yellow.

Habitat. Two specimens from Gulfport, Miss., Sept. 11, 1916 (C. C. Greer), one from Ship Island, Miss. (9-6.20) (B. L. Collins). All three from the collection of the Miss. Agricultural College, examined through the kindness of Professor Harned. Another (6-30-06) from Atlanta, Georgia, from the American Ent. Soc. Coll. Philadelphia, Pa., examined through the kindness of Mr. E. T. Cresson Jr.

Of the species discussed above, the following are pictured in Howard's Insect Book.

Mallophora orcina (Wied.) Plate XVII, fig. 21 and 23. *M. bomboides* (Wied.) Plate XIX, fig. 22. *M. fautrix* O. S. Plate XVIII, fig. 3.

TABLE OF *MALLOPHORA* OF THE *BOMBOIDES* GROUP.

	Length of wing in mm.		Color						
	Range	Average	Third joint of antenna	Light hairs on body	wings	hairs on legs	pile on under-side of abdomen	hairs on ♂ genitalia	pile on dorsum of abdomen
orcina Wied.	16-22	18.1	⅓-½ length of arista	bright yellow	dark purplish brown	black. ♂'s with white tuft on under side of hind tibia and distal joints of hind tarsus. Lacking in some ♂'s.	black	black	yellow-basal 4 or 5 tergites. black-remainder
bomboides Wied.	24-28	25.4	nearly as long as arista	white	light yellowish brown	largely white	largely white	white	white-basal 3 tergites. black-4th tergite
rex, sp. n.	26-29	27.3	sub-equal in length to arista	yellow (pale to bright)	dark purplish brown	black. ♂'s with silver tuft on under side of hind tibia	black in some; in others, black with median line of yellow hairs.	black	yellow-basal 3 tergites. black-4th tergite. Remainder black in some cases (♂'s) yellow on apical 2 segments.
hrysomela sp. n.	23-24	23.2	⅓ length of arista	yellow with slight olive tint	dark purplish brown	Mostly black Some yellow on hind femur Silver tuft on under side of hind tibia in ♂.	largely yellow	yellow	Yellow-basal 3 tergites black-4th tergite yellow on apical 2 segments.

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THE EXTERNAL ANTATOMY OF THE HEAD AND ABDOMEN OF THE ROACH, *PERIPLANETA AMERICANA*[1]

By G. C. Crampton, Ph. D.

Massachusetts Agricultural College, Amherst, Mass.

Despite the fact that the very sight of a roach engenders in the minds of many people a feeling of repugnance and disgust, while others consider that roaches are too insignificant to be worthy of one's serious attention, roaches are nevertheless extremely "ancient and honorable" creatures in the sight of the great mother Nature. In fact they were her favorite children some hundreds of millions of years ago when the coal measures were being laid down in Carboniferous times, and their fossil remains are so characteristic of the Carboniferous strata that the Carboniferous period is frequently referred to as the "age of cockroaches," just as the much later Jurassic period is referred to as the "age of reptiles," etc., from the dominant fauna of the periods in question.

We are accustomed to look upon the hills as "eternal," while the occurrence of so frail a creature as a roach is regarded as merely one of Nature's passing incidents; but, frail as roaches are, the roach type has persisted but little changed from the remote Carboniferous period, while in the meantime, mountian ranges have risen and been leveled again, and the whole face of the landscape has changed, and changed again. During the time in which the roach type has been in existence, the great dinosaurs have come and gone, and birds, mammals, and flowering plants have arisen and developed their myriad profusion; but amid there ceaseless comings and goings, the roach type has pursued the even tenor of its way practically unaffected by the passing of the ages. It is therefore of some interest to study the makeup of an organism

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

so perfectly constructed that it has been able to defy the ravages of time and changing conditions, and the fact that the "changeless conservatism" of roaches has resulted in their retaining many features characteristic of the types ancestral to higher insects, makes their study doubly interesting.

In carrying out this study, I had hoped to include all of the main features of the gross external anatomy of the roach in a single paper; but as the work progressed, it soon became apparent that roaches present so many features of morphological interest that it would require too many figures and plates to illustrate the structure of the entire body adequately in a single article. I would therefore present herewith the principal features of the head and abdomen alone, leaving for a subsequent paper the discussion of the thorax and its appendages. The American roach, *Periplanet americana,* was chosen to illustrate the anatomy of a typical roach because of its large size and relative abundance which render it exceptionally suitable for such a study. Specimens preserved in alcohol may be readily obtained from Southern supply houses for approximately five dollars a hundred, and the study of the external anatomy of these insects is well suited to serve as an introduction to the study of the external anatomy of insects in general for students beginning the study of Entomology. A binocular dissecting microscope is absolutely essential for examining the external anatomy of the specimens, which should be studied immersed under alcohol or water, and the field should be illuminated by means of a powerful lamp provided with a bulls-eye condenser.

Seen under the binocular, the head of the roach (Fig. 5) is a beautiful object, "clean-cut," and smoothly polished. The upper lip or labrum *lr* is emarginate anteriorly (i. e. there is a "nick" or emargination *em* in its anterior margin). Behind the labrum is a non-pigmented area *ac* or anteclypeus followed by a more heavily chitinized and pigmented area *eps* called the postclypeus or epistoma. The areas *ac* and *eps* comprise the clypeus, which extends from the labral, or clypeolabral, suture (along which the labrum is hinged the clypeus) to the frontal pits *fp*, which are the external manifestations of certain invginations forming the anterior arms of the tentorium presently to be described. In some insects a clypeal (or clypeofrontal) suture extends from one frontal pit across to the other to demark the posterior limits of the clypeus, but this suture is absent in many Orthopteroid insects. Each postero-latereal angle of the clypeus bears a cup-like depression, the clypeotheca or "precoila" *cth* of Figs. 5 and 4, into which is received an articulatory process of the mandible labelled *g* in Figs. 5 and 4. I formerly (Crampton, 1921) used these points of articulation of the mandibles with the clypeus, as landmarks for demarking the posterior limits of the clypeus; but it is preferable to use the frontal pits *fp* for this purpose, as suggested by Yuasa, 1920.

If we remove the labrum and clypeus and examine their inner or pharyngeal surfaces, the membranous lining is seen to form an area called the epipharynx bearing the labels *pre* and *poe* in Fig. 8. The anterior portion of the epipharynx or preepipharynx *pre* is slightly more pigmented in the median region, and on each side it bears a lateral series of sense organs (only the left hand ones are shown in Fig. 8). The posterior portion of the epipharynx, or postepipharynx *poe* is located in the clypeal region and contains two epipharyngeal sclerites which are somewhat more deeply pigmented than the rest of the membrane of this region. Between the anterior epipharyngeal region in the labium, and the posterior epipharyngeal region in the clypeus, are the tormæ *tor* or thickenings (one on each side) which serve to demark the labium from the clypeus "internally," and are therefore useful land-marks.

Behind the clypeal region *eps* of Fig. 5 is the frontal region or frons *fr*, which is limited anteriorly by the suture (or by an imaginary line when the suture is absent) extending from one frontal pit *fp* across to the other. The frontogenal (suborbital) sutures *fgs* demark the frons from the genæ *ge* postero-laterally, and the anterior arms of the epicraneal suture *frs* demark the frons posteriorly. The epicranial suture is very faint in adult Periplanetas, and is therefore represented by a dotted Y-shaped line in Fig. 5. The arms of the epicranial suture which form the frontal suture *frs* (demarking the frons posteriorly) extend to the clear spaces *ofn* or ocellar fenestræ which contain the lateral ocelli and usually remain clear or colorless when the lateral ocelli become atrophied. The scar-like area or frontal myocicatrix *mc*, near the base of each antenna, is a muscle scar—i. e. it marks the attachment of muscles inserted upon the frons.

Behind the frons *fr* is an area designated as the epicranium, or parietals *pa*, into which the epicranium is divided by the coronal suture *cs* formed by the basal portion of the Y- shaped epicranial suture bearing the labels *cs* and *frs*. The upper (apical) or dorsalmost portion of the head is the vertex—a region not clearly demarked in most insects. The postero-dorasl portion of the head in the region of the occiptial foramen *ocf* of Fig. 11 (i. e. the region bearing the label *oc*) is called the occiput.

The area situated below and behind the compound eye, bearing the label *ge* in Figs. 5 and 11, is called the gena. Its anterior limits are demarked by the frontogenal or suborbital suture *fgs* on each side of the frons, and its posterior limits are demarked by a suture or ridge, the postgenal ridge *por* (Fig. 11) which seperates it from the postgena. The basimandibular suture *bms* of Fig. 5 demarks the gena from the sclerite below it called the basimandibula, mandbiulare, or the triochantin of the mandible—i. e. the area bearing the label *bm* in Fig. 5. Comstock suggests that the region *bm* represents the trochantin of the limb forming the mandible, but the region in question was probably formed by a chitinization of the mandibular membrane between the base of the mandible and the head capsule.

Behind the genæ *ge* of Fig. 11, and seperared from the genæ by the postenal ridges *por* are the postgenæ *pge*, which form the greater portion of the posterior region of the head. A cup-like depression of the postgena, the postgenotheca *pgt* of Figs. 11 and 12, receives a condyle of the mandible labelled *h*. A narrow median area labelled *pes* in Figs. 11, and 12, extends along the vento-median portion of the postgena, in the neighborhood of the mandibles and maxillæ, and the cardo of the maxilla (*cc* of Fig. 2) articulates with its postero-dorsal region. An area called the hypostoma becomes demarked in this region in certain Coleopterous larvæ, etc., but this area is not shown in the roach, nor is there a well defined gular region along which the postgenæ usually extend in Coleoptera and Neuroptera etc.

The chitinized fold-like area labelled *tf* in Figs. 13 and 11 was termed the trophifer by Crampton, 1917, because the labium is borne by it, and the maxillæ are closely associated with it. Yuasa, 1920, calls it the "maxillaria." Holmgren considers that it represents the labial segment in embryonic termites. It bears the occipital condyles labeled *x* in Fig. 13, and the cephaligers (*z* of Fig. 13) or head-bearing processes of the lateral cervical sclerites articulate with these condyles. Two occipital tendons *oct* furnish attachment for muscles, as also do the small cervical tendons *y*. The Cushion-like prominences labelled *tpn* in Fig. 13 lie near the gular pits which are the external manifestations of the invaginations forming the posterior arms of the tentorium.

When the mandibles, maxillæ and underlip are removed, and the head capsule is boiled in 10% caustic potash to remove the muscles and other soft parts (which are removed by washing them out with a pipette, of by plucking them away with a fine forceps) one may observe the inner beam-like structures called the tentorium. These structures serve as supports for muscle attachment, for buttressing and strengthening the head capsule, and for holding in place the brain and other delicate structures within the head.

As shown in Fig. 13, the tentorium consists of the following parts. The posterior arms *pot* (called the postentoria, or the "metatentoria" by Yuasa—though the prefix "meta" should be restricted to structures belonging to the metathorax) arise as invaginations of the gular pits *gp* (Fig. 11) situated just beneath the pad-like tentorial prominences labelled *tpn* in Fig. 13; and these invaginations forming the posterior arms of the tentorium unite to form the tentorium proper, or body of the tentorium *etn*, called the eutentorium, or "corpotentorium." An invagination from each of the frontal pits *fp* of Fig. 5 forms one of the anterior arms of the tentorium labelled *ptn* in Fig. 13, and these anterior arms of the tentorium are called the pretentoria. They unite to form a transverse plate labelled *itn*, which is called the intertentorium, laminatentorium, or frontal plate of the tentorium (Comstock & Kochi). Backward prolongations of the structure *itn* extend on each side of the neuroforamen *nf* to connect the plate *itn* with the body of the tentorium *etn*; and the dorsal arms *stn* or surtentoria (supratentoria) extend upward to the region of the antennal sclerite *ban* of Fig. 5. There are thus three pairs of tentorial arms, the anterior arms, *ptn*, the dorsal arms, *stn*, and the posterior arms *pot* shown in Fig. 13; and in the embryo (according to Riley) the posterior arms unite to form the body of the tentorium *etn*, while the anterior arms unite to form the plate *itn*, and they also give off the dorsal arms *stn*, and later become connected with the body of the tentorium *etn*.

The neuroforamen *nf* forms a circular opening through which the crura cerebri pass, and within it may be seen the tentorial tendons by means of which the oesophageal muscles are attached to the tentorium. The plate *itn* is situated between the crura cerebri and the mouth, and upon it are inserted certain muscles, the median tentorial carnia which it bears being apparently developed in connection with this purpose. The body of the tentorium serves to protect the suboesophageal ganglion to some extent, and the nervous system passes below it (i. e. the body of the tentorium) while the gullet passes above it in passing backward into the thorax through the large foramen magnum or occipital foramen *ocf*.

The mouth cavity or pharynx, contains the hypopharynx or lingua, *hph* a tongue-like organ composed of a basal portion, or basilingua labelled *bl* in Fig. 10, and a distal portion of distilingua *dl*. The basal portion is strengthened by the basilingual sclerites, from which a lingualora *ll* or slender lora-like sclerite extends backward to the oesphagus *oes* on each side of the base of the tongue (hypohparynx), while a lingual tendon *lt* serves for the attachment of muscles to the base of the tongue. The distal portion of the tongue is strenghtened by the distilingual sclerites which send down ventro-mesal arms from each side, meeting at the opening of the salivary duct or salivadict *sd*. The salivary glands are paired, and their paired ducts unite to form the common salivaduct *sd* opening at the salivapore which is located below the tongue, in the median line, at its base. The tongue or hypopharynx is provided with taste organs, as are also the epipharyngeal areas in the roof of the pharyngeal cavity and the regions adjacent to the oesophageal opening, etc. The pharyngeal cavity is closed by the labrum and clypeus in front, by the labium in the rear, and by the maxillæ and mandibles on the sides, and it leads into the œsophagus *oes* of Fig. 10 which passes above the tentorial plates *itn* and *etn* of Fig. 13, and out of the head into the neck through the occipital foramen *ocf*.

The mouthparts, as was pointed out a century ago by Savigny, are modified limbs. The mandibles represent the basal segment of a mouth-part-limb (see Crampton, 1921), and their "cutting"or masticatory surface bears the incisors distally—i. e. the tooth-like projections *in* of Figs. 12 and 4, while in the middle of the median or masticatory surface is the mola *mo* or grinding area. Basal to this is the submola or "accia" *smo*, an area lacking in pigment, and clothed with fine hairs in certain insects. The mandible has two "rocking points" or fulcra used as points of support when the muscles attached to the gnathotendons or mandibular tendons *ft* and *et* of Fig. 12 open and shut the mandibles which work with a "sidewise" or "horizontal" movement as they meet under the upper lip *lr* of Fig. 5. Thus, when the muscle attached to the flexor tendon *ft* of Fig. 12 contracts, the mandible rocking on the pivotal point *h* (Fig. 12) on one side, and on the pivotal point *g* (Fig. 4) of the other side is flexed or closed. On the other hand, when the flexing or closing muscles relax, and the opening or extensor muscles attached to the tendon *et* contract, the mandible pivoting upon the same two rocking points, is opened, or extended. The flexor tendon *ft* is borne by a small plate *gn* (Fig. 12) in the medio-basal region of the madible, and the flexor tendon is usually hugely developed to furnish points of attachment for the powerful muscles which close the mandibles in the movements of chewing. Since the opening muscles need not be very powerful, their tendon *et*, which is attached to the protuberance *gpr*, is not very large. Of the two rocking or pivoting points, the posterior or ventral one *h* of Fig. 12 consists of a condyle which is received in a cup or theca *pgt 9* (Fig. 12) at the anterior (ventral) end of the postgena *pge* (compare also Fig. 11). The anterior or dorsal pivoting point of the mandible is a projection labelled *g* in Fig. 4, which is received in a theca *cth* at the postero-lateral angle of the clypeus (compare also Fig. 5). The process *g* of Fig. 4 bears a groove which fits over a ridge or projection of the clypeal angle, and is thus a kind of condyle and cup combined.

The maxilla (Fig. 2) represents a modified mouth part-limb, in which the second and third segments of the limb give off lobe-like processes (or "endites") to form the lacinia and galea, while the so-called endopodite of the limb becomes modified to form the maxillary palpus, as was discussed by Crampton, 1922, and 1923. When the extensor muscles of the maxilla, which are attached to the cardotendon *ct* of Fig. 2. contract, the point *cc* acts as a fulcrum and the maxilla is opened or extended; and when the muscles attached along the sclerite *pas* and to other portions of the maxilla contract, the maxilla is flexed or closed. The basal sclerite *bc* bears a process *cp* to which the tendon *ct* is attached, and from the point *cc*(where the sclerite *bc* of Fig. 2 articulates with the head in the region of the area bearing the label *pge* in Fig. 11) there extends a groove fitting over a ridge on the under side of the head in the neighborhood of the region bearing the label *pge* in Fig. 11. The maxilla, however, has been removed from the left hand side of Fig. 11, and the right hand maxilla dips beneath the region *sm* of the labium, so that the articulating point of the base of the maxilla with the head region is not seen in Fig. 11.

The cardo or basal region of the maxilla is divided into a basicardo *bc* and a disticardo *dc*, as is shown in Fig. 2. The stipes is divided into a true stipes *st* and a narrow median marginal region *pas*, and the muscles attached to this sclerite may have been ressponsible for its demarcation. Internally, there is a parastipital ridge extending along the parastipital suture demarking the sclerite *pas* and there is likewise an internal cardine ridge demarking the sclerite *bc* from the sclerite *dc* in the cardo. A basimaxillary membrane *bm* connects the maxilla with the region in the basal region of the underlip.

The stipes *st* bears a lacinia *la* provided with a fringe of bristles *lf* for sweeping the food into the mouth, or for preventing it from falling out of the mouth during the movements of lacinia. The laciniadentes *ld* (Fig. 2)or tooth-like processes at the apex of the lacinia *la* are probably used in aiding to comminute the food—or to hold the food when it is comminuted ("chewed") by the mandibles. A peculiar appendage *ma* is called the midappendix lacinula, or hamadens, and is present even in such primitive arthropods as the Crustacea. The palpifer *pf* is bent around on the other side of the maxilla, and is therefore not well shown in the view of the maxilla drawn in Fig. 2. The palpifer *pf* is a destinct sclerite in lower insects and bears the galea *ga*, but in the roach the palpifer becomes rather closely united with the stipes *st*, and the stipes appears to bear the galea, although if one examines the other surface of the maxilla, the connection of the basal portion of the galea *bg* with the palpifer *pf* is more readly apparent. The galea *ga* is composed of two segments, the basigalea *bg* and the distigalea *dg*, and the distal segment *dg* forms a sort of hood into which the tip of the lacinia is received. A strengthening rod *gb* (Fig. 3) stiffens the galea on its mesal surface (the one which fits around the tip of the lacinia) and a marginal region *pga* (Figs. 2 and 3) of the galea is clothed with fine hairs. The maxillarypalpus *mp* is borne by the palpifer *pf* and is composed of five segments. The terminal segment is membranous at the tip and is provided with sense organs.

The labium or underlip of the roach articulates posteriorly with the sclerite labelled *tf* in Fig. 11, and the sclerite in question probably represents the dorso-lateral portions of the labial segment, according to the investigations of Holgren, 1909. The basal sclerite *sm* of the labium (Fig. 11) is made up chiefly of the submentum, although its posterior portion may contain the gular region of other insects such as soldier termites, Coleoptera, etc. On the other hand, the gular region may form behind the submentum, and the origin of the gular region is still a matter of doubt. The gular pits *gp* of Fig. 11, which are usaully situated on the gular sutures demarking the gular region laterally, are hidden by the postero-lateral edges of the submentum *sm* in Fig. 11. These gular pits are the external manifestations of the invaginations forming the posterior arms of the tentorioum (Fig. 13 *pot*) as was mentioned above.

In front of the submentum *sm* is the mentum *mn* (Fig. 11), and the entire region in front of the mentum *mn* is referred to as the eulabium, because it is the only part of the underlip formed by the union of the labial appendages in termites, according to Holmgren, who maintains that the mentum and submentum are formed behind the labial segment in the embryo. In front of the mentum *mn* is a small median triangular region *il* or interlabium, and on each side of it are the palpigers *pgr*, which bear the labial palpi *lp*. The palpigers are larger and better developed on the other side of the labium (see Fig. 10, *pgr*). The labiostipes *ls* bear the glossa *gl* and paraglossa *pgl*. When the glossæ and para-glossæ unite to form a single median structure, they are termed the ligula. The labial palpi have a membranous region at the tip of the terminal segment which is supplied with sense organs.

It has long been known that the labium is made up of the union of two appendages like the maxillæ, which are distinct in the embryo; but it is not known what parts of the maxilla correspond to the parts of the labium in every case.. The earlier investigators thought that the cardines (pleural of cardo) unite to form the mentum, while the palpifers form the palpigers, the stipites, (pleural of stipes) form the labio-stipites, the laciniæ form the glossæ, the galeæ form the paraglossæ, and the maxillary palpi form the labial palpi, when the maxilla-like appendages unite to form the labium. The only matter which seems to be in doubt is whether the united cardines form the mentum *mm*, or whether they form the small median region *il* of Fig. 11. I am inclined to think that the small region *il*, rather than the mentum *mn*, represents the united cardines, since Holmgren states the mentum is formed in the embryo *behind* the labial segment, so that the basal segments of the maxilla-like appendages of the labium, which unite to form the underlip can have nothing to do with the mentum, if the latter is formed behind the labial segment. The whole matter is still very puzzling, and should be re-investigated with a view to determining exactly what structures represent the united cardines of the appendages which form the underlip.

Of the other external features of the head which are of any great interest, there remain to be considered only the antennæ. In the roach these are long, slender, delicate, filiform or flagellate structures composed of a great number of segments. At the base of each antenna is a narrow ring-like sclerite *ban* of Figs. 5 and 7, surrounding the antennal membrane at the base of the antenna. This ring-like antennal sclerite is called the basantenna, or antennale. (Yuasa, 1920, uses the form "antennaria," instead of the original form antennale). The basal segment or scape *sc* of Figs. 5 and 7 is borne on a process *af* originally called the antennifer, for which designation Yuasa substitutes the term "antacoila." On each side of the antennifer *af* of Fig. 7 is a small basantennal plate to which is attached a basantennal tendon labelled *tn* in Fig. 9. When the muscles attached to these tendons contract, they move the antennæ, using the tip of the antennifer *af* as a fulcrum, as shown in Fig. 9. Above the base of the antenna is a surantennifer *saf* which connects the base of the antenna above, with the antennal sclerite *ban*, and assists in the complicated movements of the antenna, which is capable of great freedom of movement ,as is necessary in a structure bearing the delicate chemical-sense organs and tactile organs of the "feelers." As is shown in Fig. 7, the scape *sc* articulates with the pedicel *pd* at a point indicated in the drawing, and a similar articulating point is located on the other surface of the antenna. Between these two "rocking points" are small chitinous pedicellar plates embedded in the connecting membrane, furnishing points of attachment for certain of the muscles operating the antennæ. Beyond or distal to the pedicel *pd* is the postpedicel *ppd*, and distal to this are the segments of the flagellum or filament, as the remainder of the antenna is called. The relative sizes of the pedicel, postpedicel etc., vary with the sex of the individual, but these slight sexual differences have not been dealt with in this paper. The flagellum is composed of four principal types of segments. Those in the proximal portion of the antenna are the brachymeres or shorter segments (i. e. *a* and *b* of Fig. 6), while those in the distal portion of the antenna are the dolichomeres or longer segments (i. e. *c* and *d* of Fig. 6). We may further distinguish the short or annular brachymeres *a* from the long brachymeres *b*, and the stout dolichomeres *c* from the slender dolichomeres *d*, though the types merge, and are rather difficult to describe.

Turning next to the consideration of the abdomen: as shown in Fig. 14, there are eight spiracle-bearing segments followed by what appear to be three non-spiracle-bearing segments (the terminal ones) best seen in the dorsal region of the abdomen. The typical segments (in the middle of the abdomen) consist of a dorsal plate of tergite *t* with a lateral subtergite or pleurite *pl* on each side (probably a demarked portion of the tergite proper), and a sternite or ventral plate *s* seperated from the subtergites by a lateral membrane. The spiracles *sp* are borne at the anterior ends of the subtergites *pl*, and if the first segment can be taken as the criterion, the spiracles apparently belong to the antero-lateral area of the tergite which becomes detached to form the subtergite The membranes connecting successive segments are called conjunctiva, and this term is also applied to the membrane connecting the sclerites of the abdominal segments. It is preferable to distinguish the lateral membranes, however, and they are here referred to as the lateral or pleural membranes.

The spiracles are extremely interesting structures, and the first may be taken as an illustration of the way in which a closing appliance was developed to prevent the entrance of deleterious substances. If the first spiracle *sp* (counting from the base of the abdomen) of Fig. 14 is removed with its surrounding body wall, and is examined from within, after removing the soft parts, it may readily be seen that within the atrium or entrance chamber there is a triangular sclerite of suboperculum *sop* of Fig. 19, which was located ventrally when the spiracle was *in situ*, as in Fig. 14, but is apparently dorsal in Fig. 18, which depicts the inner surface when the fragment containing the spiracle is turned over and viewed from within. Certain occlusor muscles such as the one labelled *m* in Fig. 18 are attached to the suboperculum *sop* and extend to the arch or bow *sar* called the spirarcus. When these occlusor muscles contract, the bow *sar*, which pivots at the point *p*, is drawn up against the suboperculum *sop* and effectively closes the entrance to the trachea by pinching the tube together. When the occlusor muscles relax, the elasticity of the parts cause them to spring back, and the trachea is opened again. This is but one more of the marvellous little mechanical devices developed by these interesting creatures, and as one studies their anatomy one's wonder increases that Nature has endowed them with such cleverly efficient mechanisms for carrying on the commonplaces of a cockroach's existence—though I suppose we should naturally expect to find some pretty efficient devices in an organism which has successfully maintained itself for so many million of years despite the vicissitudes of time and changing environment!

The typical tergites and sternites are composed of two principal areas. In the tergite the anterior area (demarked by a transtergal suture or ridge) is the antetergite *at* (Fig. 14) and the posterior region is the tergite proper or eutergite *etg*. Similarly, in the sternal plate there is an antesternite *as* and a sternite proper or eusternite *eus* seperated by a transternal suture or ridge. The antetergite and antesternite are apparently demarked by the friction of the overlapping edges of the telescoping segments, or at any rate, the antetergite and antesternite are usually over-lapped by the posterior portions of the preceding segments and are usually less deeply pigmented than the rest of the tergal and sternal sclerites. The telescoping of the segments of the abdomen allows for distention with eggs, etc., and in its normal state the abdomen of the female is more flattened than is the case with the egg-distended abdomen shown in Fig. 14; and the anterior portions of the sternal and terga are usually hidden in non-distend individuals.

Following the generally accepted usage of systematists, I have restricted the use of the terms tergite, pleurite and sternite to the dorsal, lateral and sternal plates of the abdomen alone, and I would use the designations notum, pleurum and sternum for the parts of the thoracic segments. The segments of the abdomen may be referred to as the uromeres, for the sake of brevity, and counting from the base of the abdomen, I would refer to them as uromere 1, uromere 2, etc., instead of using the longer designation "first abdominal segment, second abdominal segment," etc. The terminal abdominal segments and their various structures are referred to as the terminalia (Crampton, 1918) but Freeborn, 1924, includes in the designation "terminalia" the genital structures as well in higher insects, and the latter usage is preferable in the higher forms where the genitalia and terminal structures are compactly grouped by the shortening and telescoping of the terminal segments of the abdomen. When there is a reduction in the number of the abdominal segments. it is usually the terminal ones which fuse or unite, as is indicated by the fact that the spiracles remain distinct (for the most part) in the basal segments even when the latter become greatly reduced in size.

In Fig. 19, the terminal segments of the abdomen of the female roach are shown more enlarged than in Fig. 14, and uromeres 8, 9, and 10 are shown more in detail, while in Fig. 21 the terminalia of the male are shown more in detail.

The tenth abdominal segment is essentially the same in both sexes, and its sternite is usually reduced or atrophied, while its tergite forms the huge epiproct *ep* or supraanal plate of Figs. 14, 19 and 21. I suspect that the tergite of the eleventh segment unites with that of the tenth to form this large supraanal plate, but the embryologists claim that the eleventh abdominal segment lies behind the plate in question. The epiproct *ep* is divided into a basepiproct or basal region and a postepiproct or terminal region which becomes divided into two lobes or epiproctal lobes by a deep emargination or epiproctal cleft in its posterior margin. The membranous structure bearing the anal opening posteriorly is the protiger *pro* of Figs. 14, 19 and 21.

In may flies and other primitive insects, the parapodial plates or paraprocts form the basal segment of the cerci; and as was pointed out in a former paper (Crampton, 1921) the paraprocts apparently represent the protopodite of a crustacean limb, in which the endopodite forms the cercus in insects. In the roach, the paraprocts or parapodial plates *par* of Figs. 14, 19 and 21, are large plates situated on each side of the anal opening, and they are divided by a lateral flange, or paracarina, into an upper and lower region. When the gynovalvular membrane, which forms a pouch for carrying the oötheca, becomes distended, as is shown in Fig. 16, it extends dorsalward under the lateral flange of the paraprocts of the female, and this flange thus has an especial use in the female.

At the base of and below the cercus *ce* of Figs. 19, etc., is the basicercus *bce*, which may represent a basal segment of the cercus.

The cercus itself (*ce* of Figs. 14, 21, 24, etc.) is a multiarticulate structure serving as a pair of hinder "antennæ", and is said to bear olfactory organs as well as the tactile organs usually present in the cerci of insects in general. As is shown in Fig. 14, the cercus may be divided by a lateral ridge (cercocarina) into an upper and lower region. The basal segments of the cercus are usually more annular, while the terminal ones are more cylindrical (Fig. 24). In the roach, the cercus migrates from the paraproct *par* (Figl 19) which originally bore it, and becomes secondarily associated with the epiproct *ep*. The cerciger *cg* or process of the epiproct *ep* bears the cercus in such cases, and the surcerciger *scg* forms a second pivotal point in certain of the movements of the cercus.

In handling living roaches, one in made painfully aware of a most nauseating odor which clings to one's fingers even after repeated washing with soap and water. The fluid which produces this odor is probably secreted by the repugnatoria or scent glands labelled *rep* in Fig. 14. These repugnatoria are eversible glands located in the membrane between the fifth and sixth adbominal tergites, and are slightly nearer to the sixth than to the fifth tergite, so that they may possibly belong to the sixth abdominal segment.

The gynomeres, or abdominal segments of the female which become modified to form the secondary sexual characters of the abdominal region, are the seventh, eighth and ninth uromeres. The sternite of the seventh abdominal segment is proudced posteriorly to form the hypogynium *hg* of Fig. 14, which hides the oviositor, and forms the sides and floor of the gynatrium or genital chamber of the female, which receives the parts of the male in copula, and also forms a genital pouch for carrying the ootheca or egg-case which is carried protruding from the end of the abdomen, for a time, before it is deposited. Like the other abdominal sternites, the hypogynium *hg* of Fig. 14, has an anterior region *as* and a posterior region *eus* demarked by a transternal suture or ridge; but in addition to these typical divisions of the sterum, the seventh sternite has a backward projecting structure *gv*, which is divided into two gynovalvæ or pseudo-valves *gv* of Figs. 14, 15, and 16 in the American roach and certain of its allies. The gynovalvular membrane, as shown in Fig. 16, extends between these pseudovalves and upward on each side to the flanges of the paraprocts, to form a pouch for carrying and protecting the ootheca or egg-case, as was mentioned above. When not distended for this purpose, the membrane in question becomes folded between the valves, as in Fig. 26. The endogynal plates *eng* shown in Fig. 26 are probably involved in the stretching of the membrane in question, though it apparently becomes distended and turgid by interal pressure also. At the base of the seventh sternite is the saccopore, or external opening of a ventral bilobed sac, the ventrosacculus *sac*, which apparently serves as a glandular reservoir; and a repellent substance is secreted in it.

When the hypogyium or modified seventh abdominal sternite is removed, as in Fig. 19, the ovipositor or oviscapt with its basal plates etc., is exposed. As may be seen in Fig. 19, the eighth tergite is the dorsal portion of the eighth segment whose ventral parts form the structures labelled *pvu* etc. The sclerites *pvu* normally project backward under the sclerites *vs* and conceal the latter, but in Fig. 19 the structures labelled *pvu* are represented as though forced back and upward in order to show the relation of the parts to one onother. Similarly, in Fig. 20 the sclerites *pvu* are represented as though laid back from the sclerite *vs* which they would normally cover and hide from view. The large cavity within the opening labelled *vul* in Fig. 20, is the uterus and vagina, or common passage of the two oviducts through which the eggs are conducted to the exterior from the ovaries where they are formed. The elongated opening of the vagina, labelled *vul* is the vulva, and the sclerites surrounding it are the perivulva *pvu*. Each half of the perivulva gives off an arm *vbr*, and the two halves are joined by an arch *var*. The walls of the vaginal cavity are membranous, and are thrown into folds in specimens treated with caustic potash. If this condition is normal, it would indicate that the vaginal cavity is capable of considerable dilation at the time of egg-laying, and the character of the perivaginal sclerites would indicate that the vulva might readily be widened considerably to permit the extrusion of a batch of eggs (the eggs apparently are formed at about the same time). If one observes the relation of the sclerite *pvu* to the tergite of the eighth uromere in Fig. 19 (in which the plate in question has been forced back and the parts about it have been evertd) it would appear as though the perivulva *pvu* is a modified portion of the sternum of the eighth uromere. Paytoureau, 1895, however, and recent investigators, such as Chopard, consider that the vagina opens between the seventh and eighth sternites, and in a footnote, Peytourea refers to the observations of Miall and Denny, 1893 on the development of the region in question, in a passage which may be roughly translated as follows: "The delicate indurated membrane which leads out to the vaginal opening is not the eighth sternite, but arises as a fold of the intersegmental membrane." If this is true, it would seem to indicate that the perivulva is a thickening of the intersegmental membrane, rather than a sclerite of the eighth abdominal sternum.

The sclerites immediately behind the plates labelled *vs* in Figs. 20, 19, 17, etc., may represent the structures called the basivalvulæ in other Orthopteroid insects by Crampton, 1917, and Walker, 1919. As may be seen in Fig. 19 the plates *vs* are sclerites of the eighth uromere, and they are connected with the bases of the ovipositor valves *vv*. A small transverse ventral sclerite *ms* situated between the sclerites *vs* of Fig. 20, is considered to be the ninth sternite by Miall and Denny, 1886, although it is not quite clear how they arrived at this conclusion. Its posterior portion surrounds the thecapore *tp* of Fig. 20, or opening of the spermatheca, in which spermatozoa are stored up at the time of mating, to fertilize the eggs. Hence the opening of the spermatheca *tp* of Fig. 20 is normally situated immediately above the vulva *vul* (out of which the eggs pass) when the parts are not unnaturally separated as in Fig. 20. Dr. Walker, however, informs me that this supposed spermatheca is really a gland. The sclerite labelled *ms* in Fig. 17 represents the internal view of the sclerite labelled *ms* in Fig. 20, showing the internal projections of the plate in question.

The ovipositor of the roach is composed of three pairs of valvulæ. Of these, the dorsal valvulæ *dv* and inner valvulæ *iv* (Figs. 20, 17, 19, etc.) belong to the ninth uromere, while the ventral valvulæ *vv* belong to the eighth uromere. The dorsal valvulæ *dv* have been varioully termed the posterior or third gonapophyses, dorsovalvulæ, survalvulæ, nono-valvulæ, etc. The inner ones *iv* have been called the inner or second gonapophyses, intervalvulæ, etc.; and the ventral valvulæ have been called the anterior or first gonapophyses, octovalvulæ, subvalvulæ, ventrovalvulæ, etc.

The sclerite just behind the plate *vs* of Fig. 19 probably represents a modified coxite or protopodite of a limb (of the eighth uromere) in which the outer branch or exopodite was lost and the endopodite or inner branch became modified to form the ventral valve *vv*. The greatly elongated coxite or protopodite of the ninth uromere apparently formed the dorsal valve *dv* whose external branch or exopodite (represented by the stylus in immature roaches) becomes lost in the adult, while the inner branch, or endopodite, becomes modified to form the inner valve *iv*. This is a very complicated idea of the origin of the parts. A simpler view (though one which is less in accord with the facts of comparative anatomy) is that the ventral valves *vv* are merely outgrowths of the eighth uromere, while the dorsal valves *dv* are outgrowths of the ninth uromere, and the inner valvulæ *iv* are outgrowths of the tenth uromere which become secondarily associated with the ninth segment.

Miall and Denny state that "In the cockroach the ovipositor is used to grasp the egg capsule, while it is being formed, filled with eggs, and hardened: and the notched edge is the imprint of the inner posterior gonapophyses, made while the egg capsule is still soft. The shape of the parts in the male and female indicates that the ovipositor is passive in copulation, and is then raised to allow access to the spermatheca." A richly branched valviglandula or valve gland (*vgl* of Fig. 17), which is probably an accessory colleterial gland, pours out its secretion through the valvipore *vpo* (Fig. 20) located between the bases of the inner valvulæ *iv*.

The ninth abdominal segment is the genital segment *par excellence* in the male, and it may be referred to as the andromere. As shown in Fig. 21, its pleurite *pl* is much enlarged and extends downward to the ninth sternite or hypandrium *ha*. The hypandrium *ha* of Fig. 21 consists of a basal portion or hypandrium proper, labelled *eha* and a posterior *scx* formed by the union of the coxites, or stylus-bearing rudimentary abdominal limbs (vestigial protopodites) which unite with a portion of the sternum to form the area labelled *scx* in Figs. 21 and 24, while the styli (vestigial exopodites) remain distinct to form the peg-like appendages *stl* of the ninth sternite in the male. Normally the basal portion to the ninth sternite *eha* of Fig. 21 is overlapped by the eighth sternite and only the portion labelled *scx* projects as in Fig. 24.

Usually the parts of the male genital apparatus are withdrawn, and are concealed by the hypandrium or ninth sternite. At the time of mating, however, they are protruded, and may remain so to some extent even when the male has been killed, as is shown in Figs. 21 and 24—and in some cases the parts are even more protruded than is indicated in the figures in question. When the genitalia are boiled in caustic potash and spread apart, they are seen to consist of the following parts, shown in Figs. 23 and 25. The penis *pe* (Fig. 25) is membranous-walled and is possibly turgid in mating. It is located on the dorsal surface of the penislobus *pel* of Figs. 25, 24 and 23. The ejaculatory duct *ej* of Fig. 25, or common duct from the testes, utriculi, etc. of the male, conducts the genital products to the exterior through the meatus or opening on the side of the penis *pe* (Fig. 25). The walls of the ejacultory duct are strenghtened by depositions of chitin, and muscles involved in the mating process, are attached to these structures. The glandopore, or opening of the conglobate gland, is indicated by the label *o*, just behind the asperate lobe *asl*, in Fig. 25.

The pseudopenis *psp* of Figs. 21, 23, 24, and 25, serves to introduce the genital products of the male into the parts of the female at the time of mating, and on this account the structure in question has been called the penis by some investigators, but it is not homologue of the true penis (through which the ejaculatory duct empties) of other insects, and on this account it is here designated as the pseudopenis. It bears a lateral papilla labelled *e* in Figs. 25 and 21, and it is possible that a gland may open through this protuberance, although I was unable to find any trace of such a gland in the specimens treated with caustic potash. The process has been called the titillator by Brunner von Wattenwyl, and it has been suggested that it serves to dilate the parts of the female during copula, as may also the bird's-head-shaped, serrate lobe *ser* with its process *fa* (Figs. 25 and 23), although the latter may serve to anchor the parts when the male products are introduced during coitus. The opposing lobes *op* are called claspers by Walker, but nothing definite is known concerning their function, or that of the pointed process *acl* or of the small plate *bu* which bears a short recurved hook-like fold or process. The large supporting arches labelled *ana* and *bar* in Fig. 23 and 25 serve to strengthen the lobes and processes, and also furnish points of attachment for muscles, as do the internal projections and processes labelled *enl* and *epr* in Fig. 25.

The interpretation of the homologies of the above-mentioned parts has not been thoroughly worked out, although Walker, 1922, suggests that the structures labelled *tt*, *ser*, etc., represent the parameres of other insects. Walker, however, applies the designation parameres to entirely different structures in the Apterygota and Pterygota, and different investigators apply the term to so many different structures in different insects, that it is practically impossible to say what is meant by the term parameres. If we restrict the designation parameres to the second arily-formed outgrowths and chitinizations of the membrane about the intromittent organ, the term parameres might well be applied to the above-mentioned structures in the roach. The lobes *op* etc., of Fig. 25, however, are probably formed in the membrane about the intromittent organ also, and it is necessary to find some other method of differentiating the parameres from the other structures formed in this region. Walker refers to the lobe *pel* as the penis, but I think it is preferable to restrict the designation penis to the structure labelled *pe* in Fig. 25, since I think it very probable that the lobe *pel* corresponds (partly, at any rate) to the chitinized parts about the true penis called the adeagus in other insects. It is quite evident, however, that the whole subject of the homologies of the genitalic parts of male insects should be more throughly studied from the standpoint of comparative anatomy, development, etc., with a view to determing the true interpretation of the parts in these structures which are so much used in systematic entomology.

In the immature roach shown in Fig. 22, the chitinous projections, etc., of the adult insect are not yet developed, and the membranous lobes shown in Fig. 22 represent the undeveloped condition of the more complicated genitalia shown in Fig. 25. In capturing the specimen shown in Fig. 22, the insect was rather tightly squeezed, and the pressure apparently caused the rectum to become everted, exposing the rectal lining and the endorectal plates *enp*, which are rather weakly-pigmented chitinous protections of the rectal folds or bands. The rectum protrudes in a similar fashion in specimens of termites, psocids, etc., preserved in alcohol, and it is possible that the insects in question may be able to protrude the parts voluntarily when irritated by the alcohol into which they are thrown when collected.

In the foregoing discussion, only the external parts of the head and abdomen have been taken up. In a second paper, already practically completed, the external features of the thorax and its appendages will be discussed; and I am hoping to take up the gross internal anatomy as well, in subsequent papers dealing with the structure of the roach *Periplaneta americana*. In the present paper, most of the drawings are based upon a study of P. *americana*; but in a few instances drawings were made from specimens of a closely allied form. The parts of the other forms, however, are so similar to those of P. *americana*, that there will be no difficulty in identifying all of the structures figured, in studying P. *americana*, with the figures in question as a guide.

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Abbreviations

a.....Short antennal brachymeres
ac....Anteclypeus
acl...Pointed process (acutolobus)
af....Antennifer
am....Andromembrane
ant...Antenna
ana...Basal arch (andrarcus)
as....Antesternite
asl...Asperate lobe (asperolobus)
at....Antetergite
b.....Elongate antennal brachymeres
ban...Basantenna
bar...Basarcus
bat...Basantennal tendons
bc....Basicardo
bce...Basicercus
bg....Basigalea
bl....Basilingua
bm....Basimandibula
bms...Basimandibular suture

bse... Basiserrata
bsl... Basilamina
bu... Basuncus
c..... Broad dolichomeres
ca.... Cardo
cc.... Cardocondyle
ce.... Cercus
cg.... Cerciger
cl.... Clypeus
cm... Basivalvular membrane
cp.... Cardoprocess
cs.... Coronal suture
ct.... Cardotendon
cth... Clypeotheca
d..... Slender dolichomeres
dc.... Disticardo
dg.... Distigalea
dl.... Distilingua
dv.... Dorsal valvulæ (dorsovalvulæ)
e..... Pseudopenis papilla
eha... Euhypandrium
ej.... Ejaculatory duct
em... Emargination of labium
eng... Endogynal plates
enl... Endolamina
enp... Endorectal plates
ent... Endotergite
ep.... Epiproct or supraanal plate
eph... Epipharynx
epr... Endoprocessus
eps... Epistoma or postclypeus
epv... Epivalves
et.... Extensor gnathotendon
etg... Eutergite
etn... Body of tentorium (eutentorium)
eus... Eusternite
ev.... Endovalvula
fa.... Falx or pointed process
fgs... Frontogenal suture
fp.... Fronts pits (frontocavæ)
fr.... Frons or front
frs... Frontal suture
ft.... Flexor gnathotendon
g..... Gnathartus (articulatory process)
ga.... Galea
gb.... Galeabacillus
ge.... Gena
gf.... Galea fossa
gl.... Glossa
gn.... Gnathite
gp.... Gular pits (gulacavæ)
gpr... Gnathoprocess
gv.... Pseudovalves (gynovalvæ)
h..... Gnathocondyle or hypocondyle
ha.... Hypandrium (subgenital plate of male)
hg.... Hypogynium (subgenital plate of female)
hph... Hypopharynx or lingua
hpl... Hypoplica or endohypandrium
hs.... Hypandrial suture
il..... Interlabium
in.... Incisors
int... Intertentorium
iv.... Inner valves (intervalvulæ)
la.... Lacinia
ld.... Laciniadentes
lf..... Lacinial fringe (laciniafimbrium)

li.....Labium
ll.....Lingualora
lp....Labial palpus
lr. ...Labrum
ls. ...Labiostipes
lt. ...Linguatendon
m. ...Occlusor muscle
ma...Midappendix
mc...Myociacatrix
md...Mandible
mn...Mentum
mo...Mola
mp...Maxillary palpus
ms...Medisternite
mtn..Metanotum
nf....Neuroforamen
o.....Glandopore
oc....Occiput
ocf...Occipital foramen
oct...Occipital tendons
oes...Oesophagus
ofn...Ocellar fenestræ
op....Opponentes
p.....Pivot of spiracular bow
pa....Parietals (of epicranium)
par...Paraprocts (parapodial plates)
pas...Parastipes
pd....Pedicel
pe....Penis
pel...Penislobus (sublamina)
pes...Peristome
pf....Palpifer
pga...Perigalea
pge....Postgenæ
pgl...Paraglossæ
pgr...Palpiger
pgt...Postgenatheca
pl....Pleurite
poe...Postepipharynx
por...Postgenal ridge
pot...Postentorium
ppd. .Postpedicel
pre...Preepipharynx
pro...Proctiger
psp...Pseudopenis
pt....Pedicel tendons
pvu. .Perivulva
rep...Repugnatoria
s.....Sternite
sac...Ventrosacculus
saf...Surantennifer
sar...Spiracular bow (spirarcus)
sc.....Scape
scg...Surcerciger
scx...United coxites (syncoxite)
sd....Salivaduct
ser...Serrate lobe (serrata)
sm...Submentum
smo..Submola
so....Suboperculum
sp....Spiracles
spt..."Spermatheca" (probably a gland.)
ssa...Subserrata
st....Stipes (eustipes)
stl....Stylus
stn...Surtentorium (supratentorium)
t.....Tergite
tf....Trophifer
tor...Tormæ
tn....Basantennal tendons
tp....Thecapore
tpn...Tentorial prominences
tt....Titillator

var... Vulvarcus
vbr... Vulvabrachium
vf.. . . Valvifer
fgl... . Valviglandula
vju... Valvijugum
vl.... Valvilora
vm.. . Vulvar membrane
vpo... Valvipore
vr.... Valviramus
vs.... Valvisternite
vul.. . Vulva
vv... . Ventral valvulæ (ventrovalvulæ)
x..... Occipital condyles
y..... Cervical tendons
z..... Cephaligers

EXPLANATION OF PLATES V, VI, AND VII

Fig. 1. Tendons at base of pedicel of antenna.

Fig. 2. Posterior (ventral) view of dextral maxilla.

Fig. 3. Mesal view of tip of same.

Fig. 4. Anterior (dorsal) view of sinistral mandible.

Fig. 5. Frontal view of head.

Fig. 6. Types of antennal segments.

Fig. 7. Basal region of antenna.

Fig. 8. Inner view of labrum and clypeus.

Fig. 9. Inner view showing tendons at base of antenna.

Fig. 10. View of hypopharynx in relation to upper and lower lip.

Fig. 11. Posterior view of head.

Fig. 12. Posterior (ventral) view of dextral mandible.

Fig. 13. Posterior view of head with mouthparts removed to show tentorium.

Fig. 14. Lateral view of abdomen of female.

Fig. 15. Ventral view of valves at tip of subgenital plate of female.

Fig. 16. Lateral view of same, showing hypogynal membrane.

Fig. 17. Dorsal view of ovipositor and inner view of its basal plates.

Fig. 18. Inner view of first abdominal spiracle.

Fig. 19. Lateral view of segments 8, 9, and 10 of female.

Fig. 20. Ventral view of ovipositor and basal plates.

Fig. 21. Lateral view of segments 9 and 10 of male.

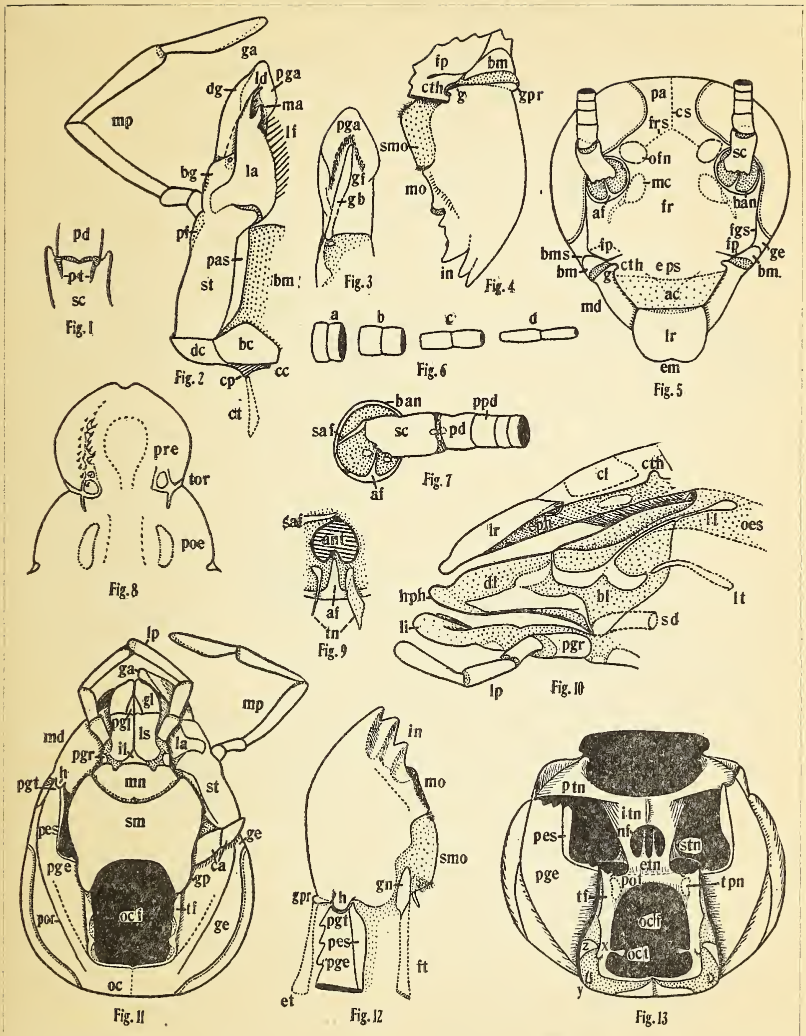
Fig. 22. Ventral view of terminal structures of immature male.

Fig. 23. Ventral view of male genitalia spread apart.

Fig. 24. Ventral view of terminal structures of adult male.

Fig. 25. Dorsal view of male genitalia and subgenital plate seen partially from within.

Fig. 26. Dorsal view of subgenital plate of female, basal portion seen from within.



CRAMPTON—ANATOMY OF THE ROACH

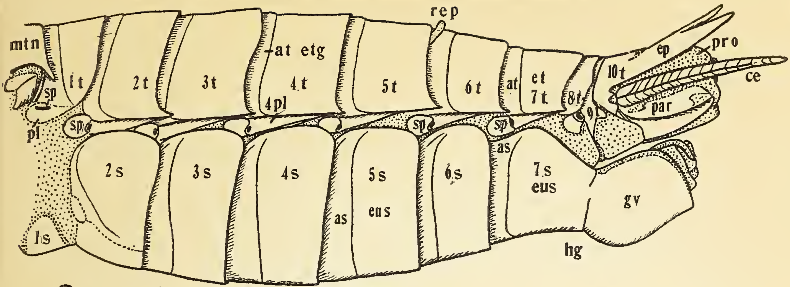


Fig. 14

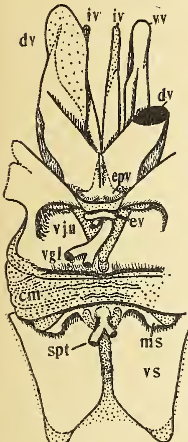


Fig. 17

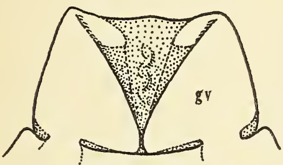


Fig. 15

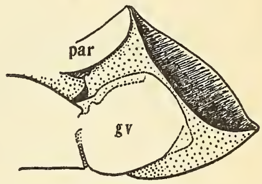


Fig. 16

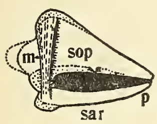


Fig. 18

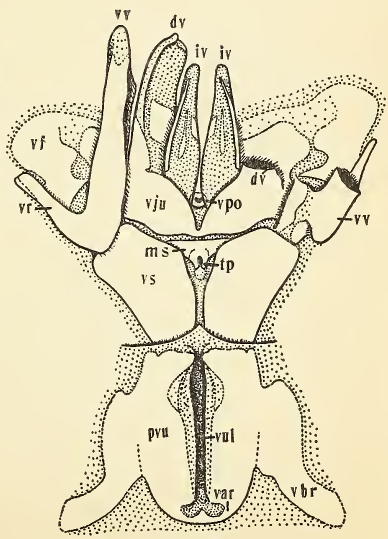


Fig. 20

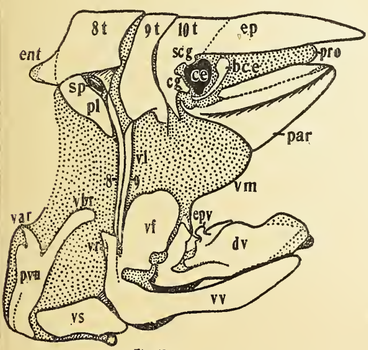


Fig. 19

CRAMPTON—ANATOMY OF THE ROACH

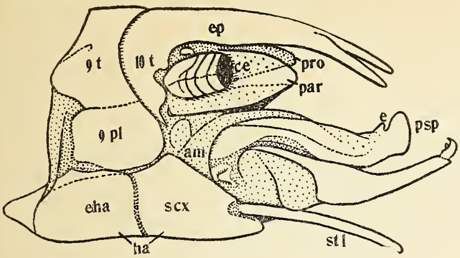


Fig. 21

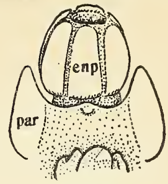


Fig. 22

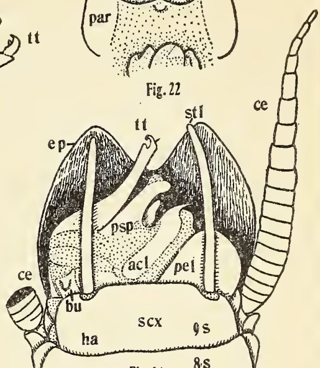


Fig. 24

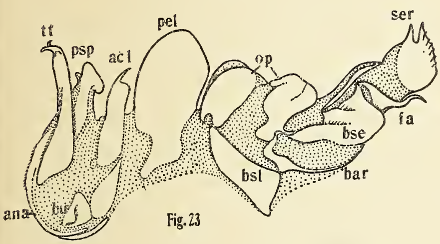


Fig. 23

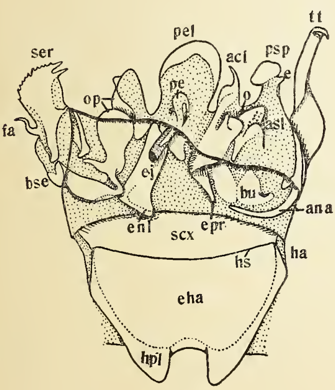


Fig. 25

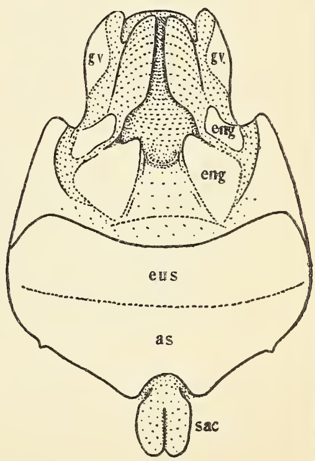


Fig. 26

CRAMPTON—ANATOMY OF THE ROACH

THE WEIGHT OF VEGETATION TRANSPORTED BY TROPICAL FUNGUS ANTS.

By G. H. Parkar.

Zoological Laboratory, Harvard University.

No one can view a nest of active tropical fungus ants without being impressed by the unusual exhibition of transportation. Converging narrow paths are crowded with myriads of ants many of the incoming members of which carry above their heads the fragments of leaves, bits of stems and the like destined to serve as the soil on which the colony will raise its food. Such a spectacle came to my attention not far from the Barro Colorado Island Laboratory in Gatun Lake, at the Panama Canal. The colony was in an open part of the jungle about a quarter of a mile from the laboratory and easily accessible by a trail. At this laboratory, which is maintained by the Institute for Research in Tropical America, I had the opportunity of studying this and many other features of equatorial life.

The nest was inhabited by the common fungus ant of the region, *Atta columbica* Guér., and comprised an approximately circular area of hummocky soil some twelve to fifteen feet in diameter. Into this area from various parts of the jungle led in all five ant-roads over which varying numbers of ants passed in and out with their burdens. It was comparatively easy to stand at a given point by one of these roads and, with a watch in the hand, count the number of ants with leaf fragments that passed toward the nest in a minute. Twenty such counts were made on each of the five roads.

In the most densely frequented road the numbers of leaf fragments carried past the observer in a minute varied from 151 to 184 and averaged 162.8. In the second most populous road the extremes were 52 and 81 and the average 69. In the third the numbers varied between 49 and 61 and averaged 53; in the fourth the extremes were 1 and 6, and the average 3.2, and in the fifth, which descended from a small tree that rose out of the nest, the numbers varied from 0 to 5, and averaged 2.2. As these five roads were separate pathways leading into the nest, the sum of their several averages, 290.2, represents the total average number of leaf fragments that were brought into the nest each minute.

One hundred of these leaf fragments were taken from the transporting ants and weighed; their weight proved to be 1.164 grams. If on the average a total of 290.2 fragments were carried into the nest each minute, the weight of vegetation added per minute must then have been a little over 3.35 grams. In an hour at this rate it would amount to 201 grams and in twelve hours to a little over 2.4 kilograms or some five and a quarter pounds. I do not know whether these ants work during the night. If they do so even at a lowered speed, the weight of vegetation added per day to the nest must be of course much more than five and a quarter pounds. The records here set down refer to daylight conditions toward the end of June. Incidentally it may be added that the rate of travel of an individual ant carrying a leaf fragment during the warm hours of the day in June varied from 1.5 to 1.2 meters per minute and averaged on ten counts 1.3 meters per minute. These incidental notes seemed worthy of record.

THE EOCENE FOSSIL FLY EOPHLEBOMYIA.

By T. D. A. Cockarell.

University of Colorado, Boulder, Colo.

In 1922 a remarkable fossil fly, evidently representing an undescribed genus, was found in the Green River Eocene shales near De Beque, Colorado. I described it in Proc. U. S. National Museum, Vol. 64, Art. 13, p. 4 (1924) as *Eophlebomyia claripennis*, with an enlarged figure from a photograph by Dr. R. S. Bassler. With hesitation, I placed it in the Trypetidæ, remarking: "I at first thought to refer it to the Anthomyiidæ, but it appears to be acalyptrate, and the venation agrees better with Trypetidæ. In certain respects, it agrees with what we should expect to find in an ancestor of the modern Trypetidæ." Some time after, I found I had a second specimen from the same region, and this I sent to the British Museum. I was particularly anxious for Major E. E. Austen to examine it, because the fly, as I had stated in my description, resembled *Glossina* in the course of the fourth longitudinal vein. In his Handbook of the Tsetse-flies, Austen called attention to this character in *Glossina* as something absolutely unique.

Major Austen very kindly examined the fossil at once, and wrote at length concerning it. I urged him to publish an article, but he asked me to do whatever seemed necessary, giving full permission to quote his opinions. I meant to wait until again publishing on Eocene insects, but as such publication may not occur for a long while, it seems best to offer the present discussion. Major Austen wrote (Dec. 13, 1924):

"After making as careful an examination of the specimen as I can, I am inclined to doubt whether the species belongs to the Acalyptratæ at all. I certainly can't distinguish any squamæ, but that doesn't prove the absence of these structures. In spite of the Trypetid-like character of the auxiliary vein, the extreme shortness of the anterior transverse vein, coupled with the apparent absence of bristles on the extensor surface of the tibiæ, in my opinion renders the inclusion of the species in the family Trypetidæ impossible. The short anterior transverse vein is characteristic of the Calyptrate, not of the Acalyptrate Muscoidea; but although the open first posterior cell would seem to suggest that the species should be referred to the Anthomyiidæ, I don't think that strictly speaking it can belong to this family, owing to its smooth tibiæ. On the other hand, the *Glossina*-like course of the fourth longitudinal vein, to which you draw attention in your description of the genus *Eophlebomyia*, is very remarkable, and may be significant. Unfortunately, since nothing can be seen of the proboscis or arista, it is impossible to determine whether or not the fly should be regarded as a blood-sucker. Be this as it may, I am, for the moment at any rate, inclined to consider *Eophlebomyia* as possibly representing an annectant form between the Anthomyiidæ and the blood-sucking Muscidæ, as represented by *Glossina*."

With regard to the tibiæ, in the original type, now in the U. S. National Museum, it was possible to see that there were no preapical bristles, but were minute dark hairs on outer side arranged in two lines.

In a later letter, Major Austen discusses the question whether *Glossina* may have originated in America, and spread later to Africa. We have of course, severals species of *Glossina* in the Colorado (Florissant) Miocene; and it is at least conceivable that the Eocene *Eophlebomyia*, from the same general region, may be ancestral to them. In this case, it appears to follow that the so-called Muscidæ are polyphyletic, the *Glossina* group having arisen independently from the others. *Eophlebomyia* is best placed in a separate family, *Eophlebomyiidae*.

It is a pity that more collecting is not done in the Eocene shales of the Roan mountains and adjacent ranges. The many excavations in the oil shales have resulted in throwing out and exposing large quantities of rock, which should be searched for fossil insects and plants. In a few years weathering will have decayed and spoiled these precious materials. The cost of an expedition, as such things go, would be very small. The best time would be in the fall. The discovery of such a fossil as *Eophlebomyia* is certainly worth the time, trouble and expense.

THE INSECTS AND PLANTS OF A STRIP OF NEW JERSEY COAST[1]

By Harry B. Weiss and Erdman West

New Brunswick, N. J.

Introduction.

This paper deals with the insects and plants of a section of the maritime region of New Jersey and is the fourth of a series of reports on surveys which have been made in different faunal areas of New Jersey.

Acknowledgments.

Identification of the various species of insects collected during the survey were made by the following entomologists to whom we are greatly indebted. Hymenoptera, Mr. H. L. Viereck; Diptera, Mr. C. W. Johnson; Coleoptera, Mr. C. A. Frost; Hemiptera, Mr. H. G. Barber; Lepidoptera, Mr. Carl Heinrich and Mr. Wm. Schaus; Cicadellidæ, Mr. C. E. Olsen; Formicidæ, Mr. M. R. Smith; Odonata, Mr. Wm. T. Davis; Orthoptera, Dr. Henry Fox.

The New Jersey Sea Coast

The maritime region of New Jersey extends along the coast from Sandy Hook to Cape May and includes the beach and its adjoining sand hills. The beaches are narrow, sandy strips often separated from each other by inlets and from the upland by bays, and channels fringed by tide-marsh or salt meadow. According to the "Annual Report of the State Geologist of New Jersey" for 1885, the beaches "are sand bars of considerable magnitude, which have been formed at a greater or less depth by currents depositing sediment under favorable conditions and subsequently brought above water by the waves, as at the present day, or perhaps in some cases by the changes of sea level which have

[1]Journal New York Entomological Society, vol. xxx, pp. 169-190; Journal New York Entomological Society, vol. xxxii, pp. 93-103; Ecology, vol. v, pp. 241-253.

evidently occurred in Quarternary time." Once above water, the particles of sand are carried by the wind and meeting some obstacle out of reach of the tide, are in time built up into dunes or sand hills. After the primary beaches are formed, various agencies combine to change their original extent. "On one side they might be worn away by storms and tidal currents, on another added to by the same agencies and finally they might be greatly extended in course of time by the action of currents running in a constant direction along their shores and depositing sediment at one of their extremeties, as happens now at the point of Sandy Hook, and the south ends of most of the beaches at the inlets."

The beach islands consist of fine white sand which is mobile in places. Dried by the sun and wind, the sand is blown inward or oceanward. The prevailing winds blow toward the ocean and as the sand dries it is blown into the water to be hurled back again by the waves. If the wind is from the ocean for some time, sand hills are formed. Small obstacles sufficient to lessen the force of the wind may serve as the starting point of a dune. Such dunes may form and reform with every action of the wind. At Seaside Park, the shifting was quite pronounced and the contour of the line of dunes next to the ocean changed frequently.

Behind the ocean line of dunes, the shapes of the smaller dunes changed infrequently or not at all. Where vegetation occurs on the beaches such plants catch and hold the sand and dunes are formed rapidly. The beaches vary in width from a few rods to a half-mile and in elevation average only a few feet above high tide. The dunes formed by winds and tides generally reach a height of from fifteen to twenty-five feet.

The Surveyed Area.

The surveyed area consists of about ten acres in the form of a strip running from the Atlantic Ocean to Barnegat Bay, across Island Beach at a point about one mile below Seaside Park, and just above the Island Beach Life Saving Station. The exact location is indicated on the accompanying map. Temperature and moisture records were not kept, but climatological data for the coastal section in which the survey was made, can be obtained from the publication of the United States Weather Bureau, entitled "Summary of the Climatological Data for the United States by Sections," Reprint of Section 99, The Southern Interior and Sea Coast of New Jersey.

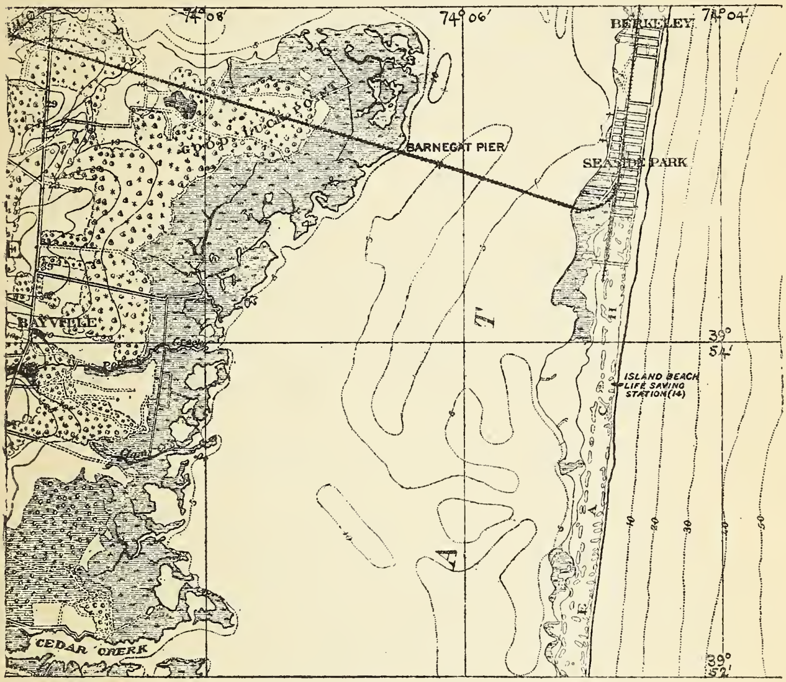


Fig. 1. Map of a portion of the New Jersey coast. The surveyed area adjoins the Island Beach Life Saving Station.

Island Beach from Seaside Park south to Barnegat Inlet is almost the only piece of natural beach left along the New Jersey coast. On account of the absence of a roadway, it has remained "undeveloped" and as such is free from bungalows, cottages, cement walks, real estate agents, swarms of bathers and the amusements supplemental thereto. It is probably only a question of time before it will be levelled, graded and cut up into building lots.

Collections were made at about ten-day intervals from the very beginning to the end of the insect seasons. All methods were employed and everything was collected. Some night collecting was done also. The area under consideration contained several shallow basins and wet places due to arms of the bay which extended toward the Atlantic Ocean, but little attention was paid to these areas and their comparatively luxurient vegetation, as it was thought desirable to limit the study to the strictly sea coast type. Insects found in "wash-up" along the shore, although collected, are not included in this report unless they are species which normally inhabit the beach and act as scavengers or in other capacities.

Although the flora of the area can be divided into parallel zones, it is necessary to consider the insects as a single group, partly on account of the comparative smallness of the surveyed territory and partly because many species exhibited no tendency to connect themselves exclusively with certain types of vegetation. Species constantly inhabiting various parts of the area will be mentioned in the text.

The Vegetation of the Surveyed Area.

The flora of this area is divided more or less distinctly into bands or zones parallelling the ocean and bay shore lines. The best way to discuss the vegetation is to take each of these groups in order as they occur, beginning at the ocean shore line. As no collections were made in the water, the only clue we had to the algæ present was the remnant in the wash. This consisted almost entirely of sea lettuce (*Ulva* sp.) and a brown strap-like kelp. From the edge of the water to the base of the dunes, the sand was devoid of plant life, but about one-half way up the dunes, there appeared an occasional plant of seaside spurge (*Euphorbia polygonifolia*).

The outer row of sand dunes had a distinct and characteristic vegetation. The sea sand reed (*Ammophila arenaria*) was the most important and abundant plant and its persistence and habit of growth enabled it to successfully combat the shifting sands of the dunes. It gave the first tinge of green to this region in spring and its lines of sprouts from the underlying roots broke the force of the winter winds and prevented the sand from drifting to any great extent. Totally different in appearance from the grass, another plant, the seaside golden-rod (*Solidago sempervirens*) was second in importance. All during the summer months, the large tufts of fleshy leaves were very conspicuous and later the heavy sprays of yellow blossoms were quite showy. Scattered all through the vegetation created by the previous plants we found the little sand hugging sea spurge. On the bay side of the dunes there were occasional patches of beach pea (*Lathryrus maritimus*). This plant constituted a prominent element with its tangled stems, bright flowers and noisy pods.

On the area between the first line of dunes and the margin of the dune formation there were a number of important groups. In the first one large masses of bayberry (*Myrica carolinensis*) occurred at regular intervals with occasional plants almost at the foot of the first line dunes. Another important shrub mixed with the bayberry was beach plum (*Prunus maritima*). Its dense masses of white flowers were very showy in the spring. The fruiting propensities of the plant however, were variable, some were loaded with plums and others bore but few. Little of the fruit ripened as people were well acquainted with its value in making jam and jelly.

Other larger areas were inhabited extensively by beach heather (*Hudsonia tomentosa*). Dull and inconspicuous throughout most of the year, it stood out in strong contrast to the sand when it was covered with yellow flowers in the spring. In this group there were also frequent plants of beach pin weed (*Lechea maritima*) and patches of sea coast joint weed (*Polygonella articulata:*, the latter being much more numerous than conspicuous. The cactus (*Opuntia opuntia*) occurred here, sometimes forming plants three feet across. In this band was found the only fungus of noticeable importance in the whole area. This was the earth star (*Geaster* sp.) which appeared late in the summer in sheltered sandy places where other vegetation was scanty or lacking. In the deep sand only the spongy, spore bearing portion was pushed above the surface of the sand by the hygroscopic action of the reflexed peridermium.

The third important group in this section was found in the low, wet spots in which no collecting for insects was done.

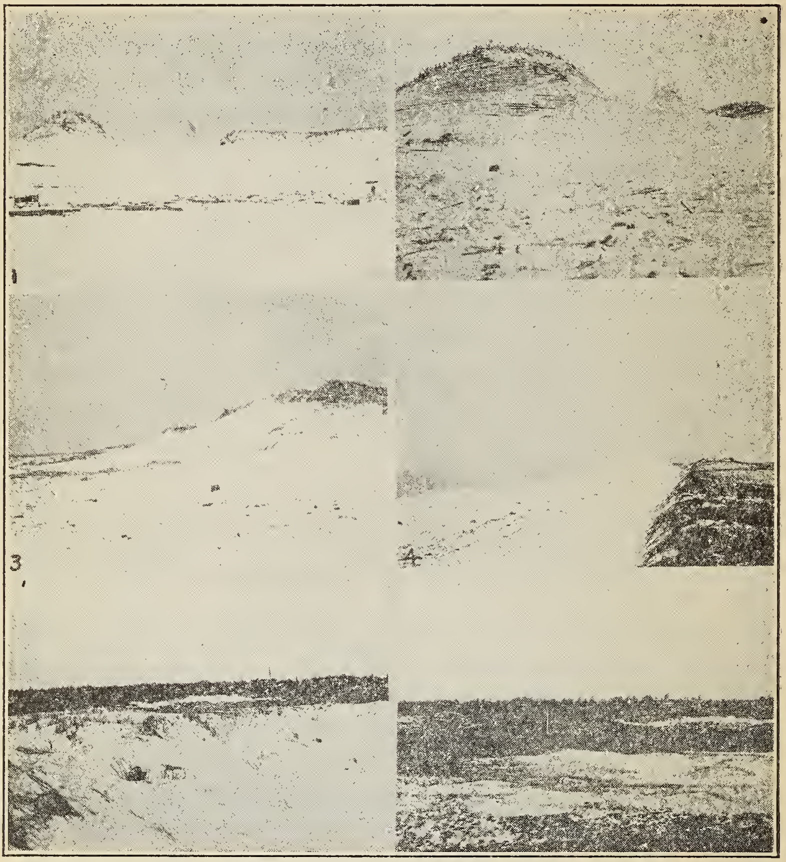


Fig. 2. Views of the surveyed area. 1, 2, 3, 4, views along the seashore showing the dunes and their sparse vegetation. 4, 5, views looking across the surveyed area showing the low vegetation and the many, open, sandy areas.

These low spots were almost impenetrable thickets of green brier (*Smilax rotundifolia*), tall blackberry (*Rubus argutus*), poison ivy and glossy rose (*Rosa virginiana*). With these there was a generous sprinkling of sheep laurel (*Kalmia angustifolia*), tall blueberry (*Vaccinium corymbosum*), bayberry (*Myrica carolinense*) and scrubby red cedar (*Juniperus virginiana*).

From the edge of the dune formation to the bay shore, the vegetation was quite uniform. A major portion of the area which comprised all of the high sandy ground on which the collecting was done, was covered with beach heather. As near the dunes, *Lechea maritima* was occasional here. A few patches of blue toad flax (*Linaria canadensis*) were found here in spots with the most underground moisture.

As the bay shore was approached this *Hudsonia* flora was diluted with various grasses in increasing amounts until it disappeared and a new type of vegetation took its place. In the beginning this transition was slow but close to the bay shore the change was rapid and other species came in. Some of the plants in this last area were undoubtedly "ballast plants." The beach goldenrod reappeared here in great profusion but due to severe insect attacks, it did not bloom freely. Wild pepper grass (*Lepidium virginicum*), sheep sorrel (*Rumex acetosella*), sea burdock (*Xanthium canadense*), goose foot (*Chenopodium polyspermum*), beggar ticks (*Bidens connata*), salt marsh fleabane (*Pluchea camphorata*), bush goldenrod (*Euthamia graminifolia*) and primrose (*Oenothera biennis*) more or less evenly mixed made up the major portion of the dry ground flora close to the bay shore. In addition there were a few patches of great bind weed (*Convolvulus sepium*) with its showy pink flowers. In the moist spots there were a few bushes of marsh elder (*Iva fructescens*) and speckled alder (*Alnus incana*).

In the lower portions of this area we found the same group of marsh loving plants as near the ocean shore but with some additions. There were also several small, wild cranberry bogs (*Oxycoccus marcocarpus*). In other spots there were patches of the sundews " *Drosera rotundifolia* and *Drosera filiformis*. *Lycopodium chapmani* was quite frequent in wet spots. The narrow leaved sundrop (*Kneiffia linearis*) was most plentiful along the margins of these moist areas.

The Insects of the Surveyed Area.[1]

Neuroptera: Chrysopidæ 1, Myrmeleonidæ 1, Total 2.

Isoptera: Termitidæ 1, Total 1.

Odonata: Agrionidæ 1, Libellulidæ 1, Total 2.

Thysanoptera: Thripidæ 1, Total 1.

Homoptera: Aphididæ 2, Membracidæ 2, Fulgoridæ 6, Cercopidæ 2, Tettigoniellidæ 4, Cicadellidæ 13, Total 29.

Hemiptera: Pentatomidæ 6, Lygæidæ 12, Coreidæ 3, Tingitidæ 1, Reduviidæ 2, Phymatidæ 1, Anthocoridæ 1, Miridæ 8, Ochteridæ 2, Total 36.

Orthoptera: Acridiidæ 10, Locustidæ 4, Gryllidæ 3, Total 17.

Coleoptera: Cicindellidæ 2, Carabidæ 7, Silphidæ 1, Staphylinidæ 7, Phalacridæ 2, Coccinellidæ 7, Dermestidæ 2, Histeridæ 7, Nitidulidæ 1, Latridiidæ 2, Dascyllidæ 1, Elateridæ 4, Buprestidæ 2, Lampyridæ 3, Malachidæ 2, Cleridæ 1, Scarabaeidæ 4, Cerambycidæ 3, Chrysomelidæ 19, Mylabridæ 1, Tenebrionidæ 6, Melandryidæ 1, Mordellidæ 2, Anthicidæ 1, Meloidæ 1, Thynchitidæ 1, Otiorynchidæ 1, Curculionidæ 7, Calandridæ 2, Anthribidæ 1, Total 101.

Lepidoptera: Nymphalidæ 5, Lycaenidæ 2, Pieridæ 3, Hesperidæ 1, Syntomidæ 2, Arctiidæ 1, Noctuidæ 12, Hypenidæ 1, Geometridæ 1, Pyralidæ 5, Oecophoridæ 1, Blastobasidæ 1, Total 45.

Hymenoptera: Tenthredinidæ 1, Vipionidæ 9, Braconidæ 6, Ichneumonidæ 18, Cynipidæ 2, Pteromalidæ 1, Callimonidæ 1, Eurytomidæ 1, Chalcididæ 2, Platygastridæ 1, Bethylidæ 1, Mutillidæ 1, Psammocharidæ 5, Vespidæ 1, Sphecidæ 3, Bembecidæ 2, Apoidea 4, Nomalidæ 1, Hylaeidæ 1, Anthophoridæ 1, Colletidæ 3, Xylocopidæ 1, Ceratinidæ 2, Apidæ 3, Formicidæ 23, Total 96.

Diptera: Tipulidæ 4, Chironomidæ 6, Culicidæ 2, Mycetophilidæ 1, Cecidomyiidæ 1, Bibionidæ 4, Tabanidæ 3, Bombyliidæ 1, Therevidæ 3, Asilidæ 3, Dolichopodidæ 4, Empididæ 5, Lonchopteridæ 1, Pipunculidæ 2, Syrphidæ 6, Conopidæ 1, Tachinidæ 1, Sarcophagidæ 2, Muscidæ 3, Anthomyidæ 9, Borboridæ 1, Sapromyzidae 6, Micropezidæ 1, Trypetidæ 1, Sepsidæ

[1]Numbers following family names indicate number of species collected.

1, Ephydridæ 3, Oscinidæ 10, Drosophilidæ 1, Agromyzidæ 5, Total 93.

Notes on Certain Species of Insects.

Neuroptera. The two species in this order were *Brachynemurus abdominalis* Say, which was common (8-5; 10-24; 11-8) and *Chrysopa oculata* Say (6-16; 8-20).

Isoptera. Termes flavipes Koll. was found early in the season (5-15) in rotten wood and wingless termintes (5-29) at the water line of the ocean.

Odonata Erythrodiplax berenice Dru. was common along the shore (7-15; 8-5) and also *Enallagma durum* Hagen (7-15; 8-5; 9-8; 9-26) the larvæ of the former living in salt water according to Smith.

Homoptera Plant lice were observed on seaside goldenrod and *Lactua* sp. Aside from *Phlepsius fascipennis* Van D., which occurs on salt marshes and which was collected July 15, nothing unusual or characteristic of the locality was observed. Several species which do not appear to have been previously recorded from New Jersey were collected and these are as folflws, *Cixius basalis* Van D. (7-15), *Myndus fulvus* Osb. (7-15)., *Megamelanus elongatus* Ball (6-16), *Bostœra nasuta* Ball (8-5). *Platymetopius cuprescens* Osb. (8-20, 9-26), *Thamnotettix nigrifrons* (Forbes) (6-16, 7-15, 10-24).

Hemiptera. The Pentatomidæ, Lygaeidæ and Miridæ were the best represented families. In the Pentatomidæ, *Aethus obliquus* Uhl. was found May 7 in the sand under *Hudsonia* and *Thyanta custator* Fab. was plentiful from May to September. In the *Lygaeidæ*, *Orthlomus ocolopa* Uhl was collected (7-15, 9-26 and *Blissus leucopterus* var. *arenarius* Barb. (5-7, 7-15-9-26. In the Coreidæ, *Harmostes reflexulus* Say and *Corizus lateralis* Say were plentiful throughout the season. *Corythucha marmorata* Uhl. was noted on seaside goldenrod and this nearness to the ocean may explain its occasional presence in "wash up." *Tetraleps insidiosus* (Say) was swept from beach pea by the thousands during September and *Ochterus banksi* Barb. which appears to like the seashore was collected on July 2.

Orthoptera. In this order *Trimerotropis maritima* (Harris) which is almost exclusively a beach species was plentiful from the middle of July to the end of October. *Psinidia fenestralis* (Serv.) was plentiful in the area from August 5 to September 26 as was *Melanoplus femur-rubrum* from the first week of September to the end of October. In the Gryllidæ, *Gryllus assimilis* Fab. form *luctuosus* Serv. was taken in various parts of the area except the seashore from May 7 to the last week of October, and was present in large numbers under a dead horse-shoe crab along the bay shore. *Oecanthus quadripunctatus* Beut. was numerous from August 8 to September 26 and occurred plentifully on seaside golden rod flowers on the latter date.

Coleoptera. *Cicindela dorsalis* Say, a seashore species was collected (7-15) on the beach. Other species taken on the beach were *Pasimachus sublævis* Beauv. (5-7), *Panagæus crucigerus* Say (7-15), *Pinacodera limbata* Dej. (7-15), *Anisodactylus rusticus* Say (5-7 to 10-24) along the seashore and also in sand under *Hudsonia* during the early portion of the season. All of the foregoing are members of the Carabidæ. *Silpha surinamensis* Fab. was collected under a dead horse-shoe crab on August 5 as were also *Creophilus villosus* Grav. and *Tympanophorus puncticollis* Er. *Staphylinus prælongus* Mann was found along the seashore together with *Diochus thoracicus* Csy. on June 16. Seven species of Coccinellidæ were present in the parts of the area covered by vegetation. *Dermestes caninus* Germ. was collected under a dead horse-shoe crab on August 5 along the shore and in other parts of the area on September 8. *Dermestes frischi* was found along the shore on May 29. In the Histeridæ, *Saprinus fraternus* Say which occurs throughout the state was found along the ocean front (5-29, 7-2); *Saprinus pennsylvanicus* occured under a dead horse-shoe crab (8-5) together with *Hister abbreviatus* Fab. *Hister arcuatus* Say was collected along the shore (7-2), *Saprinus mancus* Say in sand under *Hudsonia* (5-7) and *Hister obtusatus* Harris along shore (6-16). Other species found along the seashore were *Polyphylla variolosa* Hentz (7-15), *Collops nigriceps* Say (7-2), *Monoxia puncticollis* Say (7-2), *Epitragus arundinis* Lec. (8-5, 8-20), *Ephalus latimanus* Lec. (5-7, 6-15), *Phaleria testacea* Say (5-29, 7-15), and *Sphenophorus venatus* Say (9-8).

Galerucella kalmiæ Fall was collected under seaweed along the bayshore (5-29) and along the seashore (6-15). *Trirrhabda virgata* Lec. was noted seriously injuring the leaves of seaside goldenrod and marsh elder, being present from July 2 to September 26. *Stratægus antæus* came to our bait of molasses and fusel oil on the night of September 1 and previous to this time, many dead specimens were noticed in various parts of the area.

Lepidoptera. Many interesting species were observed, the most common being *Nomophila noctuella* D. & S. (5-29 to 10-24), *Syneda graphica* (5-7 to 8-20), *Ommatostola lintneri* Grt. visiting goldenrod flowers (9-26), *Euxoa detersa* Wlk. very common on goldenrod flowers (9-26), *Pieris rapæ* which was plentiful along the bay shore (7-15 to 9-26), and *Heodes hypophleas* Boisd. which occurred from May 7 to May 29.

Hymenoptera. As most of our Hymenoptera were not identified beyond genera, it is impossible to mention more than a few of the outstanding species. Galls of *Solenozopheria vaccinii* were present on blueberry stems. *Psammochares philadelphicus* Le P. was collected along the seashore (7-15) and in other sections (7-20, 8-20). *Pompiloides marginatus* Say occurred along shore (9-26) and in other areas (7-15, 8-20). *Polistes pallipes* Le P. was taken from May 15 to October 24 and *Colletes americanus* Cress. was plentiful on goldenrod flowers (9-26). *Bremus bimaculatus* Cress. was noted visiting beach pea flowers on June 16. Among the ants *Dolichoderus plagiatus pustulatus* Mayr. var. *beutenmuelleri* Wheeler. *Formica pallide-fulva schaufussi* Mayr var. *incerta* Emery and *Lasius niger* Linn. var. *neoniger* Emery were common throughout the season. *Camponotus caryæ* Fitch was collected May 29 from an old cone of *Pinus rigida* where it appeared to be nesting.

Diptera. Some ninety-three species were collected, many of which it is impossible to mention on account of a lack of space. The following species were collected along the seashore.

Tipula perlongipes Johnson (7-15), *Neopogon argenteus* Say a sand dune species (8-5), *Villa shawi* John. (9-26, 10-24), *Psilo-, cephala morata* Coq. (6-16), *Coloboneura inusitata* Mel. (7-2).

Fucellia maritima Hal. was plentiful both on the seashore and the bayshore from April 17 to October 24. *Sarcophaga pachyprocta* Parker was plentiful in the area at all times and was bred from puparia collected on the surface of the sand between the sand dunes. Other species plentiful in other parts of the area were *Bibio albipennis* Say (5-15, 5-29), *Epomyia rufiventris* Loew (7-15, 9-8), *Cœnosia nudiseta* Stein (6-16 to 9-26), *Scatella lugens* Lw. (5-7 to 7-15), *Hippelates subvittatus* Mall. (6-16 to 9-26), *Botanobia frit* Linn. *Rhicnœssa parvula* Loew (5-29 to 7-2), and *Toxomerus marginatus* Say 6-16 to 10-24). Visiting goldenrod flowers on September 26 and present at previous times were *Stomoxys calcitrans* Lw. *Phormia regina* Meigen, *Eristalis æneus* Scop. and *Eristalis transversus* Wied. Early in the season land breezes brought *Aedes cantator* Coq. and later *Aedes sollicitans* Wlk.

SUMMARY.

Insects of the Coast.

Order	Number of Species	Percent of total
Neuroptera	2	
Isoptera	1	1
Odonata	2	
Thysanoptera	1	
Homoptera	29	7
Hemiptera	36	8
Orthoptera	17	4
Coleoptera	101	24
Lepidoptera	45	11
Hymenoptera	96	23
Diptera	93	22
	423	100

Types of Food Habits

	Number of Species	Per cent of total
Phytophagous	189	45
Saprophagous	110	26
Harpactophagous	58	14
Parasitic	47	11
Pollen feeders, misc. spp.	19	4
	423	100

As indicated above, with respect to the number of species, the Coleoptera, Hymenoptera and Diptera each supplied an almost equal amount and these orders are followed in turn by the Lepidoptera, Hemiptera, Homoptera and Orthoptera. Concerning the types of food habits, these being based for the most part on the predominating larval habits of the families regardless of numerical abundance (and with the disadvantages of this method fully in mind) 45 per cent of the species present can be classed as phytophagous, 26 per cent saprophagous, 14 percent harpactophagous and 11 per cent parasitic and it is assumed that similar ratios will be found in other coast sections where similar conditions prevail.

NOTES ON GALERUCINÆ IN MY COLLECTION.

By F. C. Bowditch,

Brookline, Mass.

In bringing my material in line with the new catalogue of Galerucinæ by Weise, I have run against many troubles. In the new list are many typographical omissions and mistakes and very many species omitted altogether (these will shortly be treated in a separate paper by M. Laboissiere). Possibly the state of Mr. Weise's health prevented the proper finishing touches. The catalogue revision was a big job but it lacks finish to make it reliable; and then, what to me is a serious drawback, the paper it is printed upon (my copy at least) does not admit of notations in ink.

Oides niasensis sp. nov.

Large sized, honey yellow with black elytral spots, elytra with 4 round sub basal spots 2 on each side, subhumeral and almost submedian, four large rounded and median, joined in pairs (dumb-bell shaped) not attaining either the edge or suture, and lastly a small round ante apical, sides of the breast and abdomen spotted with black.

Types of 2♂ 2 ♀ Lahago Central neas 4-11-10-111 1896 12 Kannegieter length 10-11 mm. Bow Coll.

Head smooth with impressed line on vertex, antennæ about half as long as body entirely yellow, joint 3-5 about equal, clypeus swollen and smooth, thorax evenly rounded, impunctate and without a definite depressions (1 example with 2 small brown submedian spots) elytra thickly and rather coarsely punctate without transverse depression but with rather a deep subhumeral; what I take to be the ♀ has rather a pear shaped form with the dilation at the rear; ♂ is not dilated but ovate, rather pointed behind. Near 12-maculata Cl. but differently spotted, shaped and marked.

Mr. Van de Poll had among his material 3 new species of *Haplosonyx* with Mr. Kannegieter's manuscript names attached which have been retained in the following species:

Haplosonyx frenbi sp. nov.

Median sized, light flavous, each elytron with 4 cyaneous blye, round spots, a humeral, two median, placed transversely oblique, and the last ante apical, the spots very lightly edged with brown.

Type 1 example Tandjong-Djati, Ran. Palembang '90, (J. Z. Kannegieter) length 10 mm. Bow. Coll.

Head with obsolete transverse depression but a deep frontal foveæ, antennæ, joints 2, 3, short, equal, thorax sparsely punctured with a deep transverse depression, elytra very obsoletely depressed below the base, thickly strongly punctured with two or three ill defined longitudinal, smooth lines. The markings easily indentify this form.

Haplosonyx humeralis sp. nov.

Much smaller than *Frenbi*, light flavous, antennæ fuscous between joints 2-10, each elytron with a large purplish spot covering the humerus, and sometimes attaining the scutel and extending nearly half the length of the body, inner margin rounded and very narrowly brown.

Type 1 example Tji Solak Wynkoopsbaai (Grelak) also 2 Java Oc. Sukabumi 2000 '93 (Fruhstorfer) Bow. Coll. length 6-8 mm.

Head sparsely punctate, foveate at the vertex, antennæ with joint 2-3 short, thorax sparsely punctate, with usual transverse depression, sides less angulate and more evenly rounded than usual, elytra, without transverse depression, but faintly impressed within the shoulder, thickly and evenly punctate, with in one example obsolete traces of longitudinal lines (♂?). The Grelak specimen is the one with Mr. Kannengieter's name.

Haplosonyx monticola sp. nov.

Large, stout, fulvous, with joints 6-8 of antennæ and tarsal claws brown, elytra brilliant metallic green with cyaneous reflexions, strongly transversely depressed below the base and with semi-regular seriate punctuation.

Types 12 examples Mt. Kina Balu, No. Borneo (Whitehead and Waterstradt) length 13-17 mm. Bow. Coll.

Head with sparse fine punctures, the usual transverse depression divided by a deep fovea, antennæ with 3 joint much longer than 2 (varying in sex) extreme tip dark, thorax with sparse, fine, scattered punctures, transverse depression obsolete in middle, deeply foveate at side, elytra strongly depressed within the shoulders and below the base, producing a tumid effect, punctures impressed but without striæ, fairly regular in front and on the disk, becoming confused at the sidees and obsolete towards the apex, the cyaneous color seems more intense at the sides, elytral margin strongly reflexed and deeply foveate laterally below the shoulder. Easily distinguished by the color and striate elytra.

Hoplosoma melanocephalum sp. nov.

Medium size, shining, light chestnut brown, head, antennæ and feet more or less blackish, the latter especially on the upper side.

Type 8 specimens, Fokien Bow. Coll. length 5-5½ mm.

Head convex, front very finely alutaceous, antennæ half as long as body, 3 joint rather more than twice as long as 2, thorax nearly square, deeply arcuately depressed behind, the sides the most so, also a supplementary fovea on the anterior middle disk, elytra nearly impunctate, lightly depressed below the scutel. The dark head and legs help distinguish this form. In M. Donckier's material labelled with what purports to be Mr. Jacoby's manuscript name which I have preserved. Among the Donckier material is a set of specimens labelled *Hoplasoma 4-pustulatum* Jac. This is *Phyllobrotica* ? *ornata* Jac.

In looking over the new Catalogue of Galerucinæ I am sorry to see generic names like Aulocophora, established for fifty years, superseded by others; and aside from strict priority (if that is granted) the utility of such change seems dubious. *Ceratia* in place of *Triaplatys* does not appeal to me. I retain *denticornis* Jac. in place of *Jacobyi* Wa. and *martia* Ws.=*denticornis* Jac.

Two new forms should be added to this subgenus.

Ceratia (Triaplatys) foveata sp. nov.

Small, ferrugineous, breast and abdomen and 4 spots on the elytra black. Head of ♂ with two large approximate foveae occupying the whole front, limited by a ridge or line between the eyes, antennæ nearly as long as elytra, scape slightly curved and inflated, 2 joint small, rounded, 3d elongate, somewhat curved, flattened and concave in the inside, 4th broad quadrate, concave on the inside edge, 5th triangular, with inside angle truncated, vertex smooth convex, thorax impunctate, deeply transversely impressed behind the middle, less so in ♀ elytra very nearly parallel, not transversely depressed, sparsely and finely punctate, an elongate basal median, and subapical transverse spot, black; neither spot attains the suture or margin. The only ♂ among my examples is on a card, so I am unable to give details of the last abdominal segment.

Types 1 ♂, 3 ♀, Dilli, Port Timor, 2500' (Doherty) iv v also ♀'s from Batjan, Ternate, Timor (Doherty) Bow. coll. Length 3½-4 mm.

The dilated ♂ antennæ and foveate head distinguish this form. *Duboulayi* Baly (not seen by me) is described as having foveate head; the elytral markings are those of *tetraspilota* Baly.

Ceratia (Triaplatys) dohertyi sp. nov.

Similar in coloration to *foveata* supra, ferruginous head, smooth with a deep frontal fovea, antennæ ♂ about ¾ length of elytra, scape somewhat inflated and curved, 2 joint small, rounded, 3 elongate, triangular, flattened, 4 and 5 elongate, rounded on sides and ends flattened, smooth, shining and slightly concave within, thorax smooth impunctate angulate before the middle, deeply transversely grooved at about the middle, elytra slightly dilated behind, slightly depressed below the scutel, and very finely punctulate, a basal patch which does not attain the scutel but usually covers the shoulder and a transverse outer apical patch which does not touch either the margin or suture, black, legs yellow, breast and abdomen black, except the last segment which is deeply cut on either side, and deeply longitudinally channeled in the middle, the extreme ends and edges being yellowed.

Type 1 ♂ Dilli Port Timor 2500 (Doherty) IV V 2 ♂ Dili May '92 Doherty 3 ♀ do Bow. coll. Length 5-6 mm.

The flattened elongate, concave joints of the ♂ antennæ distinguish this form and are a connecting link between species with dilated triangular joints, *denticornsis* Jac. and these with scant dilation like *diversa* Baly.

Luperodes pustulatus sp. nov.

Small, black, thorax and legs rufous, each elytron with three round flavous spots placed in line down the middle, on each side, the one nearest the end sometimes faint or wanting.

Types 5 examples Cordico Bolivia (green label) Bow. coll. Length 3 mm.

Head sparsely finely punctate, finely transversely and longitudinally sulcate, thorax rather transverse, finely punctate, feebly impressed either side behind, elytra very finely punctulate; the spots are placed, one just below the base, the second antemedian, the third on the elytral declivity. The tibiæ and tarsi are more or less brown; the spots easily distinguish this form.

Luperodes mapirii sp, nov.

Small, stout, shining rufous, antennæ, tibiæ and tarsi browned, elytra entirely black excepting a common triangular rufous spots, which begins on the base at the inner shoulder and runs obliquely to the suture at the apical third.

Type one specimen San Augustin Mapiri 3500 ft. 95 (Stuart). Length 3 mm. Bow. coll.

Antennæ slender, joints 2, 3, 4 gradually increasing in length, head and thorax very finely punctate, the latter obsoletely depressed at the sides, elytra finely punctured, obsolete behind, and very slightly transversely depressed, first joint of hind tarsi very elongate, more than half as long as the tibia, apex of all the tibiæ and tarsi brown. Easily distinguished by the color.

Luperodes pilosus sp. nov.

Medium sized, rather stout, nearly parallel sided, black, elytra only, dull dirty yellow, with dusky suture and sides, tending to run together in the middle, sparsely pilose.

Type one specimen Cochabamba, Bolivia Germ. Length 5 mm. Bow. coll.

Head with longitudinal groove on vertex, elongate frontal tubercle between the eyes, antennæ with joints 2, 3, 4 gradually increasing in length, thorax with sides very slightly rounded, upper surface finely punctulate, uneven, with side depressions obsoletely indicated, elytra closely, finely punctate, semi-rugose, the surface showing faint sulcations on the rear half especially on the sides—the pilose elytra easily distinguish this form.

Luperodes flavipennis sp. nov.

Large sized, shining, black, except the elytra and abdomen which are pale yellow.

Type 3 examples Cachabé low. c. xii 96'7 Rosenberg. Length 6-6½ mm. Bow. coll.

Form stout, oval, like *angusto-lineata*, antennæ about two-thirds length of body, slender, 2 joint a trifle more than half as long as 3, front transversely impressed between the eyes, head and thorax sparsely, minutely punctulate, the latter arcuately impressed at the rear, obsolete in the middle, elytra thickly but very finely punctulate, without transverse depression below the base. A well marked form unlike any other.

Luperodes hebardi sp. nov.

Medium size, narrow, and parallel shaped, thoracic margin bright, elytra dull, opake, ochre yellow, head, antennæ, body beneath and legs black, also a shining discoidal thoracic spot, two large sutural spots widened abruptly at the scutel and behind the middle, the lateral margin (not reaching the apex) and three branches from the marginal color, humeral, median and post median black.

Var. a. The marginal marking absent, the three branches therefrom, representing three dots, a humeral, median and sublateral at apical two thirds, also the sutural stripe reduced to two common spots, scutellar and submedian.

Type 4 examples Caracas, 1 Venezuela (probably Caracas) var. a 1 example Magdalena Columbia.

Sn Lorenzo Mt. 8500 ft. vii-28-20 (M. Hebard) No. 151 from Mr. Frank R. Mason. Length 4 mm. Bow. coll.

Head punctate with strong cross and longitudinal grooves, antennæ reaching beyond the middle of elytra, joints 2, 3 small, the latter slightly the longer, thorax with arcuate impression, deep at sides, obsolete behind, with marked longitudinal groove, the discal spot attains only the front margin and the sides form the ends of the arcuate depression, the whole surface is shiny but finely punctulate. The elytra dull without luster, or depression, with the black markings sharply defined, in some specimens the sutural edge is very narrowly darkened to the apex. In the var. the thoracic spot approximates to the basal margin. Seems related to *intramarginalis* Kirsch.

Luperodes suturalis sp. nov.

Very like *hebardi* only larger and very similar in looks and markings, the difference being the thoracic spot leaves only the lateral margins yellow, on the elytra the lateral stripe is much thicker and is submarginal, leaving the edge itself yellow, the sutural spots coalesce into a stripe a little widened before and behind, the general effect being to show the elytra black with a narrow lateral border or a sinuate median vitta on each side, joining at the apex, which is broadly yellow, sutural area lightly depressed behind the scutel.

Type 3 examples Marcapata Peru marked n. i. m. in 2nd Jac. coll. Length 5 mm. Bow coll.

Very closely related to *hebardi*, but the general effect is shiny not opake. In one specimen the black oclor shows a tendency to cross the yellow median vitta, the punctuation is very minute while the thorax shows 4 well marked foveæ, 3 where the arcuate depression is, or should be, the 4th apical.

Luperodes vittatus sp. nov.

Very like *suturalis* but with the black color replaced by greenish aeneous, thorax entirely of this latter color margined with yellow and with 3 large foveæ placed 2-1, also a small apical; elytra yellow, with a broad humeral sublateral, and sutural, aeneous stripe, the former not quite attaining the tip the latter becoming very fine at the apex.

Type 4 specimens (green label) Bolivia (Cordico?). Length 5½ mm. Bow. coll.

Head æneous, sparsely punctate, with well marked frontal fovea and cross sulcation, thorax sparsely punctate, more thickly in the foveæ, margined, and sides rounded, the yellow margins broadened at the anterior angles, elytra parallel, smooth, shining, sparsely punctate, the sutural stripe is a little widened at the scutel; the general appearance is of an evenly striped handsome form, body beneath and legs with less greenish tinge.

Luperodes bruchii sp. nov.

Again close to *suturalis*; entirely shining black, except the sides and base of the thorax are yellow, and on each elytron, nearly surrounding the humerus is a triangular yellow patch, partly encircling the humerus (leaving it black) with an agle directed towards but not reaching the suture, the yellow patches on either side leave an even, wide sutural black band a trifle wider at the scutel.

Type 1 specimen Argentine Prov. Catamarca 4-111-07 (Bruch). Length 4 mm. Bow. coll.

Head punctate, with deep transverse and longitudinal furrow, antennæ moderate, joints 2, 3 equal, thorax very sparsely punctulate obsoletely foveate on either side, the ordinary connecting acruate depression very obsolete, the black spot is discal, including the anterior edge, the elytra are finely punctate, somewhat depressed along the suture, but no basal depression, body below not as shining on account of short pubescence.

Luperodes klageri sp. nov.

Small sized, head, thorax and scutel fulvous, antennæ and legs more or less brown, elytra, straw yellow with common sutural and broad humeral sublateral, brownish æneous stripe.

Type 2 examples San Catharine Brazil (Klages) length 2½ mm. Bow. coll.

Antennæ reaching nearly the tip of body joints 2, 3 almost equal, thorax with transverse arcuate depression well marked at the sides, the outward stripe attains the apex in a very fine line, the other vitta stops abruptly, near the turn of the wing cover. Easily distinguished by the size and elytral pattern.

Luperodes maculicollis sp. nov.

Large sized, black æeneous above, thorax yellow except for an anterior discal æneous spot, elytra æneous with an almost straight yellow median fascia, abdomen yellow.

Type 1 specimen Rio Madeira Brazil (Mann & Baker) 1 specimen Porto Velho, Amazons No. 2220 (Prof. Thaxter) Bow. Coll. Length 6 mm.

Head with deep transverse groove between the eyes, vertex evenly and rather strongly punctate, antennæ more than half the length of body, joints 2, 3, gradually increasing in length, remainder elongate, nearly equal, thorax shining, nearly impunctate obsoletely arcuately impressed at the rear, the discal dark spot covers the middle of the anterior margin and is rounded so as to reach the arcuate impression, elytra with bronze color well marked, without transverse depression; the yellow fascia is about ½ mm. wide, very lightly arcuate and does not pass the reflexed margin.

Luperodes cyaneoplagiata nov. sp.

Large sized, fulvous yellow; head, metasternum, tibiæ and tarsi (except the last joint) antennæ joint 2 to 8½ brownish black; elytra with a broad basilar cyaneous basal, and a large cyaneous transverse ante apical spot.

Type 2 examples Cochabamba Bolivia (Germ) Bow. Coll Length 6½ mm.

Head with usual transverse groove, vertex almost smooth, antennæ nearly as long as body, extreme tip of last joint dark, thorax punctulate and depressed at the sides, which are slightly rounded, elytra without depression, thickly and finely punctate, the basal band is a little longer at the sides than the middle, where it is a little short of one third the length, the posterior spot is at the apical third and does not attain either the suture or margin, the rear portion of the elytra including the spot shows faint sulcations; all the legs have the last tarsal and claw joints fulvous.

Luperodes javanensis Jac=*Monolepta subra* Gyll next following the description of *M. rubra* Gyll. is ? *flavicollis* Gyll. This seems to be a form of which many examples are in my collection, all apparently coming from North Borneo (Waterstradt), the color is *coccineus* with very light flavous thorax, head with a large, deep, semicircular fovea, anterior femora with a minute tooth. Temporarily I place it in *Monolepta*.

From the descriptions of Monsieur Pic, I mark in my collection of *Crioceris*; *laosensis* Pic=var *impressa* Fabr, *borneensis* Pic=*binotata* Boh, *malaccana* Pic=*seminigra* Jac, *rouyeri* Pic=*dromedarius* Baly, *latefasciata* Pic=*unipunctata* Fabr.

Luperodes rufescens Bow. nom. præoc, changed to *weisei* Bow.

Luperus masoni sp. nov.

Small, flavous, antennæ darkened at tip, thorax with two small discal spots indicated, and a long seta on each rear angle, elytra, black, slightly iridescent, all the margins narrowly flavous, the suture and base more broadly than the sides.

Type 1 example Bolivar; Colombia, Cartagena, vii-11-20 Chapparal, Fred Mason, No. 92 Bow coll. Length 2 mm.

Very close to *marginatus* Jac. (type in my coll.) and *albomarginata* Jac. but much smaller than either; the former has a black head and thorax; the latter in addition to being much larger has the elytra much more heavily margined with flavous, moreover these margins are even and well defined, whereas *masoni* has them narrow and *not* well defined or limited. The Jacoby species has also a dark spot on the breast.

Luperus beniensis sp. nov.

Small, below dirty testaceous, antennæ and body above very dark brown, fairly thickly punctulate, the edges of the elytra especially the sutural, diffusely light colored.

Type 4 examples Reyes, Beni Riv. 7-8-95 (Stuart) 3 specimens labelled Peru, M. Kirsh (2 Jac. coll) Bow. coll. Length 2 mm.

Antennæ ♂ (?) slender, longer than the body, somewhat flavous at base shorter ♀ (?). Again very close to *marginatus* Jac., but that form is black below, less punctured above, with the light margins plainly defined, besides being larger.

Luperus pallidus sp. nov.

Small, entirely dirty yellow, antennæ comparatively short and slightly darkened towards the tip, surface very lightly punctulate, smooth, shiny, no depression on the thorax and only a very obsolete one on the elytra below the inner shoulder, one specimen has the elytral edge slightly darkened, also the abdomen. It is small, insignificant, but the only light colored form rated from South America.

Type 3 specimens Bolivar, Colombia, Cartagena vii-11-20 (F. A. Mason) No. 93. Length 2½ mm. Bow. coll.

Luperus blumenensis sp. nov.

Medium sized, shining black, head, thorax, scutel and base of femora yellow, elytra without depression, thickly and closely punctate.

Type 1 example Blumenau, So. Brazil (Reitter) Bow. coll. Length 4 mm.

Head with smooth shiny vertex, antennæ not reaching the end of the body, joints 2, 3, 4 gradually increasing in length, thorax rather transverse, convex, obsoletely punctulate, the black in the femora is more extended on the upper than the under side, smaller than *xanthaspis* Germ. and more shining.

Malacosoma (Exora) cyaneomaculatum sp. nov.

Medium sized, fulvous yellow, antennæ, tibiæ, tarsi and apex of femora bluish black, the apical third of elytra covered by a cyaneous blue patch, which attains but does not cover the inflexed edge, the basal two thirds with a distinct golden sheen.

Type 3 examples Callanga, Peru, sent me by Messrs. Staudinger and B. Haas as cotypes of *Diabrotica cyaneo-maculata* Jac. (M. S. S.). Length 6 mm. Bow coll.

Head with a deep transverse groove and a few punctures on the vertex, antennæ long, joints 2-3 nearly equal, thorax shining with obsolete basal and lateral depressions and everywhere, finely punctured, elytra closely, strongly, evenly punctate, slightly depressed at the suture below the base, the fulvous part somewhat sheeny. In all probability the specimen sent Mr. Jacoby for identification was *Diabrotica*; this looked like it superficially and were so sent out by the dealers.

Malacosoma (Exora) basale sp. nov.

Large sized, deep orange yellow, antennæ excep t (first 2 joints) (last 3 lacking) tibiæ and tarsi blackish blue, elytra very closely coriaceously punctate, base broadly cyaneous purple, or blue.

Type 1 example Santa Fe de Bogota, 1 in the 1st Jac. coll. Bogota; 1, 2nd Jac. coll. no locality, the last two specimens have the purple confined to a broad basilar band and this I regard as the typical form. The first specimen, which is the most perfect, has the dark color extended nearly to the apex. Length 9-10 mm. Bow. coll.

Head with well marked transverse groove, at vertex sparsely, finely punctate, antennæ with 3 joint twice length of 2, thorax transverse, sides nearly straight very finely sparsely punctulate, depressions only indicated, elytra, stout, parallel, without depression, coriaceous, the yellow color has more or less metallic sheen. A fine well marked form, *dubia* Oliv. seems to be smaller and smooth.

Malacosoma (Exora) guttatum sp. nov.

Medium sized, dark chestnut brown, head except the lower face, and metasternum black, elytra very thickly punctate, normally with two elongate parallel black spots on each side, one humeral, the other basilar and almost touching the end of scutellum and parallel to the first spot and the suture, this 4 spotted is the normal form, varieties occur where there is a further double series of spots, in direct extension of the normal spots, these additional spots are median and ante apical.

Type Rio Janeiro, Espirito-santo, Brazil, 2 labelled Miers. Coll. represent the most spotted vars. 6 specimens in all. Bow. coll. Length 7 mm.

Head with transverse depression and frontal fovea, vertex shining, nearly impunctate, antennæ more than half the length of body, joints 2, 3 equal, first 3 or 4 joints rufous, rest black, thorax same shape as *obsoleta*, shining nearly impunctate, elytra without depression, the punctuation a trifle obsolete at apex, in *obsoleta* the sutural spots are *subbasal* and do not attain the margin, in *guttata* they always start *at* and *include* the margin.

Malacosoma (Exora) quadripustulatum sp. nov.

Small, black, head and thorax rufous, each elytron with two large flavous spots, one triangular subhumeral, with apex near the suture, the other oval, midway between the middle and apex.

Type 1 example Rio (2 Jac. coll.) 2 Misiones Prov. Argentine, Bow. coll. Length 4½-5mm.

Head with front more or less darkened, antennæ nearly as long as body, joints 2, 3 equal, thorax sparing punctulate, sides very nearly straight, elytra finely punctate, depressed along the suture, below the scutel, the spots rest on the inflexed margin and do not attain the suture.

Malacosoma (Exora) rosenbergi sp. nov.

Medium sized, yellowish fulvous, antennæ, knees and tibiæ and tarsi dark brown, elytra with two rufous stripes on each side the first sublateral from the humerus to below the middle, the second almost median curving outward below the middle, but not quite joining the first.

Type 3 examples Cachabé low c xii-96 and i-97 (Rosenberg), Length 5½ to 6 mm. Bow. coll.

Head transversely sulcate, vertex almost impunctate, antennæ with joints 2, 3 nearly equal, thorax with form of *encaustica*, almost impunctate, elytra thickly and evenly punctate, without depression, the suture very narrowly edged with rufous; the first stripe begins on the shoulder and running nearly parallel to the edge, ends at the curve of the elytra; the second begins below the base at about the middle and runs straight to a little below the middle half, when it curves gracefully outward, so that (if prolonged) it would join the first. The apex is ciliate with a few fine hairs, the under edge of the epipleuræ is also narrowly rufous, the color of the brown parts varies tending to become rufous. The curved stripe easily separates this form.

Malacosoma (Exora) buckleyi sp. nov.

Medium sized, brown, head (except the labrum) black, elytra with a large ill defined humeral, and an oblique ante apical patch blackish blue, breast more or less black.

Type 3 examples Yurimaguas, Peru (Buckley). Length 6½ mm. 2 examples Surinam (Fruhstorfer) (2 Jac. coll.) Bow. coll.

Head with strong transverse depression and frontal calli, vertex finely punctulate, antennæ moderate, joints 2, 3 nearly equal, thorax transverse, slightly angulate at the middle, very obsoletely depressed and punctulate, elytra moderately punctate, showing traces of longitudinal sulci here and there, the extent of the dark area varies greatly being in one specimen extended along the side and towards the suture and in another reduced to a mere wisp on the shoulder and the same with the rear spot, the forms with a minimum of dark have rather stronger punctuation. There seems no particular distinctive feature to this form. The Surinam examples are smaller and darker colored, only the sutural area being indefinitely lighter.

Malacosoma bellum sp. nov.

Medium sized, rufous, antennæ, apex of tibiæ and tarsi darkened, elytra closely finely punctate shining violet purple.

Type ♂, ♀ Rio Janeiro, Brazil (Klages ?). Length 5-5½ mm. Bow. coll.

Head with well marked transverse impression, with convex nearly smooth vertex, antennæ moderate length, joints 2, 3 equal or nearly so, 3 basal rufous; thorax transverse, smooth shining convex, almost without trace of depression or punctures, elytra parallel, impressed within the shoulder and very slightly at the suture below base, punctuation obsoletely seriate on the ♀ disk, the suture very narrowly cyaneous. I should have referred this form to *dubia* Oliv. if that did not call for *smooth* elytra.

Malacosoma (Exora) simile sp. nov.

Medium sized dull fulvous, antennæ, 4 spots at base of elytra and 4 anteapical black

Type 1 ♂ Caraca, Brazil. Bow. coll. Length 5½ mm.

Head scarcely depressed between the eyes, vertex convex smooth, antennæ (last 4 joints missing) 2, 3, very small, nearly equal, remainder elongate, thorax transverse, smooth, almost impunctate elytra very thickly evenly punctate like *guttata*, an elongate spot at the shoulder and a round one either side of the scutel, and 4 placed transversely just before the apex. *Guttata* is larger, has a black head and breast and light antennæ, *similis* has black antennæ and light head and breast.

Malacosoma (Exora) octoguttatum sp. nov.

Small, chestnut brown, antennæ dark, elytra with four elongate spots at the base (2 each side) and four round spots transversely placed just behind the middle.

Type 1 specimen Rio Janeiro, Bow. coll. Length 5 mm. var. A, So. Brazil, anterior spots joined, forming a band and rear spots a lunule.

Antennæ nearly as long as body, joints 2, 3 nearly equal, front of head and thorax convex smooth, elytra smooth shining obsoletely punctate, the basal spots are humeral and next the scutel, the other spots are placed evenly in line just back of the middle; near *similis* and *guttata* but without the elytral punctures of either, and the rear spots are much nearer median.

Malacosoma (Exora) maculatum sp. nov.

Size of *olivacea*, color light yellow, elytra alutaceous with punctuation, antennæ, tibiæ and tarsi, scutel and 5 spots on each elytron black, body beneath more or less brown on the breast and segments, thorax with 5 spots indicated in dark red.

Types 5 examples San Augustin, Mapiri, 3500 ft. ix 95 Stuart. Length 6 mm. Bow. coll.

Var. a, thoracic spots shown in brown, median spots on either side joined. Cochabamba, Bolivia, Germ.

Antennæ about two-thirds length of body, joints 2, 3 about equal, upper joints lighter color, head with well marked transverse groove, vertex convex, thorax with wide, though not deep, median lateral foveae and with 5 spots indicated in color, 2 lateral, 2 median with an apical between, scutel black, elytra with punctuation more marked, but still semi shiny, the spots on each side are a subbasal humeral and median, two median directly in their rear and the fifth large rounded, subapical, in the variety the median are joined together, and the thoracic spots are brown; near *olivacœ* Oliv. but that species has 4 series of spots and this only 3.

Chthoneis Baly, as at present used, seems to contain rather incongruous forms. It was founded upon *apicipennis* from Colombia this species has joints 2, 3 of antennæ very short, equal, the following joints compressed and elongate; a smooth thorax and unarmed hind tibiæ, then followed species with foveate, thorax (albicollis) in 1880 Jacoby added *apicalis* (type in my coll.) (also Godman and Salvin, Brit. Mus.?) though apparently with some latent doubt; the antennæ are (in my specimen ♂ ?) very different from the typical form and the hind tibia have a short spine, in the Biologia, Jacoby adds two Mexican forms, *dilaticornis* where the ♂ has distorted antennæ, both this and *jansoni* have a rather slender elongate body tending towards *Luperus*; on the other hand *Luperus fucatus* Er. I remove to Chthoneis. There are several new forms which are closely allied to the foregoing.

Chthoneis grossa sp. nov.

Size, form, and structure of *apicalis*, Jac, rufous, the edges of the elytra and thorax a little yellowed, antennæ, tibia and tarsi and nearly the whole of the abdomen black; rufous part of the elytra with a distinct iridescent tinge.

Type 1 specimen, Brazil (Mann) Bow. coll. Length 10 mm.

Head with transverse groove between the eyes, vertex sparsely and finely punctate, antennæ barely two-thirds length of body, 2 joint short, 3 half longer, remainder elongate and somewhat compressed, thorax (exactly like *apicalis*) transverse, all the angles prominent, sides slightly rounded, depressed anteriorly on either side, and with a median posterior fovea and anterior longitudinal sulcation, whole surface punctate, scutel almost smooth, elytra much wider than the thorax, without any depression, very thickly evenly punctate, the hind tibiæ have a small but distinct spine. The claws are appendiculate.

The future will probably separate both this form and *apicalis* from the present genus. I merely follow Mr. Jacoby.

Chthoneis marginipennis sp. nov.

Medium sized, black, with epipleuræ, reflexed edge of elytra to the tip, the basal margin, and suture so as to enclose the scutel, white.

Type 1 example Gua. (G. D. Smith) Bow. coll. Length 6 mm.

Antennæ not quite as long as body (♀) ? 3 joint longer than 2, first few joints narrowly white at base, head sparsely punctate with a deep frontal fovea, thorax transverse, thickly coarsely punctate, deeply foveate either side of the middle and with a moderate subapical depression, scutel smooth, elytra thickly and evenly punctate, more finely than the thorax, quite strongly impressed within the shoulders and somewhat along the anterior suture, so that the scutellar area seems prominent. Rather an intermediate form but easily recognized by its color.

Chthoneis foveicollis sp. nov.

Moderate sized, elongate, rufous, antennæ, tibiæ, and tarsi blackish purple, elytra very closely punctate, purple violet, semi alutaceous.

Type 1 example (♀) San Augustin, Mapiri 3500 ft. 1-95 Stuart. Bow. coll. Length 8 mm.

Belongs near *dilaticornis* Jac. being of the same elongate form, head sparsely punctate, with frontal fovea and transverse depression, antennæ not quite as long as body, joints 2, 3 equal, though not very small, thorax transverse, sides slightly rounded, surface rather thickly punctured with 4 fairly well defined foveæ, an apical and basal and lateral median, elytra slightly impressed within the shoulders and on the suture below the base, very obsoletely sulcate toward the apex.

Chthoneis stuarti sp. nov.

Small, head rufous with black spots on the labrum and vertex, antennæ black, apical joints white, body below black, legs black with basal two-thirds of femora rufous, thorax rufous, scutel and elytra black, very slightly viridi-æneus.

Type 4 examples Reyes 7-8-95 (Stuart). Length 4½ mm. Bow. coll.

Head with deep transverse groove at the top of the eyes, vertex finely and sparsely punctate, antennæ longer than the body ♂, shorter ♀, 3 joint half longer than 2 (like *apicalis*) extreme tip of 11 and base of 9 dark, intermediate joints ♂, dilated and lengthened (fairly typically), thorax convex, shining, sparsely punctulate, distinctly foveate either side at the middle, elytra faintly impressed within the shoulder, very thickly evenly punctate, first joint of front and middle tarsi dilated ♂. Intermediate between the strictly typical forms and the elongate Mexican, like *Jansoni* Jac.

Chthoneis rufulum sp. nov.

Small, entirely rufous—flavous, except the eyes, which are black and the antennæ after the third joint dark brown.

Type 1 example ♂, So. Brazil. Bow. coll. Length 4 mm.

Head with frontal fovea between the eyes, antennæ longer than the body, strictly generically typical, i. e. joints 2, 3 very small, equal, subsequent joints dilated and elongate, thorax convex, transverse, smooth, with a very obsolete lateral fovea, elytra smooth, shining, sparsely finely punctulate, very obsoletely depressed at the suture below the base. This form is at once separated by its size and color.

Chthoneis boliviensis sp. nov.

Small, æneous brown, elytra cyaneous blue, lower face, last 2 joints of antennæ (except extreme tip) sides of the thorax, and femora pale yellow.

Type 4 examples San Augustin, Mapiri 3500 ft. 95, Bow. coll. Length 4½ mm.

Head smooth, with usual cross depressions, and fovea, antennæ elongate, joints 2, 3 very short, equal, remainder elongate, compressed, vertex shining, almost impunctate, thorax shining sparsely punctate, obsoletely depressed on the sides and disk, the former narrowly flavous, this color impinging upon the base in a fine line, elytra slightly depressed at the scutel, parallel, surface very closely strongly punctate and rugose.

Like *marginicollis* Jac. but very much smaller.

Chthoneis rosenbergi sp. nov.

Medium sized, elongate parallel, lower face and thorax rufous, last 4 joints of antennæ and legs flavous, upper head, and body below black, elytra dark blue.

Type 8 specimens Cachabè low c. xii 96 (Rosenberg) Length 7 mm. Bow. coll.

Head with swollen shining vertex, antennæ about as long as body, nearly typical, joints 2, 3 short, equal, thorax nearly smooth, shining, deeply foveate each side at middle (like *bivittata*) elytra very closely, strongly punctate, legs flavous with extreme tarsal joint and claw dark, the same elongate form as the Mexican species of the Biologia.

Chthoneis donckieri sp. nov.

Medium sized, rufous, antennæ, tibiæ and tarsi purplish black, elytra bright purplish violet.

Type 8 specimens Cochabamba, Boliv. Germ. Length 4½-5 mm. Bow. coll.

Head with vertex finely punctate, antennæ nearly as long as body ♂, shorter ♀, joints 2, 3 short, equal, remainder elongate, compressed, thorax convex, shining, rather strongly punctate, moderately foveate on either side at the middle; elytra feebly impressed within the shoulder, very thickly evenly and strongly punctate, close to *æneipennis* and possibly only a variety of that form. Was among the material sent me by M. Donckier.

Chthoneis æneipennis sp. nov.

Medium sized, elongate, parallel, shape of *jansoni* Jac. Head, thorax, base of femora, pro, and meso thorax rufous, antennæ black, except last 3 joints white, elytra very closely punctate, æneous, body beneath and legs except as above black.

Type many examples Cochabamba Boliv. (Germ.) Bow. coll. Length 5-5½ mm.

Head with frontal fovea and sparse punctures, antennæ about as long as body, 2 joint not very small, 3 half longer, following joints dilated, extreme apex dark, thorax convex, nearly smooth, distinctly foveate each side at middle, elytra more or less distinctly impressed within the shoulder, the surface very closely and at the sides rugously punctate.

Scelolyperus tenuimarginata sp. nov.

Long, parallel, straw yellow; tibiæ, tarsi and upper sides of femora dark brown, abdomen and metosternum metallic cyaneous with gray pubescence, epipleura, the reflexed edges posteriorly, and the suture for apical two thirds, very narrowly edged with metallic greenish black.

Type 1 ♂ example Brazil ♀ (2d Jac. coll.) Bow coll. Length 8 mm.

Head with long well marked longitudinal furrow, antennæ long and slender (4 upper joints missing), thorax broader than long, smooth with vague lateral impressions, elytra thickly rather coarsely and confusedly punctate with numerous obsolete costæ, especially indicated towards the middle, the metallic coloring below is almost similar to that of S. *bella* Jac. and S. *viridis* Jac. In the shape of the thorax this species is allied to S. *flava* All. from Argentine, which is not strictly typical in the shape of the thorax.

Scelolyperus rosenbergi sp. nov.

Medium sized, black, with lower face, thorax, joints 9-11 antennæ (except tip), fulvous or yellowish white, elytra dark purplish blue, very closely, thickly and rugosely punctate with two or three obsolete costæ, of which the most marked is one at apical third, a little the lateral side of the middle.

Type 1 example Cali, Colombia ix-xii-94 Rosenberg. Bow. coll. Length 7 mm.

Head with vertex almost smooth, in certain lights tinged with greenish, antennæ graceful, nearly as long as body, joints 2, 3 almost equal, thorax rather transverse, smooth, convex, almost impunctate, the scutel is smooth, the punctuation of the elytra, excepting the costal indications is similar to *bella* Jac.

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NOTES ON HIPPOBOSCIDÆ.

1. Lynchia Weyenbergh and Lynchia Speiser are not Congeneric.

By J. Bequaert,

Department of Tropical Medicine, Harvard Medical School.

While attempting to identify a hippoboscid obtained in Brazil, I was struck with the considerable disparity in size between *Lynchia penelopes* Weyenbergh, the type of the genus *Lynchia*, and the other species subsequently placed by Speiser in *Lynchia*. A closer study of the original description of *Lynchia* brought me to the conclusion that Weyenbergh's species does not fit the generic diagnosis of *Lynchia*, as drawn up by Speiser and accepted by subsequent investigators.

Briefly stated, Speiser's genus *Lynchia* is characterized in the first place by the absence of the anterior basal cross-vein (M_3) : "däs Geäder dadurch auffallend und charakteristisch, dass die hintere Basalzelle ganz offen ist, die hintere Querader total fehlt." Such is the case with *Olfersia maura* Bigot, *Olfersia lividicolor* Bigot, and other related species. But it is not true of *Lynchia penelopes*, which, according to Weyenbergh's description, has the second basal cell (M) closed by a cross-vein.

I subjoin a translation of Weyenbergh's original, since it is inaccessible to most students. In order to make the author's meaning quite clear, I have inserted in brackets the names of the veins as used by most modern writers and also the corresponding symbols in the Comstock-Needham system. For the latter, I have accepted Ferris and Cole's interpretation of the hippoboscid wing (1922, Parasitology, XIV, p. 195, fig. 12.)

Lynchia Weyenbergh

Lynchia Weyenbergh, 1881, Anales Soc. Cientif. Argentina, XI, p. 195 (monotypic for *Lynchia penelopes* Weyenbergh.)

"Antennæ gemmiformes elongatæ setosæ, lateribus hipostomatis insertæ. Ocelli nulli. Tarsi unguibus tridentatis. Alæ latæ incumbentes abdomine multo longiores, acuminatæ.

"This genus must be placed between *Ornithomyia and Olfersia.* Although the antennæ are bud-shaped, they are longer than in *Ornithomyia* and hairy, especially at the tips, and are inserted very low down. The two compound eyes are very globular and leave between them a wide front; but there are no ocelli, instead of which one finds on the spot where they usually occur a small triangular plate, of a dark color, and somewhat raised. This peculiarity, *viz.* the lack of ocelli, removes the genus from *Ornithomyia* and brings it near *Olfersia.* The tridentate claws, on the other hand, bring it nearer the former and remove it from the latter, which has bidentate claws [the claws are tridentate in *Olfersia* also.—J. B.] The wings are on the whole similar to those of *Ornithomyia* and *Olfersia*, but in the last-named genus they are much rounded off at the apex, and they are also quite obtuse in *Ornithomyia*; while in *Lynchia* they are much pointed, although being also very long. The head is flat, disciform, as in the genera mentioned, which it also resembles in the mode of articulation with the thorax and in general appearance. The mouth-parts are very short and completely hidden within the short sheath that envelops them. The line or transverse suture, which divides the thorax into two parts, is very distinct in this genus; but the longitudinal line, which in the other genera is furrow-like, is much raised in *Lynchia*, even forming a linear elevation. On the outer angle of the thorax one sees an ovate spiracle, with several stiff hairs on the anterior margin. The scutellum is very short and broad. The abdomen bears strong spines on the lateral margins of the segments, and long hairs at the apex. The legs are little hairy; one finds only a few stronger hairs about the claws. The veins of the wings are quite characteristic, although showing some similarity to those of *Ornithomyia*; but the difference is greater than the resemblance. Only three veins run from the articulation to the lower [posterior] margin of the wing. Furthermore, as in *Ornithomyia*, the system of wing veins is colored in dark in the portion of the wing toward the anterior border and the articulation, as if the hollow veins were filled there with dense matter; while over the remainder of the wing the veins are delicate and transparent. Meigen shows this quite well in his drawings of the genus *Ornithomyia* (Syst. Beschr., VI, Pl. 64.) In this connection there exists in *Lynchia* a peculiarity which has arrested my attention: *viz.* that the discoidal vein [fourth longitudinal; M_1+_2] is always interrupted by a clear and transparent portion, placed a short distance from the forking of the common posterior [sub-stem vein] into the discoidal [fourth longitudinal; M_1+_2] and the true posterior [fifth longitudinal; M_3+Cu_1]. At first sight one might believe that the vein is actually interrupted in this spot, but in focussing correctly one soon is convinced that the interruption is merely in the substance filling the vein and not in the vein itself. I had at first thought that this was an accidental abnormality, but it now appears to me to be a typical feature. The costal vein [first and second sections of costa] is very short, not extending over one third of the wing, where the subcostal [first longitudinal; R_1] unites with it and then forms about one third more of the anterior margin, extending as far as the point where the radial [second longitudinal; R_2+_3] unites with the subcostal. The mediastinal [auxiliary; Sc] almost touches the subcostal [first longitudinal; R_1] and consequently the space between both is very narrow. The transverso-basal [humeral cross-vein; h] is, however, not absent, but is placed in an outwardly oblique direction between the costal and the subcostal [first longitudinal; R_1], before the point where the subcostal gives origin to the mediastinal [auxiliary; Sc.] The first longitudinal [second longitudinal; R_2+_3] bifurcates into the radial [second longitudinal; R_2+_3] and the cubital [third longitudinal; R_4+_5] very close to its origin. The radial [second longitudinal; R_2+_3] runs toward the anterior border, where it continues some distance as if it were the continuation of the subcostal [third section of costa], and soon unites under an acute angle with the cubital [third longitudinal; R_4+_5], that is to say in the same anterior border;

this junction takes place at a point about two-thirds of the distance along the anterior border. The margin of the remainder of the wing carries no vein. The second longitudinal or common posterior [sub-stem vein] bifurcates almost immediately beyond its origin, the bifurcation resulting in the discoidal [fourth longitudinal; M_1+_2] and the true posterior [fifth longitudinal; M_3+Cu_1.] The first of these runs at first a little toward the hind margin, thence with a bend toward the fore margin, so that the first articular cell [first basal cell; R_2], lying between the cubital [third longitudinal; R_4+_5] and discoidal [fourth longitudinal; M_1+_2] and closed by the transverso-media [anterior cross-vein; r-m], is very angular in its outer portion. After being connected with the cubital [third longitudinal; R_4+_5], at a point about two-thirds along the cubital, by means of the transverso-media [anterior cross-vein; r-m] just mentioned, the discoidal [fourth longitudinal; M_1+_2] runs in a gradual curve toward the lower margin of the wing, where it ends in about the fourth of the lower margin. The other branch, the true posterior [fifth longitudinal; M_3+Cu_1] runs, also with a gentle curve, toward the same border, where it ends about the middle. The *transverso-discoidal* [anterior basal cross-vein; M_3] *unites it with the discoidal* [fourth longitudinal; M_1+_2] *at the point where that vein forms the above-mentioned bend, thus forming the discoidal cell* [second basal cell; M.] There are no transverso-posterior veins [posterior cross-vein; m and posterior basal cross-vein; Cu_2.] The anal vein [sixth longitudinal; An] has a double origin, runs with a strong curve to the hind margin of the wing, and ends at a point three-quarters of the way along the hind margin, as measured from the tip of the wing. The several veins which form together what we call the anterior system, are all crowded near the fore margin of the wing, and this is true also of the discoidal [fourth longitudinal; M_1+_2], so that the cells and spaces between the veins are very long and narrow. Only the three posterior and the axillary cells [R_5; M_2; Cu_1 +1st A; and 2d A] are large and wide. The crowding of the veins near the fore margin of the wing is also observed in *Ornithomyia*, though not as pronounced as in *Lynchia*, and consequently the cells mentioned above are not so much lengthened and not as narrow as in *Lynchia*. Another difference with *Ornithomyia* is the absence of the mediastinal [auxiliary; Sc] in that genus, where it is fused with the subcostal [first longitudinal; R_1] [This is an error, as the auxiliary vein is present in *Ornithomyia* also.—J. B.] The transverso-basal [humeral cross-vein; h] is more perpendicular in *Ornithomyia.* It appears that in that genus an incomplete vein starts from the point where the cubital [third longitudinal; R_{4+5}] ends in the fore margin, and runs with a strong curve toward the tip of the wing, cutting off part of the first posterior cell [R_5], but incompletely, since, as I have said, this rudiment of vein does not reach the margin itself. It also seems that in *Ornithomyia* the fore margin is bordered by a vein to within a short distance from the tip, a feature not seen in *Lynchia* [Neither this nor the foregoing feature of the wing exist in *Ornithomyia.*—J. B.] In addition in *Ornithomyia* there is a first transverso-posterior vein, which is found at about the level of the transverso-discoidal [anterior basal cross-vein; M_3], of which it appears the continuation, forming with it a figure resembling S, and it is especially this feature which makes an important difference in that part of the wing, when the two genera are compared [In *Ornithomyia* the anterior cross-vein and the anterior basal cross-vein are close to each other, whereas in *Lynchia* they are far apart.—J. B.] In *Ornithomyia* there seems to be also a second transverso-posterior vein [posterior basal cross-vein; Cu_2], placed very near the articulation, between the anal [sixth longitudinal; An] and the posterior [fifth longitudinal; M_3+Cu_1], immediately beyond the bifurcation of the common posterior [sub-stem vein] into discoidal [fourth longitudinal; M_{1+2}] and true posterior [Cu_2 is present in *Ornithomyia,* absent in *Lynchia.*—J. B.] As I have said before, these cross-veins are entirely lacking in *Lynchia.* Tarsi as elsewhere throughout the family; halteres as in *Ornithomyia.*"

Weyenbergh adds that he uses Schiner's orismology of the wing venation, as set forth by van der Wulp (1871), and that the peculiarities of the wing of *Ornithomyia,* which he introduces for comparison, are taken from Meigen's drawing of that species. This explains some of the erroneous interpretations which I have pointed out. Weyenbergh failed to notice that the "first transverso-posterior vein," which he describes in *Ornithomyia,* is homologous with the "transverso-discoidal" which he found in *Lynchia,* the second basal cell being merely much lengthened in *Ornithomyia.* Evidently this has been the source of Speiser's erroneous assumption that the second basal cell was not closed by a cross-vein in *Lynchia.*

From the above account it appears that *Lynchia* Weyenbergh is a synonym of either *Olfersia* Wiedemann (*Feronia* Leach; *Pseudolfersia* Coquillett) or *Ornithoponus* Aldrich (*Olfersia* of authors, not of Wiedemann.) Although the description is not very explicit with regard to the structure of the head, the statement that there is a small, triangular, somewhat raised plate in the ocellar region, can, in my opinion, only apply to a species of *Ornithoponus.* I believe that the name *Lynchia* will eventually be used instead of *Ornithoponus.* Since the problem will be fully solved only with the rediscovery of the type-species, I deem it worth while to give a translation of the specific description also.

Lynchia penelopes Weyenbergh, 1881, Anales Soc. Cientif. Argentina, XI, p. 199.

"L. sepia-obscura, oculis subfuscis margine orbitali piceo. Antennæ flavescentes extremo obscuro. Frons flavescens. Alæ hyalinæ. Femora anteriora aurata.

"The eyes are of a dark reddish brown color and an orbital, nearly black half-circle incloses them on the frontal portion. These eyes are large and spherical, and show punctiform facets. The antennæ and the front are yellowish and at the top of the occiput one sees a triangular, dark, somewhat raised plate. On the labrum one sees a dark spot. The tip of the first segment of the antennæ also is nearly black. The thorax is of a dark sepia color; the median, raised line is brownish black, and the whole shows a yellowish sheen, somewhat metallic, especially on the metathorax and along the margins of the scutellum, which latter bears hairs along its posterior border. The abdominal segments are of the same color, very dark; and their margins have a yellowish sheen on the articulations. The veins have the same general color, a little grayish, and the wings are very transparent and large. The halteres are dirty white. The claws of the legs are black and the tarsal segments dark brown, a little paler in the middle. The femora are flat, yellowish, with the upper margin nearly black, while the flattened sides are yellowish; the tibiæ of the hind legs are entirely dark or dark brown. The femora of the fore legs are golden yellow on the ventral surface. The articulations of the legs are all dark. The ventral surface of the insect is also very shiny and of a dark sepia, metallic color. The labium is pale brown and the genitalia are yellowish. The venter is finely granulose or shagreened a character which is especially evident in the female. The interruption of the discoidal vein [fourth longitudinal; M_1+_2], which I have mentioned before in the generic description, is perhaps but a specific character; yet this peculiarity seems to me to be constant. Spread of the wings, from the tip of one to that of the other, 2.5 cm. Length (including the head, but not the wings), of female, 1 cm.; of male, 8 mm."

Off "Pavo del monte, Yacú, or Charate," *Penelope canicollis* Wagler, in the Province of Tucuman, Argentina.

This is evidently one of the largest species of the genus and as such must be related to *Ornithoponus obliquinervis* (Rondani), of Mexico, and *O. rufiventris* (Bigot), of Brazil.

Pseudolynchia, new name.

Lynchia Speiser, 1902, Zeitschr. Syst. Hym. Dipt., II, p. 155. Massonat, 1909, Ann. Université Lyon, N. S., I, Sci., Fasc. 28, p. 295. Aldrich, 1923, Insecutor Inscitiæ Menstr., XI, p. 77. Ferris, 1925, Philippine Jl. Sci., XXVII, p. 415 (Not of Weyenbergh, 1881.)

Type by present designation: *Olfersia maura* Bigot, 1885.

The generic characters have been correctly given by Speiser, Massonat, Aldrich, and Ferris, so there is no need repeating them here. Of the described hippoboscids, the following appear to belong to *Pseudolynchia.*

1. **Pseudolynchia brunnea** (Latreille.)

Ornithomyia brunnea Latreille, 1811, in Olivier, Encyclop. Méthod., Insectes, VIII, p. 544 (Carolina; no host.)

I refer to *P. brunnea* eight specimens from the following localities:

Alamogordo, New Mexico, three females, without host, May 8, 1902. Academy of Natural Sciences, Philadelphia.

Wareham, Massachusetts, two females, off adult male whippoorwill, *Antrostomus vociferus* Wilson, June 6, 1901 (O. Bangs Coll.) Museum of Comparative Zoology, Cambridge.

Hot Springs, Virginia, three females, off whippoorwill, *Antrostomus vociferus* Wilson, July, 1897 (Wirt Robinson Coll.) Museum of Comparative Zoology, Cambridge.

I believe that this species has not been properly recognized thus far. Speiser does not appear to have known it. Coquillett determined as *brunnea* specimens which were sent to him from Ceará, Brazil (see F. Dias da Rocha, 1908, Bol. Museu Rocha, Ceará, I, p. 77), but these Brazilian specimens were *P. maura* var. *lividicolor* (Bigot.)

Although closely allied to *P. maura* (Bigot), *P. brunnea* is undoubtedly a distinct species. It is of a very dark brown color, often nearly black. It differs from both *P. maura* and the variety *lividicolor* in its robust build, in the much shorter and broader wings, which are 5 to 5.5 mm. long and 1.8 mm. wide, and in the shape of the head, the front being distinctly longer. The eyes extend farther toward the occiput, their upper margins reaching much beyond the anterior margin of the smooth vertex. The frontal lunule is relatively short; the basal, undivided portion of the clypeus is rather narrow, but long, the apical, diverging arms being not much over twice as long as the basal portion. The dorsum of the thorax is somewhat less hairy than in *P. maura*. The entire anal cell [Cu+1st A] is covered with microscopic setulæ, the axillary cell [2d A] being the only bare part of the wing membrane.

The specific name has usually been credited to Olivier, but the article "Ornithomyie" of the Encyclopédie Méthodique was written by Latreille and is signed "(Lat.)"

2. **Pseudolynchia capensis** (Bigot.)

Olfersia capensis Bigot, 1885, Ann. Soc. Ent. France, (6) V, p. 240 (♂; Cape of Good Hope; no host.)

Speiser (1902, Zeitschr. Syst. Hym. Dipt., II, p. 166), who examined Bigot's type, has given a few additional details regarding the coloration of this species, but its structural characters are not known.

I am inclined to believe that all later records of *capensis* from Somaliland, Natal, and the Canary Islands, really refer to *P. maura.*

3. **Pseudolynchia exornata** (Speiser.)

Olfersia exornata Speiser, 1900, Ann. Mus. Civ. Genova, XL, p. 562 (Doloc Tolong, western Sumatra; no host.)

This species is extremely close to *P. maura*, if at all distinct. Speiser (1902, Zeitschr. Syst. Hym. Dipt., II, p. 163) states that *maura* differs from *exornata* "durch ein dunkler braune Farbe der Stirn und ganz wesentlich geringere Beborstung des Kopfes."

Speiser has also recorded *exornata* from the Oasis Merv, in Russian Transcaspia, and from the River Luazomela, Kenya Colony; but in both cases the specimens were probably *P. maura.*

4. **Pseudolynchia garzettae** (Rondani.)

Olfersia garzettæ Rondani, 1879, Bull. Soc. Ent. Italiana, XI, 1879, p. 23 (Insubria, Italy; no host.)

This species has not been properly recognized. Speiser has referred to it a specimen from Bavaria, but gave no details as to how to separate it from its allies.

5. **Pseudolynchia maura** (Bigot.)

Olfersia maura Bigot, 1885, Ann. Soc. Ent. France, (6) V, p. 237 (Algeria; no host.)

This is the common parasite of the domestic pigeon in the tropical and subtropical parts of the Old World: Mediterranean Region, Asia Minor, India, Mauritius, Africa (from Algeria to the Cape), Philippine Islands, and Hawaiian Islands. I have seen two specimens (♀ ♂) from Asmara, Eritrea, kindly sent by Prof. Bezzi.

From *P. brunnea*, *P. maura* differs in the much longer wings, which are 6.5 to 7.5 mm. long and 2 to 2.4 mm. wide; the front is distinctly shorter, the space between the inner orbits nearly as broad as long, the upper margins of the eyes reaching hardly beyond the anterior margin of the smooth vertex; the frontal lunule is long; the basal, undivided portion of the clypeus is rather broad, but very short, dividing almost at once into the very long, diverging arms; the anal cell [Cu+1st A] is covered with setulæ over the anterior half only, the remainder of the cell, as well as the axillary cell, being bare. I have selected *P. maura* (Bigot) as the type of the genus *Pseudolynchia*, because it is not only widely distributed, but also one of the few species that may be recognized without hesitation. Excellent drawings of *P. maura* have been recently published by Ferris (1925, Philippine Jl. Sci., XXVII, pp. 416-417, figs. 2 and 3.) The short, stout, black setæ on the plantar surface of the middle basitarsus, mentioned by Ferris, are apparently a sexual character. I find them in all my male specimens, also of the var. *lividicolor*; in the female they are replaced by small, slender setæ.

5*a*. **P. maura** var. **lividicolor** (Bigot.)

Olfersia lividicolor Bigot, 1885, Ann. Soc. Ent. France, (6) V, p. 238 (Brazil; no host.)

This is the common parasite of domestic pigeons in South and Central America and the West Indies. I have seen it from the following localities:

Cuba, one male, without host (Poey Coll.) Museum of Comparative Zoology, Cambridge.

Barbados, one male, without host, October 16, 1904 (G. S. Evelyn Coll.) Academy of Natural Sciences, Philadelphia.

Puerto Arturo near Tela, Honduras, four specimens (♀ ♂), off domestic pigeons (F. M. Root Coll.) These specimens have been recorded as *Lynchia maura* by Dr. Root (1925, 13th Ann. Rept. United Fruit Co. Med. Dept., (1924), p. 209.)

Manâos, Brazil, one female taken in flight, at the hotel, September 14, 1924 (J. Bequaert Coll.)

After carefully comparing these American specimens with the Old World *P. maura*, I am unable to find any structural differences. Since, however, they are distinctly paler than the typical *P. maura*, I regard *lividicolor* as the Neotropical variety of that species. Bezzi (1909, Broteria, Ser. Zool., VIII, 2, p. 64) and Austen (1921, Bull. Ent. Research, XII, p. 122) regard the South American form as identical with *P. maura*.

6. **Pseudolynchia rufipes** (Macquart.)

Olfersia rufipes Macquart, 1848, Dipt. Exot., Suppl. III, p. 69 (Reunion; no host.)

The species has not been properly recognized.

7. **Pseudolynchia simillima** (Speiser.)

Lynchia simillima Speiser, 1904, Ann. Mus. Civ. Genova, XLI, p. 337 (Java; no host.)

This was based upon a specimen recorded as "*Olfersia spinifera*" by van der Wulp (1880, Tijdschr. v. Entom., XXIII, p. 193.) Speiser's description mentions no structural characters to separate it from the allied species.

Of the seven species listed above, only two have been sufficiently characterized thus far. Probably several of the others are mere synonyms.

Lynchia pusilla Speiser (1902, Zeitschr. Syst. Hym. Dipt., II, p. 157; Cuba) is the type of the genus *Microlynchia*, which differs from *Pseudolynchia* in the presence of minute ocelli and a differently shaped scutellum. I also regard *Olfersia falcinelli* Rondani (1879, Bull. Soc. Entom. Italiana, XI, p. 23; Malta) as a *Microlynchia*. The size is that of *M. pusilla* and the shape of the scutellum is the same. The ocelli were probably overlooked owing to their small size.

ADDENDA.

After the present paper was sent to the printer, I had occasion to examine many additional specimens of *Pseudolynchia*, from various sources. Since I was, nevertheless, unable to distinguish more than the two species recognized above, I am more than ever inclined to doubt the distinctness of some of the others. Some readjustment of names will eventually be necessary.

1. **Pseudolynchia brunnea** (Latreille.)

Specimens at the United States National Museum:

Ames, Iowa, without host; two specimens, which F. Knab (1916, Insecutor Inscitiæ Menstr., IV, p. 3) referred to *P. maura.*

St. Vincent Island, Florida, off *Antrostomus carolinensis* (Gmelin) (W. L. McAtee Coll.)

Princeton, Florida, off *Antrostomus vociferus* (Wilson) (W. Byrd Coll.)

Barro Colorado, Gatun Lake, Panama, off a nighthawk, *Chordeiles acutipennis* (Boddaert), September 24, 1923 (R. C. Shannon Coll.)

Specimens at the American Museum of Natural History:

Sherborn, Massachusetts, off *Antrostomus vociferus* (Wilson) (C. W. Johnson Coll.)

St. Augustine, Florida, off chuck-will's-widow, *Antrostomus carolinensis* (Gmelin) (C. W. Johnson Coll.)

Specimens received from the Entomological Branch of the Department of Agriculture of Canada (through Mr. C. H. Curran):

Low Bush, Lake Abitibi, Ontario, off a nighthawk, *Chordeiles virginianus* (Gmelin), four specimens (N. K. Bigelow Coll.)

2. **Pseudolynchia maura** (Bigot.)

A study of an extensive series from all parts of the world has now convinced me of the utter futility of separating *lividicolor* from *maura,* even as a variety. One finds all transitions between pale-colored and dark specimens. Moreover, I am inclined to believe that *P. maura* was originally an Old World insect, which was introduced by man into the Americas, together with the domestic pigeon.

Unless otherwise stated, the host of the specimens recorded below is in each case the domestic pigeon.

Specimens at the United States National Museum.

Palermo, Sicily.

Asmara, Eritrea.

Umbeluzi, Lourenzo Marques, Portuguese East Africa, off "*Strix flammea*" (C. W. Howard Coll.) This specimen was identified as "*L. rufipes*" in the collection, but I was unable to find that it differed structurally from *P. maura*.

Oahu, Hawaiian Territory (J. F. Illingworth Coll.)

Kawailoa, Oahu, H. T. (H. T. Osborn Coll.)

Philippine Islands (C. S. Banks Coll.)

Savannah, Georgia (W. Duncan Coll.)

Atlanta, Georgia (L. Brown Coll.)

Jackson, Mississippi (Mrs. J. V. Bogert Coll.)

Hattiesburg, Mississippi.

Charleston, South Carolina (V. T. Rogers Coll.)

Little Rock, Arkansas (W. J. Baerg Coll.)

Birmingham, Alabama (J. M. Lowrey Coll.)

Baton Rouge, Louisiana (Bishopp Coll.)

Key West, Florida (J. Y. Porter Coll.)

Orlando, Florida (W. W. Yothers Coll.)

Larkins, Florida (S. Graenicher Coll.)

San Diego, Florida.

Havana, Cuba (J. R. Taylor Coll.)

Ceará, Brazil (F. D. da Rocha. Coll.)

Campinas, Brazil (A. Hempel Coll.)

São Paulo, Brazil (Ad. Lutz Coll.)

Some of these localities have been reported by F. Knab (1916, Insecutor Inscitiæ Menstr., IV, pp. 3-4.)

Specimens at the Bureau of Animal Industry, U. S. Department of Agriculture:

Montgomery, Alabama (M. J. Myers Coll.)

Meridian, Mississippi.

HABITS OF THE HIBISCUS BEE, *EMPHOR BOMBIFORMIS*

By Charles Robertson,

Carlinville, Illinois.

The following paragraphs have been overlooked in the bibliography of this bee, and by authors who have made observations upon it. The passages have been shortened a little by leaving out some irrevelant words.

1. 205.—"*Emphor bombiformis* is by far the most abundant visitor (of *Hibiscus lasiocarpus*). Indeed, in two seasons' collecting of insects on flowers, I have failed to find this bee except on this plant. The female visits the flower for honey and *pollen, her loose scopa being well adapted to hold the large grains.* The male comes for honey *and in search of the female.* In sucking, this bee generally begins with 4 (the middle nectary on the right) and turns to the left, often missing 5, but sometimes reversing, so as to empty all. Of 27 individuals, only 10 sucked 5 nectaries, 17 missing one or more. The 27 sucked 113 out of a possible 135, and missed 22."

2.—"Mr. Charles Robertson, of Carlinville, Ill., read a most interesting note upon the habits of the bee *Emphor bombiformis.* This bee, it was started, confines itself almost exclusively to *Hibiscus*, chiefly *H. lasiocarpus.* It was stated that in collecting these bees it is important to catch *those flying around the plant without alighting, as these were generally the males,* whilst those visiting the flowers for honey and *pollen* were the females. On August 5th, when walking along a dam with water on one side, he had noticed a female standing upon the water; she then flew to a bank, and he observed that she was *carrying water* to facilitate the excavation of hard ground, into which she was burrowing to build her nest. Sometimes one pellet of earth would be taken out after such an application of water, but at others three or even four. An interesting discussion followed which was participated in by Messrs. Osborn, Cook, Weed, Fletcher and others." Published in 1890 (**2**) and cited in 1918 (**9**), this was overlooked y two bibliographies (**11** and **14**).

4, 31-2.—"As a *typical case of an oligotropic bee, Emphor bombiformis* may be mentioned. Both sexes occur in abundance on flowers of *Hibiscus lasiocarpus,* the female collecting the *pollen,* the males often spending the night in the flowers. *The bees do not occur except when the Hibiscus is in bloom.* Within several yards of the *Hibiscus* I have seen the female making nests in a dry bank, *carrying water* to soften the earth she was excavating. *The bees coming out next year find the Hibiscus in bloom near by.* The only visits to other flowers I have seen the bees make were to those in the neighborhood of the *Hibiscus.* Thus I have seen a single female sucking the nectar of *Cephalanthus occidentalis,* and another that of *Vernonia fasciculata,* as well as a single male sucking nectar of *Ipomoea pandurata.* The outside visits in no way modify the essential relation of the bee to the *Hibiscus.*"

9.—"The fact that *Emphor bombiformis* rests upon the water when drinking, mentioned under the above title by Frederick Knab (**7**) was observed in 1890 and was recorded in **2**. It is fairly certain that the bees were not drinking in the ordinary sense, but that they consisted exclusively of females which were getting water to soften the earth in which they were making excavations for their nests."

This passage is casually cited (**11**:588) under Knab, as if it related to "drinking" instead of *carrying water,* and in spite of the fact that Knab's observation was not new.

Phenology.—*Hibiscus lasiocarpus* blooms 59 days, July 20-Sept. 16. *Emphor bombiformis,* its oligolege, flies 53 days, July 21-Sept. 11, the male 44 days, July 21-Sept. 2, the female also 44 days, July 30-Sept. 11. The male is 9 days earlier than the female, which is about the average for males, 9.6 mentioned in **10.** The female is 9 days later than the male, which is 13 less than the average for females given in **10.** This is one of 5 long-tongued bees in **10,** 341. Grossbeck and Nichols give Aug. 22, 25 and Sept. 3.

Flower visits (7).—♀ c(2)—Malvaceae: Hibiscus lasiocarpus, H. militaris.

♀s(3)—Compositae: Vernonia fasciculata; Convolvulaceae: Ipomœa pandurata; Rubiaceae: Cephalanthus occidentalis.

♂s(5)—Compositae: Cirsium lanceolatum; Convolvulaceae: *Ipomoea pandurata*; Malvaceae: *Hibiscus lasiocarpus*, *H. militaris*; Verbenaceae: Verbena stricta. Flowers also visited by the female are in italics. Of the general visits, 57.1 per cent fall under Mas, Hb and red (=red, purple etc.).

In my lists of visitors to local flowers I have distinguished the visits of the males and females and noted the pollen visits of the females. These are ignored and mixed with notes where the distinctions were not made. In **12,** 149, it is stated that visits of nest-making bees should show the pollen visits of the female, the nectar visits of the female and the nectar visits of the male. This was carried out in **13.** The female of *Calliopsis andreniformis* shows 33.3 per cent under Mas and 52.3 under red, while the male shows 27.5 under Mas and 48.2 under white. The pollen visits of the female show 48.7 under Mas and 47.3 under red, while the nectar visits show 30.4 under Mas and 56.5 under red. In **15**, 82 it is shown that oligolectic bees exhibit remarkable differences in their pollen and nectar visits. At *Hibiscus lasiocarpus*, at *Ipomoea pandurata* and at *Verbena stricta* mean three different things. Probably most people would not regard the distinctions as important. Many people, however, think science and the applications of science are the same thing and that there is no conflict between science and 1000 conflicting religions. In references to my papers "*Hibiscus*" means *H. lasiocarpus*. The bee never occurs on *H. trionum*.

E. fuscojubatus (8) was based on comparison of three females from New Jersey with one of *E. bombiformis* from Georgia. Local specimens show that differences like those credited to these species are not constant are not correlated. Any repectable local collection is likely to discredit the validity of *E. fuscojubatus*. Twenty-two local females and 12 males vary as follows: mesonotum pale 22, 12; scutel ochraceous 18, 0; vertex rufofuscous 12, 6; vertex ochraceous 3, 3; front rufofuscous 6, 3; front ochraceous 6, 4; cubital cell 3 longer than second 7, 5. The hair of vertex varies from nearly black through ochraceous to quite pale. How can one tell that the characters of *E. bombiformis* are shown by one specimen or that Grossbeck's observations were on *E. fuscojubatus*?

Historically the relations of flowers and insects was a botanical subject as shown by the works of Sprengel, Darwin, Delpino, Mueller, Mac Leod and others. Most of the papers and abstracts are in botanical journals, a fact which indicates the place to look for the literature.

Dependence of *E. bombiformis* on pollen of *H. lasiocarpus*, and adaptation of scopa to large pollen grains was recorded in **1**, 1888 (see also **2** and **4**); habit of male of flying about flowers in search of the female, in **1**, 1888, and **2**, 1890; female carrying water to soften ground, in **2**, 1890 (also in **4** and **9**); phenological correlation with *H. lasiocarpus* and habit of nesting near it, in **4**, 1899.

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2; 1890 Habits of *Emphor bombiformis*. Proc. Ent. Club A. A. A. S. Can. . Ent. **22**: 216-17. Abstract by James Fletcher?
3. 1893. *Hibiscus lasiocarpus*. Flowers and insects. XI. Bot. Gaz. **18**: 270-1.
4. 1899. On the flower visits of oligotropic bees. Flowers and insects. XIX. Bot. Gaz. **28**: 27-38.
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6. 1911. Grossbeck, J. A. A contribution toward the life history of *Emphor bombiformis*. Journ. New York Ent. Soc. **10**: 238-43.
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9. 1918. Robertson, C. How Emphor drinks. Can. Ent. **50**: 320.

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11. 1920. Lutz, F. E. and Cockerell, T. D. A. Distribution and bibliography of N. A. Apidæ etc. Bull. Am. Mus. Nat. Hist. **42**: 490-641.
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14. 1922. Frison, T. H. Notes on life history etc. of *Anthophora abrupta.* Tr. Am. Ent. Soc. **48**: 137-56.
15. 1924. Robertson, C. Color preference of bees. Flowers and insects. XXIII. Bot. Gaz. **78**: 68-84.

A NEW GENUS OF SUCKING LICE,

By Eric Mjöberg

Hamophthirius n. g.

Antennæ three-jointed, first joint very strongly developed, with a large chitinous hook; head anteriorly very strongly constricted, with a strong and sharp chitinous hook on each side, posterior half transverse, nearly twice as broad, posterior angles protruding, forming two processes, posterior margin strongly emarginate on each side of the middle; thoracic segments coalescent, parallel-sided, all pairs of legs fairly equally developed; abdomen of normal type, with pleural scelerites developed on segments two to six. Integument scaly.

Type, the following species:

Hamophthirius galeopitheci n. sp. (Fig. 1.)

Yellowish, depressed; head in front strongly chitinized; lateral hooks parallel, very sharp; antennæ with the first joint enormously developed, with a very large hook and ventrall yon the posterior margin with a smaller one; second joint shorter than the third, both nearly parallel-sided; third joint with two lateral sensitive fossæ, its terminal field with eight to ten sensitive seta-like organs. On the ventral side of the head posteriorly there is a dagger-like spine at each side; posterior lower angles obtuse, the upper angles distinctly produced, rounded at the tips, and provided with three long setæ. Thoracic segments coalescent, anterior angles of prothorax rounded; at the middle of the anterior margin deeply excised to receive the corresponding protruding part of the occipital region of the head; legs moderate in size, fairly equally strongly developed; tibiæ with four small terminal chitinous spines opposite to the claw; claws large, distinctly striated (fig. 1, b). Abdomen in both sexes of normal development; pleural scelerites small, posteriorly emarginate (fig. 1, c and d); tergites and sternites with two more or less regular rows of fine depressed setæ. Chitinous parts of genitalia in ♂ (fig. 1, e) forming two parallel jointed rods, simple gonapods of normal type, forming two flat lobes of more or less triangular shape and provided with numerous chitinous setæ; last segment produced into two small, unjointed processes.

Length of body: ♂ 1.7 mm; ♀ 2.5 mm. (Fig. 1, f).

Eggs: Oval, whitish, with a series of faint transverse ridges on the upper half, the top set off as a distinct micropyle field with numerous small protruding tubercules in a row.

This remarkable form of louse which offers in its external general appearance a striking resemblance to the mallophagan

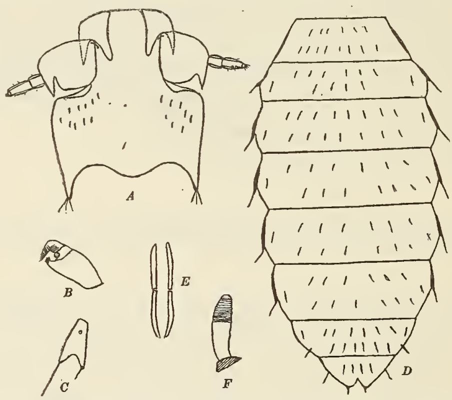

Fig. 1. *Hamophthirius galeopitheci* n. sp. A, head; B, tarsal claw; C, pleural sclerite; D, abdomen; E, genital rods of male; F, egg.

genus Trichophilopterus Stobbe in possessing strong chitinous hooks on the head and antennæ, was taken by me near Fesseltan in British North Borneo on a freshly shot Galeopithecus sp. Like its host it occupies a very isolated position and it is difficult to place it even in one of the known families. The mouthparts are very delicate but mainly of the same type as in other Anoplura. The three-jointed antennæ and the strongly developed chitinous hooks as well as the general shape of the head point to a high degree of specialization.

A SPECIMEN OF *MELANOPLUS DIFFERENTIALIS* THOMAS WITH FOUR OCELLI[1]

Robert D. Glasgow

University of Illinois.

For some reason contributions to the literature of teratology from insect examples have been made in far greater numbers by European entomologists than by their American colleagues, yet there seems to be no apparent reason why abnormalities should be proportionately rarer among American insects or in the materials handled by American students of entomology. The writer has himself encountered no less than six interesting examples of arthropodan malformations in the course of his work, and every entomologist who has examined carefully any considerable amount of insect material must have observed some specimens which presented noteworthy abnormalities that should be recorded in the literature of biology, and thus made available for consideration by investigators who may have a special interest in these phenomena.

From the nature of these phenomena the occurrence of examples must be sporadic, and since each case standing alone may seem to the observer to have little signficance, they are likely to be unheeded, or at least unrecorded, and consequently lost to science. It is probable also that many examples of insect abnomalities have never been reported because the observers have hesitated simply to describe them without comment, and have not felt prepared to supplement their presentation with a plausible explanation or interpretation.

Not only is an interpretation not necessary in reporting examples of such malformations of insects, or of other organisms, but indeed any attempt to formulate an interpretation of such phenomena is scarcely warranted, unless the observer has studied a considerable body of data accumulated from many similar or related cases. It is sufficient simply to place each example on

[1]Contribution from the Entomological Laboratories of the University of Illinois, Number 92.

(Read at the Cincinnati meeting of the Entomological Society of America, December 27, 1924.)

record as it comes to the attention of the observer, by publishing a good description, accompanied by a figure if possible, and by stating where the specimen has been deposited. It may well be considered a duty to do this much, since it must be largely from such reports of sporadic cases that data and materials may be assembled for consideration by those who may wish to make intensive studies of teratology to supplement experimental data to which it may be pertinent. Moreover, every case of insect abnormality should be reported however commonly the particular type of malformation may have been reported before; for the multiplication of examples of any one type of variation may well be as important as reporting unique examples of entirely new types.

Among the various examples of insect malformation encountered by the writer, one of the most interesting is a specimen of the common short-horned grasshopper, *Melanoplus differentialis*. This specimen, which seems to be normal in every other respect, has four ocelli instead of the three which are normal for this species. In this specimen the lateral ocelli are normal in position, in form, and in size. The median ocellus, however, is represented by two perfectly formed ocelli which are disposed symmetrically, one on each side of, and laterad from the point where the normal median ocellus should be, and separated from each other by a distance somewhat greater than the diameter of a normal median ocellus.

Each of these para-median ocelli presents the characteristic oval form of a normal ocellus, each has a characteristically distinct, convex cornea, and each is situated in a separate characteristically oval depression in the front; but these aberrant ocelli are somewhat smaller than normal, so that the two ocelli together would present an aggregate area but little if at all greater than the area of a normal median ocellus.

The individual presenting this abnormality was found[2] in a lot of several hundred specimens which had been preserved for

[2]The attention of the writer was first directed to the anomalous condition of the ocelli in this specimen by a student in the introductory course in general entomology, Miss Margaret Windsor, who protested that the specimen given her for study did not agree with the specifications in the laboratory outline.

the study of external anatomy, and which were of uncertain origin. Because of the lack of suitable preservation, no attempt was made to study the structure of the median ocellar nerve. Instead, the specimen was preserved intact, and will be placed in the type series of the insect collections at the University of Illinois, where it can be studied further by anyone to whose work such a study may be relevant.

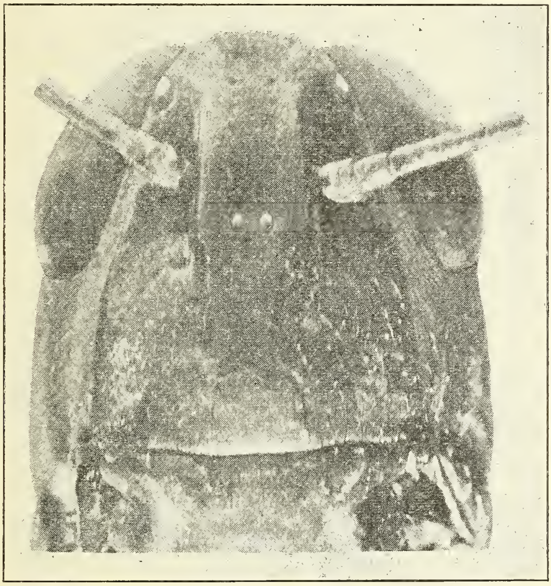

Fig. 1. *Melanoplus differentialis* with four ocelli, anterior view of head.

This particular malformation appears to be exceedingly rare among insects. The only other examples known to the writer are a specimen of the common meadow grasshopper, *Melanoplus femur-rubrum* Riley, described by M. W. Blackman,[3] and a specimen of a saw-fly, *Tenthredella simirubra* Norton, described by M. T. Smulyan.[4] In Blackman's specimen the median ocellus was replaced by a second pair of ocelli in a manner almost identical with the example here reported.

[3]Blackman, M. W., Psyche, v. 19, 1912, pp. 92-96, 1 fig.
[4]Smulyan, M. T., Proc. Bost. Soc. Nat. Hist., v. 36, 1923, p. 401.

The first hypothesis to suggest itself, and one that has already been advanced to explain this type of malformation, is that it may have a phylogenetic significance, and may constitute a reversion to an ancestral condition.

Examining the plausibility of this hypothesis, we find that Patten[5] has shown in a late larval or prepupal stage of a wasp, that the median ocellus first appears as a pair of separate pits or vescicles, which later unite to form a single ocellus on the median line. Packard[6] has stated that in the pupa of a bumble bee the median ocellus presents a "double shape, being broad, transversely ovate, and not round like the two others, as if resulting from the fusion of what were originally two distinct ocelli."

Leydig,[7] Rabl-Rueckhard,[8] Carriere,[9] Viallanes,[10] Janet,[11] and others have shown that in certain adult Hymenoptera the median ocellar nerve is double throughout some part of its length, while Burgess[12] in his figure of the brain of the Rocky Mountain Locust shows the median ocellar nerve to be unpaired in that species; still, in common with all structures located on the middle line of an organism having bilateral symmetry, where in early segmentation stages the plane of one of the cleavages corresponds to the future middle line, the median ocellus must in all groups of insects have been double at some point in the course of its development in the individual, and the condition of this structure in the Hymenoptera might seem to indicate that its origin from the fusion of an ancestral pair of ocelli may have occurred at no very remote period in the phylogeny of the class.

Indeed, the hypothesis begins to look delightfully plausible when only the supporting evidence is considered, but on the other hand it is well known that organisms tend to vary in all

[5]Patten, W., Journal of Morphology, Boston, v. 1, 1887, pp. 193-226.
[6]Packard, A. S., Text Book of Entomology, 1898, p. 250.
[7]Leydig, F., Tafeln zur vergleichenden Anatomie, Tubingen, 1864, Figs. 3-4.
[8]Rabl-Rueckhard, Archiv. f. Anat., Physiol., und Wiss-Medicin, 1875, pp. 480-499, pl. XIV.
[9]Carriere, J., Die Sehorgane der Thiere, Muenchen und Leipzig, 1885.
[10]Viallanes, H., Ann. Sci. Nat. Zool. 1887, 7 Ser. II, pp. 5-100, 6 plates.
[11]Janet, Chas., Anatomie de la Tête du *Lasius niger*, Limoges, 1905, 40 pages, 5 plates.
[12]Burgess, E., 2nd Report, U. S. Ent. Comm., 1880, pp. 223-242, pl. IX.

directions from the type. In organisms having bilateral symmetry where either paired structures, or the two halves of unpaired structures standing on the middle line, are geometrically related to each other as optical images with reference to the meson or axis of major symmetry, meristic variation in such a bilateral series may take either one of two directions. Bilaterally paired structures may be placed farther apart, or they may be brought closer together; and in the latter direction the degree of variation may extend to their becoming united to form a single median structure or even to their complete suppression. Normally unpaired, median structures may on the one hand be divided into two, so as to form a pair of bilaterally symmetrical structures, while on the other hand they may be reduced in size or entirely lost.

Indeed, it contrasts with the variation resulting in the division of the median ocellus, examples are also available to illustrate meristic variation of the same bilaterally symmetrical series fo structures in the direction of fusion, and even to the point of complete suppression.

Stannius[13] reported a worker honey bee specimen in which there is a complete fusion of the two compound eyes into a single symmetrical, elongate compound eye, that is uniformly continuous across the middle line. In this specimen there is also a reduction from the three ocelli which are typical for this insect, to a single ocellus located on the dorso-meson. Lucas[14] reported the similar fusion of the compound eyes in a honey bee of doubtful caste, accompanied by the complete suppression of the ocelli.

The median union of the ocelli could scarcely be interpreted as a reversion to an ancestral condition, and certainly the two opposite variations exhibited by these structures could not both be so interpreted. What may be the causes leading to either of these discontinuous changes we do not know; but it is not unlikely that variation in either direction may be found to result from the operation of the same factor or group of factors. At least it is better to refrain from drawing superficially plausible conclusions until we know more of the directive mechanism which

[13]Stannius, Mueller's Archiv. f. Anat. u. Physiol., 1835, P. 297. Pl.
[14]Lucas, H., Ann. Soc. Ent. France, 1868, ser. 4, v. VIII, p. 737, Pl.

molds the developing organism so uniformly true to type, and of the condition which now and then may cause the development of an individual in some detail to halt a little short of, to over-run, or otherwise to deviate from its due course.

It is truly an obligation, very generally neglected by American entomologists however, to record each example of insect teratology simply and directly, just as it is observed; but the fulfilment of this obligation is by no means accompanied by any additional obligation to offer at the same time an explanation or interpretation of the phenomenon. Indeed, in the present state of our knowledge of such phenomena any attempt to interpret individual examples is rarely demanded, or even scientifically justifiable.

THE SECOND ABDOMINAL PLEURITE IN THE HIGHER COLEOPTERA

By W. T. M. Forbes,

Cornell University, Ithaca, New York.

It is generally recognized that the first sternite of the abdomen is membranous in all the holometabolous insects. As to the first pleurite and the second segment there takes place a gradual reduction, which reaches such a stage that in the majority of Coleoptera the first two segments are represented by a more or less membranous dorsal and spiracular region only.

The usual statement is that the first segment of the abdomen has atrophied, and that the second is ventrally absent and laterally fused with the third. An examination of fresh specimens shows that this is not strictly the case. In fact the second pleurite may disappear in at least two different ways.

In the Bostrychiformia (Fig. 1, A) the first stage seems to have been an infolding of the whole subspiracular region of the first two segments, so that the hind coxa comes to lie against the anterior edge of the third segment or even overlap it somewhat. In this way the two segments are completely buried from view, and their sclerites become more or less completely de-chitinized, except on the mid-ventral line where the second segment takes the form of a strong keel, filling the space between the coxæ. The second pleurite is frequently completely membranous, but in the species figured (Trypopitys) it still shows some feeble chitinization and even a few rudimentary hairs

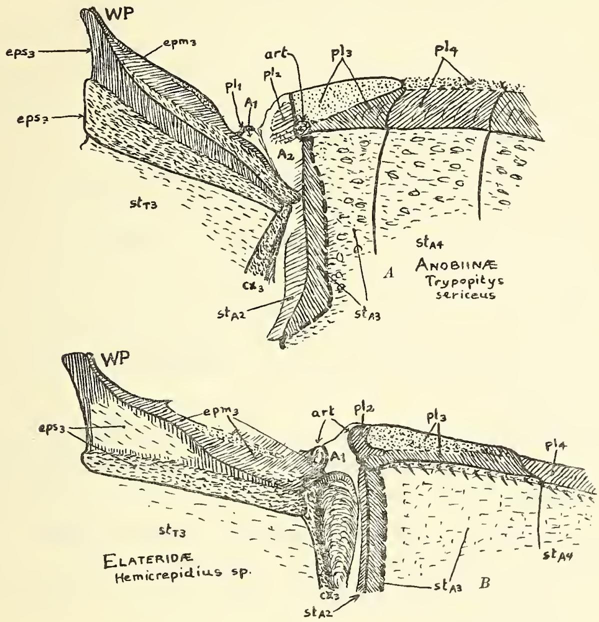

Fig. 1.

Each figure gives a ventro-lateral view of the junction of thorax and abdomen, with the articulation separated to expose the membranous structures. The variously shaded areas represent sclerites, the plain white, membrane. Hairy surfaces indicated, pads for the reception of the elytra stippled, the plain chitin striated.

A_1 Membranous first sternal region of abdomen. A_2 Membranous second sternal region of abdomen. eps_3 Metepisternum (the hairy ventral portion only is exposed when the elytra are closed). epm_3 Metepimeron (apex uncovered in Trypopitys, wholly covered in Hemicrepidius). pl_2, pl_3, pl_4 Pleurites of successive segments of abdomen. pl_1 rudimentary chitinous nodule, perhaps representing the first pleurite. st_{T3} Metasternum of thorax. st_{A2}, st_{A3}, st_{A4} Successive sterna of abodmen. art. Articular facets indicating the junction of metepimeron and second (or third) pleurite. WP Wing process. Heavy solid line. Edge of superficial portion of pleura, adjoining pleura of thorax in life. Heavy broken line. Edge of coxal cavity on surface of third sternite.

Fig. 1, *A*. Bostrychiformia, Anobiidæ. *Trypopitys sericeus.*

Fig. 2, *B*. Serricornia, Elateridæ. *Hemicrepidius* species.

(pl_2). The first visible pleurite in this case then is wholly formed of the third segment.

On the other hand an elater (Fig. 1, B) shows clear evidence of the fusion commonly assumed. The second pleurite is very small (pl_2), but lies completely flush with the surface of the body and forms the actual articular surface facing the metepimeron. The suture is traceable dorsally, and continuous with the well marked fold between the second and third dorsal segments, but it soon becomes ambiguous, and I am not sure I have indicated its course correctly.

The obvious conclusion from this is that the loss of the second pleurite has taken place twice independently (at least), and that its absence is not necessarily an indication of a homogeneous series of "higher Coleoptera." In fact the presence of forms with a well marked second pleurite is known in both series (Omethes, for instance in the Serricorns besides the possibly degenerate Lampyridæ; the early Dascyllidæ in the Bostrychiform series).

Incidentally it appeared in this work that the common statements as to the number of free segments of the abdomen are not correct. In the elater only the last segment is free, while in Trypopitys the entire abdomen is ankylosed, even the sutures being obliterated, except the first. This is correctly stated in the descriptions of the genus, but not allowed for in any key I have seen.

SOME UNUSUAL AND INTERESTING BUTTERFLIES FROM EASTERN MASSACHUSETTS.

By Austin H. Clark.

Smithsonian Institution, Washington, D. C.

During the months of July and August in 1923, 1924 and 1925 such time as could be spared from my regular duties was occupied in a study of the butterflies in eastern Massachusetts. The territory covered in 1923 extended from Needham to Waltham, Weston and Lincoln with headquarters at Newtonville. In 1924 and 1925 the region studied was from Manchester to Ipswich, especially Essex, with headquarters at Manchester.

On all of my excursions I was accompanied by my two sons, Austin B. J. Clark and Hugh U. Clark who are responsible for most of the captures recorded below.

In 1923 our efforts were mainly directed toward determining the status of *Feniseca tarquinius* in the region covered. We found it to be common, generally distributed, and readily secured in quantities after one has learned to recognize its characteristic haunts.

In 1924 and 1925 we concentrated our attention mainly on three localities in Essex which are natural butterfly traps. The first was an enormous patch of milkweed (*Asclepias syriaca*) by the roadside on Conomo street nearly opposite the farm house on Mr. S. D. Warren's estate. The next was a bog of considerable size wholly surrounded by wooded hills off the same street half a mile or so further on. Here numerous scattered examples of the red milkweed (*Asclepias incarnatum*) and later an abundant growth of *Cephalanthus* and subsequently patches of Joe Pye weed (*Eupatorium purpureum*) served as bait for the multitudes of argynnids and other butterflies that filtered in through the woods. The third was a dry hillside on the north side of Apple street near Bixby's camps sloping downward toward the west to a marshy spot protected from the wind by a fairly steep hill just beyond.

The summer of 1923 in eastern Massachusetts was noteworthy for the great abundance of *Satyrodes canthus* which in early July swarmed in all wet grassy places more or less protected by woodlands, and for the abundance of *Feniseca tarquinius* in correlation with the unusual abundance of its host (*Schizoneura tessellata.*)

The summer of 1924 was marked by the appearance of *Vanessa cardui* in great abundance and an increase in the numbers of *V. virginiensis*, together with an abrupt decrease in the numbers of nearly every other butterfly except *Anosia plexippus*, especially those types like *Argynnis*, *Brenthis*, *Satyrodes*, *Epidemia* and *Feniseca* which live in moist localities.

In 1925 *Vanessa cardui* was absent and *V. virginiensis* very scarce. In early July *Papilio glaucus* was unusually abundant, so numerous indeed that I counted more than twenty at one time about a single patch of milkweed in Essex. All the fritillaries were unusually abundant except *Speyeria idalia*, which was scarcely so numerous as in the preceding year, though still quite common. Hair-streaks and blues, as in 1923, were very common. A curious feature of the year was the great scarcity of *Anosia plexippus* which had been abundant in the two years preceding; not over half a dozen were seen in the course of the whole summer, and no larvæ were found.

Argynnis atlantis Edwards.

Essex: Bog off Conomo street, August 24, 1924, one female (A. H. C.); July 12, 1925, one female (A. B. J. C.); July 22, 1925, one male (A. H. C.); August 9, 1925, one female (A. H. C.). Milkweed patch on Conomo street, July 9, 1925, one reported (A. B. J. C.); July 10, 1925, remains of a female found on the ground (A. H. C.); August 9, 1925, one male (A. H. C.).

Apparently this butterfly is resident in this region. All the specimens seen were caught, though one was subsequently lost. It is easily distinguished from *A. cybele* and *A. aphrodite* both when on the wing and when resting. The preponderance of females among the captures was undoubtedly due to the lateness of the season.

Junonia coenia Hübner.

Essex: Marshy spot at the base of a dry hillside near Bixby's camps, Apple street, August 29, 1925, one (A. H. C.). Salt marsh at the junction of Apple street and the road to Essex Centre, August 30, 1925, one seen but not caught.

When resting this butterfly is very conspicuous but on the wing it is difficult to follow and is easily mistaken for a dragon-fly or grasshopper. It probably is a not uncommon casual in the extensive salt marshes and among the sand dunes of Essex county. In July 1898 I found it in numbers at Coffin's beach where apparently it had survived the winter.

Basilarchia arthemis (Drury).

Newtonville: Hillside west of Lowell avenue and south of Otis street, July 28, 1923, after a strong northerly gale, one (H. U. C.). This northern form is strikingly different from the usual, though not common, "white admiral" of this region.

Feniseca tarquinius (Grote).

Manchester: Tennis courts, Essex County club, July 21, 1925, one (A. H. C.). Alders along road over outlet of Gravel Pond, August 1925, larvæ (A. B. J. C.; H. U. C.).

Essex: Bog off Conomo street, August 30, 1925, one (A. B. J. C.). Main road from Manchester to Essex just beyond the Manchester line, fifteen larvæ, August 28, 1924; adult and eleven larvæ, September 1, 1925. Conomo road, on alders by a stream, August 1925, larvæ.

Newton Centre: Alders near stream east of Walnut street near Newtonville, August 1923, a few larvæ.

Newtonville: Woods south of Cabot street, two localities, abundant in both in 1923, apparently absent in 1924, a few in 1925. Hillside west of Lowell avenue and south of Otis street, abundant in 1923, absent in 1924 and 1925.

West Newton: Braeburn Club, near Pond, 1923.

Weston: west of the road to Lincoln, about alders, two localities, abundant in all stages, 1923.

Near the Lowell avenue locality in Newtonville larvæ were found on the carrion flower (*Smilax herbacea*) feeding on the large woolly aphid (*Neoprociphilus attenuatus*) that infests that plant. All of these larvæ were light pink in color and unmarked, but the butterflies reared from them were indistinguishable from those reared from larvæ found feeding on the woolly aphid of the alder (*Schizoneura tessellata*).

Two pupal skins from which the butterflies had emerged were found. One of these, at the Lowell avenue locality in Newtonville, was about four feet up on the main trunk of a large alder which had no aphids on its branches; the trunk was about three inches in diameter. The head of the pupa was directed downward. The other, from the locality in Essex near the Manchester line, was on the upper side of an alder leaf about a foot from the ground and directly beneath a large colony of aphids about six feet above it. The leaf was smeared with the exudations from the aphids to which cast skins and "wool" adhered. The pupa was in the inner half of the leaf and was attached to one of the veins near the midrib; its axis was paralle to the vein and its head was directed outward toward the margin of the leaf. In both these cases the larvæ had evidently dropped to the ground and thence crawled up to the supports on which they were found.

This is the easiest to rear of any of our butterflies, but reared adults are so very much more variable than those caught wild as to be practically useless for comparative purposes. Reared specimens in collections should be always labeled as such.

Chrysophanus thoë Boisduval

Essex: Marshy spot at the base of a dry hillside near Bixby's camps, Apple street, September 1, 1925, one female (A. B. J. C.).

Epidemia epixanthe (Boisduval and Le Conte)

Essex: Bog off Conomo street, common in a very small area in the southeastern portion, but scarcely ever seen beyond this area.

This species is common in all suitable localities in Waltham, Weston and Lincoln, but it is so inconspicuous that it frequently escapes observation.

Iphidicles ajax (Linné).

Brighton: one much broken specimen, June 1898 (Charles M. Bowers).

Laërtias philenor (Linné).

Manchester: Blossom Lane, August 17, 1925, one female (A. H. C.). This is not a common insect in this part of Essex county, though it appears from time to time.

Eurymus eurytheme (Boisduval).

Ipswich: About a mile east of the lighthouse, August 25, 1925, five seen, three males caught (A. B. J. C., 2; A. H. C., 1). All of these were fresh, though somewhat broken; apparently they had not come from any great distance.

Essex: Dry hillside near Bixby's camps, Apple street, August 30, 1925, one male.

Eurymus philodice (Godard).

Essex: Dry hillside near Bixby's camps, Apple street, August 30, 1925, one very pale, almost white, male (H. U. C.).

Eurema euterpe (Ménétries).

Manchester: Field west of Proctor street, September 4, 1924, two (A. B. J. C.). Blossom Lane, September 5, 1924, two (A. B. J. C.).

Essex: Bog off Conomo street, August 10, 1924, one fresh male (A. B. J. C.); July 30, 1925, one fresh male (A. B. J. C.).

Ipswich: about a quarter of a mile east of the lighthouse, August 25, 1925, one fresh female (A. H. C.).

This insect is probably less infrequent in Essex county than the records would seem to indicate as it is very easily confused with *Eurymus philodice.* In calm weather it is readily distinguished by its slower, feebler, lower, and more tortuous flight, but if there is any wind the differences tend to vanish. Although I am very familiar with this species I mistook the one captured at Ipswich for its larger and more powerful relative until it alighted on a beach pea immediately in front of me.

SOME RARITIES FROM ESSEX COUNTY, MASS.

By A. P. Morse.

Peabody Museum, Salem, Mass.

Several years ago I recorded (Psyche, vol. 28, p. 7,-1921) the capture of three examples of a dragonfly, *Sympetrum corrupum,* rare in Massachusetts, at Plum Island, Ipswich, Sept. 10, 1911.

On July 11, 1924, it was a common and conspicuous insect at a small pond in Marblehead, a dozen or more individuals being seen, of which four males and a female were secured.

Another rarity in eastern Massachusetts, the butterfly *Chrysophanus thoë,* believed to be the first example recorded from the county, was taken Sept. 6, 1924, at Salisbury, Mass.[1] This was a female in perfect condition, and was found on goldenrod flowers at the edge of the saltmarsh. A male also was seen but not secured.

[3]See this issue of Psyche, p. 296. [Editor.]

NEW SPECIES OF DIPTERA FROM NORTH CAROLINA AND FLORIDA

By Charles W. Johnson.

Boston Society of Natural History.

The following descriptions of the species from Florida have been taken from the manuscript of a supplementary list of the Diptera of Florida, which it seems undesirable to publish at present when so much still remains to be done on the insect fauna of that state.

Macrocera floridana sp. nov.

♂. Head yellow, ocelli black, antennæ brown, base yellow. Thorax yellow, with three broad shining brown stripes, the lateral ones shortened anteriorly. Abdomen yellow. Halteres and legs yellow, tarsi brown. Wings hyaline, slightly tinged with yellow, veins brown, a single brown spot is present at the bases of the submarginal and first and second posterior cells; only a small portion of the spot is in the first posterior cell, the slight brownish tinge at the tip of the wing is entirely due to minute hairs. Length 4 mm.

Two specimens. St. Augustine, Fla., April 16 and 17, 1919.

This species is related to *M. clara* Loew, but is separated by the absence of brown at the apex of the wing and at the stigma and the smaller clouding at the center of the wing.

Psilocephala subnotata sp. nov.

♂. Face and front black, entirely covered with a whitish pollen, in certain lights showing two dark spots above the base of the antennæ, eyes narrowly separated, about one third as wide below the ocelli as at the vertex, antennæ and proboscis black. Thorax blackish with light gray vittæ bordering a dark central stripe, pleura and scutellum black grayish pollinose, the latter with four black marginal bristles. Abdomen black with dense silvery white pollen and white hairs, the third and fourth segments only with shining black spots on the sides, the one on the third small while that on the fourth extends entirely across the segment; genitalia reddish with yellow and black hairs. Legs yellow, tips of the femora, tibiæ and tarsal joints brown. Halteres dark brown. Wings yellowish hyaline, veins and stigma light brown. Length 5 mm.

♀. Face and front entirely whitish pollinose, the latter above the antennæ about one third the width of the head and at the ocelli one sixth. Thorax as in the male. Abdomen shining black, with black hairs, posterior margins of the first, second, and third segments with a narrow border of silvery pollen and white hairs, fifth and sixth with a white pollinose spot on each side, tip of the abdomen dark brown with black hairs, otherwise like the male. Length 8 mm.

Two specimens, St. Augustine, Fla., April 12 and 18, 1919. Types in the author's collection.

Taken by the writer in company with *P. notata* Wied., with which it was at first confused. It is readily separated by its smaller size, the eyes not contiguous in the male, and the front entirely pollinose in both sexes.

Psilocephala davisi sp. nov.

♂. Face black whitish pollinose, hairs on the lower part of the face and inferior orbits white and much longer than in closely related species, front black whitish pollinose except the extreme upper and narrow part of the triangle which is shining black; first antennal joint black, the others dark brown. Thorax and scutellum black with long grayish hairs, dorsal stripes obsolete, the white hairs on the pleura long with dense tufts before the squamæ. Abdomen black, hairs white, forming dense tufts on the sides of the first and posterior margins of the second and third segments, the margins of which are also narrowly whitish pollinose, the shining spots on the sides of the second, third, and fourth segments conspicuous. Genitalia reddish with white hairs Femora black, hairs white, bristles black, tibiæ yellow, tips brown, base of the tarsi yellow, tips of the meta-tarsi and the remaining joints dark beown. Halteres black. Wings hyaline, veins near the base yellow, stigma and outer portion of the veins brown. Length 8 mm.

One specimen, Southport, N. C., April 10, 1914. Dedicated to its discoverer, Mr. William T. Davis.

The species might be confused with either *P. hæmorrhoidalis* Macq. or *P. frontalis* Cole. It is, however, more robust, with longer pile and narrower pollinose bands on the posterior margins of the abdominal segments. The shining black of the front is confined to the extreme upper point of the triangle.

Mixogaster delongi sp. nov.

♀. Head red, facial vitta brown, ocelligerous triangle black, front with a pair of longitudinal ridges on each side midway between the base of the antennæ and the orbits, antennæ red, the first and second joints together not quite as long as the third, the latter spatulate, about twice as wide near the tips as at the base, arista yellow, base black. Thorax: disc black with two narrow brown lines joined to a brown spot in front of the scutellum, lateral margins and a large spot on the pleura below the wings red, humeri, a small spot at the transverse suture, a large V-shaped mark on the pleura and the scutellum yellow, a spot in the the middle of pleura, the sternum and metanotum black. Abdomen, first segment yellow, second red, margined posteriorly with yellow, third and fourth brownish-black margined posteriorly with red and yellow. Genitalia reddish. Legs red, the basal half of all the tibiæ yellow. Halteres yellow. Wings brown, the costal and greater portion of the first and second basal and discal cells yellow. Length 11 mm.

One specimen, Paradise Key, Fla., April 6. Dedicated to Dr. D. M. DeLong, who collected this interesting species. A specimen has also been taken by Mr. H. C. Fall, Dunedin, Fla., Mar. 22, 1925.

Chaetopsis brooksi sp. nov.

♀. Head brown, the entire orbital margins whitish, ocellar triangle and sides of the vertex bluish, metallic, first and second joints of the antennæ yellow (third joint missing). Thorax bluish, shining, and slightly pruinose, an obscure dorsal stripe, pleura and scutellum brown; the pleura shows in certain light. a bluish metallic lustre. Abdomen blackish, shining, base brown. Legs brown, the tibiæ and tarsi slightly darker than the femora. Halteres light yellow. Wings brownish, with a whitish hyaline spot, partly in the first and partly in the second posterior cells about halfway between posterior cross vein and the edge of the wing, a middle whitish band extends from the costa across the discal cell and into the third posterior cell but not quite reaching the posterior margin, base of the wing hyaline. Length 4 mm.

Two specimens collected by Mr. W. Sprague Brooks at Paradise Key, Fla., Feb. 25, 1920. The species is readily separated from the other American forms by its peculiar wing pattern, which resembles that of *C. angustata* Hendel from Brazil.

SOME MYRMECOPHILOUS PHORIDÆ FROM THE NEOTROPICAL REGION.[1]

By Charles T. Brues.

The several interesting flies described in the present paper have been sent to me through the kindness of Dr. Wm. M. Mann. During the course of his myrmecological excursions he never fails to obtain series of myrmecophilous insects and among these there are usually a few forms of wingless or subapterous Phoridæ. Those obtained by him recently in Mexico and Central America include several remarkable species taken in the nests of a number of ants, mainly with Eciton and Pheidole.

The types of the new species are deposited in the United States National Museum in Washington.

Ecitomyia Brues.

American Natural., vol. 35, p. 347 (1901)

Since I described this genus nearly twenty-five years ago, the type pecies, *E. wheeleri* remained its only representative until 1923 when Borgmeier added two species from Brazil. The name Ecitomyia was originally applied as the Texan *E. wheeleri* was found to be regularly associated with *Eciton cæcum.* Borgmeier's two species were, however, found associated with *Solenopsis sævissima* var. *picea* and I now have a fourth species taken in Costa Rica with Pheidole.

It is evident therefore that the genus is by no means restricted to the driver ants although there can be no doubt that *E. wheeleri* is a true ecitophile and that it is restricted at least in Texas to association with *Eciton cæcum.* I have taken it many times and in considerable numbers, but never encountered it with any of the other species of Eciton that are common in that region.

Ecitomyia is closely similar to Ecitophora Schmitz and in error I once referred the type species to Ecitomyia (Psyche, vol.

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 253.

30, p. 21, February 1923) although later in the same year I have correctly referred it to Ecitophora (Zoologica, New York, vol. 3, p. 439; (October 1923). As Schmitz has since pointed out on numerous occasions Ecitophora possesses well developed ocelli while these are entirely lacking in Ecitomyia.[1]

The Costa Rican species is most closely related to its northern congener, *E. wheeleri* Brues, but differs in chætotoxy and considering its different host relations must I think be regarded as a distinct species.

Ecitomyia manni sp. nov.

♀. Length 0.7-0.8 mm. Very similar to *E. wheeleri*. Eyes decidedly smaller in diameter than the third antennal joint. Post-antennal bristles large and strong, as long as the tennal joint; lateral bristles of the second and third row very weak, much smaller than the median ones. Lateral thoracic bristle nearly as long as the dorsum of thorax (.075 mm. as compared to .063 mm. in *E. wheeleri*). Wing as long as the dorsum, its bristles about 25μ in length (compared to 13μ in *E. wheeleri*). Second abdominal tergite not noticeably narrowed basally.

Type and two paratypes from Estrella Valley, Costa Rica (W. M. Mann). These were taken by Dr. Mann in April, 1924 in a nest of Pheidole.

[1]In his original description Schmitz speaks of the type of Ecitophora having been bleached in the preservative fluid and of the extreme difficulty in detecting the bristles of the front. In Psyche (l. c.) I have suggested that possibly Schmitz might have mistaken the insertions of bristles for the ocelli. This remark was certainly not intended as any criticism of this author's uniformly painstaking work on these extremely small insects. The writer appreciates only too well the difficulties of studying them when imperfectly preserved or when injured before or after preservation or even when the mounting does not allow one to turn the specimen into the proper position to determine minute characters. On finding finely preserved specimens agreeing almost exactly with Schmitz's description of *Ecitophora comes*, but without ocelli, I naturally supposed that the ocelli described were really the points where bristles had been inserted. Father Schmitz has however assured me that the condition of the type allows *three* ocelli to be distinguished. I wish therefore to make an apology for my seemingly very hasty remark which as indicated above was in no way intended to suggest any carelessness on the part of a most accurate observer. Further work also attests the accuracy of Schmitz's first observation as additional specimens of *E. comes* have since been collected and other species discovered.

As indicated this species differs from *E. wheeleri* by the much longer lateral thoracic bristle and wing bristles and in the form of the second abdominal tergite.

In addition to the above I have another most remarkable species which is referred provisionally at least to Ecitomyia. It certainly cannot be placed in any other genus so far described and differs also very conspicuously from the other very closey allied species of this genus in possessing a number of enormously enlarged bristles on the abdomen. These form transverse rows at each side of the tergites which are formed as in Ecitomyia as are also the head, thorax and wings. As I suspect that intermediate forms may be discovered it does not seem wise to make this the type of a new monotypic genus.

Ecitomyia spinosa sp. nov. (Fig. 1)

♀. Length 1.5-1.7 mm. Head, thorax and abdominal plates and spots yellowish brown; abdomen pale yellowish white; legs brownish yellow; antennæ pale yellow; wings dark, almost black except at base. Head somewhat more than twice as broad as long, the anterior margin of the front rounded, more sharply so at the middle. Mouthparts very small, retracted within the oral cavity which is sharply carinate anteriorly. Eyes small, oval, about one-fourth as long as the head-height; ocelli entirely absent. Antennæ ovate, quite distinctly contracted at the apex; arista long, strongly pubescent, as long as the head-height. Four strong proclinate antennal bristles medially at the anterior margin of the front, the upper pair longer and set further apart; middle frontal row represented only by one lateral bristle near the eye; upper row of four about equally spaced. Thorax oval, twice as wide as long, with a strong bristle at each side and four across the disk; also a pair of smaller ones near the middle behind and another toward the side between the lateral pair of the transverse row. Wings reduced to small band-shaped pads as long as the dorsum of the thorax; the upper surface is convex, the tip more or less pointed and the surface strongly bristly, some of the bristles almost as long as the wing. Abdomen broadly ovate, the four apical segments forming a tube of rather narrow diameter which is distinctly turned upwards in fully developed specimens; one stenogastric individual has the abdomen much smaller. Dorsal plates of the second to fifth segment present; the second large, with four strong bristles along the hind margin; the others much smaller, each with a pair of bristles

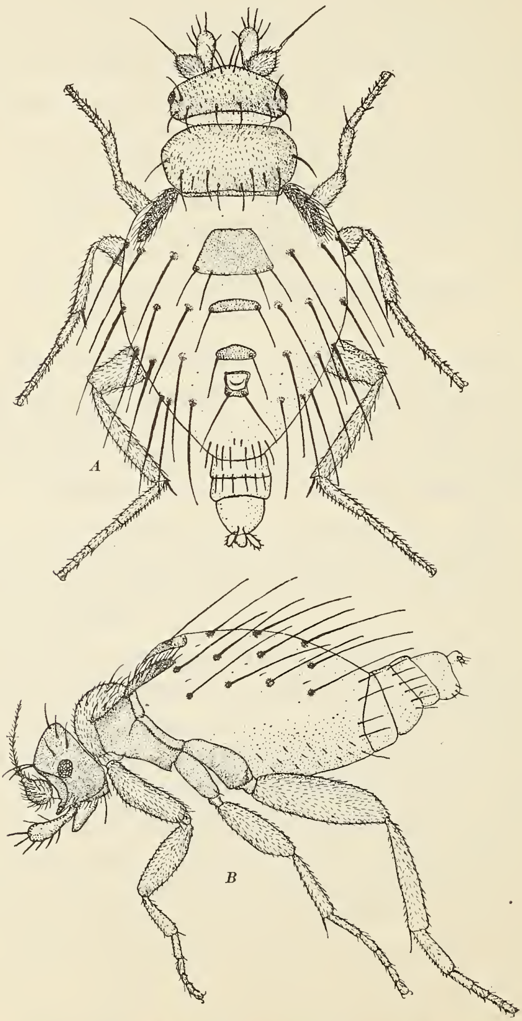

Fig. 1. *Ecitomyia spinosa* sp. nov., female. A, dorsal view; B, ventral view.

placed behind close to the lateral angles. Fifth segment with a gland opening which lies within a quadrangular chitinous rim that arises from the front margin of the fifth plate. Abdomen bearing twenty-four greatly enlarged marcochætæ, each about as long as the hind tibia. These are arranged in four transverse rows, three bristles at each side of each abdominal plate. Where each is inserted to the pale abdominal membrane there is a small rounded dark brown spot. These stout, intensely black bristles are very conspicuous and together with the blackish wing pads give the insect a most extraordinary appearance. Legs rather long and not very stout; the hind femora rather noticeably compressed.

Type and three paratypes from Huascato, Jalisco, Mexico (W. M. Mann). These were taken in a nest of Pheidole sp. Another specimen from San Diego de Cocula, Jalisco, Mexico (W. M. Mann) was taken with Eciton.

The small wings are unusually dark and heavily chitinized, but are evidently very weakly attached to the body as one specimen has lost both wings and two others had only one wing remaining attached when I received them.

Ecitophora costaricensis sp. nov.

♂. Length with abdomen well extruded 1.6 mm.; without tubular apex of abdomen, 1.3 mm. Length of wing 0.30 mm.; of dorsum of thorax 0.24. Front with 14 bristles comprising four strong post-antennal ones of which the upper ones are twice as far apart as the lower, four in the lower frontal row disposed as a pair close to each eye with the outer bristle well above the inner one, six in an upper row close to the vertex with the lateral bristle near the eye margin. Head covered with coarse, well separated hairs, very conspicuous on the sides below the eyes; cheek with a strong downwardly directed bristle. Palpi rather slender, each with six strong bristles. Eye elongate oval, longer than the third antennal joint, but only about two-thirds as wide; ocelli present, well developed. Third joint of antenna subovate, as long as broad; arista distinctly longer than the head-height. Thorax above with eight bristles, one at each anterior angle, one lateral one just behind the middle and four forming a dorsal line behind the middle with its lateral bristle quite close to the one in front of it; in addition there are two shorter bristles near the median line close to the posterior margin which are undoubtedly homologous to the scutellar bristles although there is no trace of a scutellum. Wing narrow, strap-shaped, strongly bent near the middle, its outer edge clothed with fine bristly hairs at the base and small bristles apically, and in addition with a series of five longer bristles each about half as long as the wing. Abdomen with the second tergite chitinized, one-third longer than wide, the base four-fifths as broad as the apex; anterior angles rounded, posterior ones sharply angulate; with the usual hairs and row of minute apical bristles. Third tergite absent; fourth very small, crescentic, with four marginal bristles; fifth a minute band with a circular ring behind enclosing the gland opening, with two minute bristles at tip. Posterior margin of second to fifth segments with a row of minute bristles; sixth segment bristly medially and at tip. Legs rather stout, the hind metatarsi unusually stout.

Type from Hamburg, Farm, Sen Jose, Costa Rica (F. Nevermann) taken with Eciton sp.

This species agrees closely with the previously described species. From *E. parva* Schm. it may be distinguished by the complete absence of the third tergite and longer wing bristles; from *E. bruchi* Schm. by the presence of 14 frontal bristles; from *E. comes* Schm. by the presence of eight dorsal thoracic bristles and a greater number of wing bristles; and from *E. collegiana* Borgm. and *E. æqualis* Borgm. also by the eight thoracic bristles. Heretofore no species of this genus have been reported outside of the South American continent.

Ecituncula Schmitz

Tijdschr. v. Entom., vol. 66, p. LXXIX (1923)
Schmitz, Pub. No. 4, Mus. Nat. Rio de Janeiro, p. 26 (1924).

A species probably referable to this genus was taken by Dr. Mann in the nest of Pheidole in Mexico. It differs greaty from the type and only described species of Ecituncula in having the abdomen beset with a large number of bristly hairs arranged in transverse rows. It differs also in having a lateral pair of well developed frontal bristles in addition to those present in the type species and also has the full number of mesonotal bristles.

There are no wings in either of the two specimens, but as the wings of some of these forms are very readily deciduous, it is impossible to be positive that wings may not have been present. In the species described on an earlier page as *Ecitomyia spinosa* some specimens had lost either one or both wings. As the attachment of the veistigial wing, in this form at least, appears to be very feeble and as microscopical examination does not readily disclose any indication of a rupture of the cuticle, I cannot feel perfectly satisfied on this point.

Ecituncula setosa sp. nov. (Fig. 2).

♀. Length 1.0-1.3 mm., dependent upon the stenogastric or physogastric condition. Head, metathorax and basal abdominal plate dark brownish; antennæ and legs pale testaceous; abdominal membrane pale yellowish white. Head, seen from above, more than twice as wide as long; rounded at the sides and sharply rounded medially in front. Eyes small, about half the diameter of the antenna, with contiguous facets. Four postantennal bristles near the anterior margin of the front, the upper pair farther apart than the lower one; middle frontal row consisting of four long bristles forming a pair rather close to each eye, the inner one of each pair much higher than the lateral one; ocellar row of four, the median ones nearer to each other than to the adjacent lateral one. Ocelli absent. Palpi of the usual form, with about five strong bristles along the margin. Antennæ oval, slightly acute apically, very densely pubescent; arista very short and thick, composed of three very distinct segments. Mesothorax about twice as broad as long, the sides rounded, slightly angulate just in front of the middle; with a large stout bristle close to each lateral angle and a transverse series of six across the middle of the disc. No trace of wings, although there is a small impression at each posterior angle of the mesothorax at the point where strap-shaped wings are attached in forms where these are present. Metathorax forming a narrow band lying in a basal emargination of the abdomen. Abdomen in the fully developed physogastric form ovate, at least twice as broad as the head and thorax, widest near the middle of the second segment; dorsum with only one chitinized plate, that of the second segment and a chitinized ring surrounding the gland opening of the fifth segment; the second plate is about as long as broad at

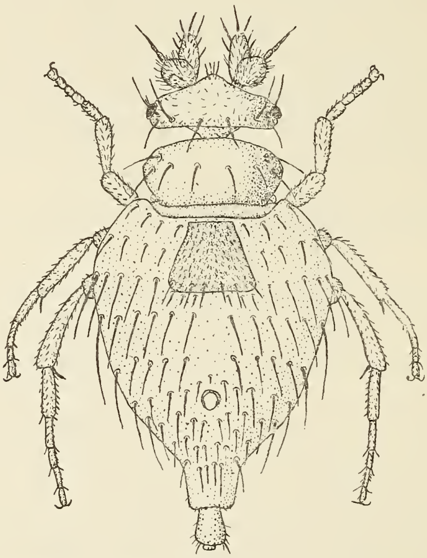

Fig 2. *Ecituncula setosa* sp. nov., female.

apex which is one-half broader than the base. Abdomen very bristly, the bristles arranged in about eight transverse rows very clearly aligned except near the narrow apex of the abdomen; the bristles are longer and stouter at the side of each row and the lateral bristle is in each case much the largest. Legs rather short and stout, with the usual minute bristling.

Type and one paratype from San Diego Cocula, Jalisco, Mexico, with Pheidole sp. (W. M. Mann).

Puliciphora myrmecophila sp. nov. (Fig. 3).

♀. Length 1.0 mm. Head and thorax brownish yellow, darker above; dorsal abdominal plates piceous, the abdominal membrane yellowish white; antennæ, palpi and legs pale brownish yellow. Four strong postantennal bristles, the upper pair nearly twice as far apart as the lower; other frontal bristles very weak except the two in the upper row between the ocelli which are long and stout; the lateral bristle of this row and the one within the eye-margin very small and scarcely differentiated from the frontal hairs which are unusually large. Three stout bristles below each eye above the oral margin. Proboscis stout, oval, nearly as long as the head height. Third joint of antennæ rounded, the arista rather strongly pubescent, one-fourth longer

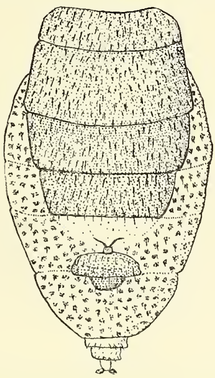

Fig. 3. *Puliciphora myrmecophila*, female, dorsal view of abdomen.

than the head height. Eye as large as the antenna; composed of about twenty-five facets. Thorax slightly wider than long, with a transverse series of six bristles behind, the median pair close to the hind margin and farther apart than their distance from the adjacent ones which are placed farther forward; lateral bristle placed at the posterior third of the mesonotum. Abdomen with six dorsal plates; first unusually long, the lengths of the plates 25:45:29:25:16:8. There is no distinct slit in the fifth segment for the opening of the gland but a transverse crescentic or almost semicircular clear area indicates its position. That this area represents the fifth segment is evident from the furcula (apodeme) of the sixth segment which extends forwards at this point (see fig. 3) although there is no segmentation of the sides of the abdomen to mark off the fifth segment. Sixth and also a small seventh tergite present. Legs rather slender, the four posterior tibiæ each with a single small apical spur; hind metatarsus with six transverse rows of bristles. The abdominal membrane is covered with conspicuous dark chitinized specks, each bearing a minute bristle; these extend also over the entire venter but are absent on the sides except on the last two segments.

Type and one paratype from Ototonilco, Jalisco, Mexico (W. M. Mann), taken in a nest of a species of Pheidole.

The absence of a distinct fifth tergite and the well developed sixth and seventh tergites seem to distinguish this form from any others described although to judge from his figure, it is possible that *P. pusillima* de Meijere may have a similar conformation of the abdominal plates. De Meijere indicates however only five tergites with a space between the fourth and fifth. In my specimens of the present form the apodemes described by Schmitz as arising from the sixth segment are very clearly to be seen arising from the anterior margin of the penultimate tergite. Under a very high power (oil-immersion) it is seen that they are attached to a small median plate more or less separate from the one I have called the sixth, but I think the larger part must be the sixth and not a seventh tergite.

Chonocephalus jamaicensis Brues.

There is a single female of a species of Chonocephalus from Costa Rica bearing the label "with *Coptotermes niger* Snyder (Coll. F. Nevermann). After a very careful examination, I cannot distinguish it from *C. jamaicensis* Brues[1]. In Jamaica, at least, this species is not associated with either ants or termites and such seems usually to be the case with members of this genus although Borgmeier[2] has described *C. ecitophilus* taken with Eciton in Brazil. I am therefore satisfied that the association of the present specimens with termites is accidental.

[1]Psyche, vol. 22, p. 102; 1915.
[2]Deutsch. Ver. Wiss. u. Kunst. São Paulo, Jahrg. 3, p. 145; 1923.

A JAPANESE DOHRNIPHORA BRED FROM DEAD SNAILS (DIPTERA: PHORIDÆ)

By Charles T. Brues.

Bussey Institution, Harvard University.

Several species of the genus Dohrniphora in various parts of the world regularly develop in the bodies of dead insects and molluscs. These forms are apparently never parasitic as their eggs are not deposited until after the death of the host.

In 1914 Schmitz described[1] an African species, *D. bequærti* which was obtained in East Africa by Dr. Joseph Bequaert who found it developing in the body of a decaying snail. Schmitz believes however that the species is probably not restricted to a shell-fish diet as he states later (1919, Biolog. Centralbl., vol. 37, p. 40) that larvæ of the same form have been observed in soured milk.

Prof. T. D. A. Cockerell has just sent me a male and female of a species of Dohrniphora which I cannot distinguish from *D. bequærti* on the basis of Schmitz's description. These are from Hongo, Wakasa, Japan and were bred by Mr. T. Okano from the bodies of dead snails of the genus Euhadra. Whether the Japanese examples are really cospecific with the African form mentioned above is perhaps doubtful, but such species are readily spread by commerce and such a wide distribution would be by no means surprising.

NOTES ON THE ANT FAUNA OF OAK GALLS IN THE WOODS HOLE REGION.

By A. H. Sturtevant.

Columbia University, New York City.

During August and September, 1925, several hundred "oak apples" (galls of *Cynips* (*Amphibolips*) *confluens* Harris or a similar species) were examined from the region near Woods Hole, Massachusetts. These galls were in all cases picked up from the

[1]Jaarb. Natuurh. Genootsch. Limburg, p. 105.

ground under oak trees. Though only a small proportion were inhabited by ants, fourteen colonies of six forms of ants were found, including one that has not hitherto been recorded from New England. There follows a list of the species found.

1. *Myrmica punctiventris* Roger. Woods Hole, five colonies. Workers, queens, males, eggs, larvæ, and pupæ. The four queens found were all dealated; three of these were in one colony, that also contained nineteen males and one male pupa.

Identified by Prof. W. M. Wheeler who has also verified the identification of number 4 below.

2. *Leptothorax curvispinosus* Mayr. Falmouth, one colony. One deälated queen, over 100 workers, numerous eggs and larvæ, a few pupæ.

3. *Leptothorax curvispinosus ambiguus* Emery. Falmouth, one colony. Workers, a few eggs, larvæ, and pupæ. This gall was under the same tree as that containing the colony of the typical form of the species.

4. *Harpagoxenus americanus* Emery. Tarpaulin Cove, Naushon Island, August 30; one colony. One deälated queen, nine workers; 152 workers of *Leptothorax curvispinosus*, several eggs, 21 larvæ, 5 pupæ. The pupæ appear to be Leptothorax, and several of the Leptothorax workers are evidently callows. The species is recorded from the District of Columbia; Beatty, Pennsylvania; Bronxville, New York. *L. curvispinosus* is its usual host (see Wheeler, 1910. Ants, p. 494).

5. *Tapinoma sessile* Say. Cotuit, Pocasset, Falmouth, Naushon Island; five colonies. Workers, deälated queens, eggs, larvæ, pupæ. One of the colonies contained fifteen deälated queens.

6. *Lasius niger*, var. *americanus* Emery. Woods Hole, one colony. Workers, pupæ. A populous colony (104 workers, 12 pupæ), but no eggs, larvæ, or sexual forms were found.

THE RELATIVE IMPORTANCE OF VISION AND THE CHEMICAL SENSE IN ANAX LARVÆ.

CYRIL E. ABBOTT.

University of Wisconsin, Madison, Wis.

General observations and experimental work on the larvæ of *Anax junius* for over a year, seemed to indicate that the responses of these insects are chiefly dependent on the sense of sight. Thus taking of food, in particular, seems to be the result of reactions to form and movement. General observation also indicated that the chemical sense was correspondingly weak. Although the question of image-formation in insects has been treated by Cole (1907), Demoll (1910), Forel (1908), and Seitz (1912); and the chemical sense by numerous authorities, including Forel (1908), Kafka (1918), and Lubbock (1888); apparently no work has been done with dragon-fly larvæ. Accordingly, two experiments were made; one to test the reactions of the larvæ to form, the other to determine whether or not they would react to the chemical emanations from distant objects. Each experiment is a check on the other, and both are related to prehension.

Reaction to Form.

Individual.		Positive responses	Negative responses
1.	Food:	15	0
	Triangle:	4	7
2.	Food:	9	7
	Triangle:	1	12
3.	Food:	11	2
	Triangle:	0	9
4.	Food:	10	0
	Triangle:	4	15
5.	Food:	9	5
	Triangle:	1	11
6.	Food:	8	5
	Triangle:	0	13
7.	Food:	13	2
	Triangle:	0	16
8.	Food:	10	0
	Triangle:	1	15
9.	Food:	9	7
	Triangle:	0	12
10.	Food:	11	4
	Triangle:	0	8

Chemical Sense.

In ten of the twelve tests a broth made from meal-worms was used. In the remaining trials pyridine was substituted for the broth.

Individual	Positive response	Negative response	No response
1.	5	0	6
2.	0	4	8
3.	1	1	10
4.	1	3	8
5.	4	4	4
6.	0	0	12
7.	0	0	12
8.	0	0	12
9.	3	1	8

Discussion.

The larvæ were numbered and a record kept of their behavior. Almost daily, but not always at the same hour, each insect was fed a bit of meal-worm (*Tenebrio molitor*) about three cubic mms. in volume. Every day the insects were stirred with a paper triangle on the end of a needle. The triangle had an area of about one square cm. It was at first presumed, because of the results of experiments indicating that these animals have some degree of memory, that learning would simplify the experiment; but in this case the larvæ gave no evidence of associating either a pleasant sensation with the food or an unpleasant one with the triangles. Probably any tendency to form associations was inhibited by the complexities of the experiment.

The above experiment is open to the objection that some chemical sense may have influenced the behavior of the larvæ. Nine insects were tested by introducing into the water near them a broth made from meal-worms. This was introduced at all possible distances from, and all possible angles to, the insects. Some larvæ moved their mandibles when surrounded by a dense cloud of the suspension; most of them seemed totally unaware of the presence of the liquid. This broth was a visible suspension, which probably accounts for the fact that larvæ 1 and 9 extended their labia when it was introduced. They gave no response when their eyes were covered with asphaltum.

Both normal insects and those with covered eyes gave no response to pyridine. This is interesting, because many aquatic insects have a strong aversion to even a minute quantity of the substance. Psephenus larvæ, whose intense thigmotropism is undisturbed by the presence of formaldehyde or alkalies, will release their hold and make violent efforts to escape the instant pyridine is present in their habitat. Dytiscid larvæ behave in a similar way.

Although Anax larvæ gave no indication of ability to sense the chemical nature of distant objects, it is quite evident that they have a sense of taste. Unpleasant substances are quickly rejected, and the animals move their mandibles for some time subsequently.

Conclusion.

Anax larvæ distinguish small edible objects from larger triangular figures. Thus they distinguish the size, and probably the form, of objects.

The larvæ are incapable of sensing the chemical nature of a distant object. While antennal pits are present, they are few and scattered; experiment indicates that the chemical sense of these animals is located in the mouth.

The perception of form and movement through vision is the chief means utilized by these larvæ for obtaining food.

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Mantispa interrupta and M. brunnea in New England.

In 1913 (Psyche Vol. 20 p. 170) the writer recorded a specimen of *M. interrupta* Say, from Lake Boone, Stowe, Mass. This year the collection of the Boston Society of Natural History has been enriched by two additional specimens. The first was taken by Mr. Henry A. MacDonald at Lake Cochituate, Natick, Mass., July 3, 1925, and the second by Mr. E. J. French, at Nutting's Pond, Billerica, Mass., July 6, 1925. All three specimens were taken on window screens.

In 1913 there was but one specimen of *M. brunnea* Say (Walpole, Mass.) in the Society's collection. Now there are the following additional specimens—Hampton, N. H., June 30, 1918 (S. A. Shaw), Milton, N. H. Aug. 20, 1923 (A. F. Magrew), Centerville, Mass., July 15 (C. J. Maynard) and Canton, Mass. June 25, 1919 (D. H. Linder).

C. W. Johnson

On July 13, 1925 Professor Ulric Dahlgren captured at Salisbury Cove, Mt. Desert, Me. a specimen of the white-banded day-sphinx, *Aellopos titans* Cram. It is considered by some authors to be a variety of *A. tantalus* Linn. This is probably the most northern record for this southern species. There is also in the collection of the Boston Society of Natural History a specimen of this moth, taken at Cohasset, Mass., a number of years ago.

C. W. Johnson.

PROCEEDINGS OF THE CAMBRIDGE ENTOMOLOGICAL CLUB

The annual meeting was held January 13, 1925. The secretary's report showed a slight increase in the attendance at meetings, the average being 15 members and 2.6 guests. Eight members have been elected, one resigned, and two died, leaving a total membership of 78, an increase of 5 over last year. The editor's report showed that volume 31 of Psyche, just completed, contains 325 pages, a substantial increase over the preceding volume. The following officers were elected: President, J. H. Emerton; Vice President, C. W. Johnson; Secretary, J. Bequaert; Treasurer, Fred H. Walker; Editor, C. T. Brues. Executive Committee: W. M. Wheeler, O. E. Plath, S. S. Crossman.

Prof. C. T. Brues, retiring President, read an address on Predatism among Insects.

Mr. S. M. Dohanian told of his experiences in Spain, during his work on the Gipsy Moth and its parasites.

At the meeting of February 10, 1925, the following amendment to the by-laws was adopted: "Any member may become a life member on the payment of fifty dollars in one sum to the treasurer of the Club, and only the income of funds thus received shall be applied to the current funds of the Club.

"Persons having performed signal services for the Club may be elected honorary life members and shall not be subject to dues."

Mr. C. W. Johnson presented some notes from the Washington Meeting of the Entomological Society of America.

Dr. J. Bequaert spoke of Some African Social Wasps and their Parasites.

At the meeting of March 10, 1925, Mr. O. E. Plath read a paper on the Natural Grouping of the Bremidæ (Bombidæ), with special reference to biological criteria.

Dr. J. Bequaert exhibited a collection of wasps of the genus *Ancistrocerus* and commented upon their habits and classification.

At the meeting of April 14, 1925, Mr. J. H. Emerton spoke of the Ornaments of the Male Spiders of the Genus *Pellenes*.

Mr. C. W. Johnson discussed the North American Varieties of *Volucella bombylans* Linn. See vol. 32, No. 2.

Prof. C. T. Brues exhibited a number of American species of *Peripatus*. See vol. 32, No. 3.

At the meeting of May 12, 1925, Mr. H. Morrison read a paper entitled: "Notes upon Scale Insects or Coccidæ."

At the meeting of June 9, 1925, Mr. O. E. Plath presented a paper on the Rôle of Bumblebees in the Pollination of Several Cultivated Plants.

Dr. J. Bequaert spoke of work he had done with Mr. O. E. Plath on the taxonomy of certain North American *Psithyrus*.

Mr. L. W. Swett discussed the characters presented by the male genitalia in the Geometridæ.

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INDEX TO SUBJECTS.

All new genera, new species and new names are printed in Small Capital Letters

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CAMBRIDGE ENTOMOLOGICAL CLUB

A regular meeting of the Club is held on the second Tuesday of each month (July, August and September excepted) at 7.45 p. m. at the Bussey Institution, Forest Hills, Boston. The Bussey Institution is one block from the Forest Hills station of both the elevated street cars and the N. Y., N. H. & H. R. R. Entomologists visiting Boston are cordially invited to attend.

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VOL. XXXIII. FEBRUARY 1926 No. 1

NOTES ON THE ODORS OF SOME NEW ENGLAND BUTTERFLIES.

AUSTIN H. CLARK.

Smithsonian Institution, Washington, D. C.

Considering the strength of the odors exhaled by one or both sexes of many of our common butterflies it is quite extraordinary that they have received so little attention.

The following notes were made chiefly at Manchester and Essex, Massachusetts. It is quite possible that in certain species there will be found to be a geographical variation in the strength or type of the odor which may or may not be correlated with variation in color or in other characters. It is also quite possible that further investigation will show in certain types more or less dimorphism in the odors such as has been reported in the southern *Papilio polydamus*.

The noses of my two young sons being much more acute than mine, their assistance in experimenting with some scores of captured butterflies was of the greatest value; in fact some of the odors readily detected by both of them I was unable to perceive at all. Ordinarily the testing of butterflies for odors is an interesting and pleasant task; but one must always be prepared for most unwelcome surprises as in the case of the females of the fritillaries.

Close observation of the courting of the argynnids and of *Eurymus philodice* has led me to believe that the male odors are sexual stimulants pure and simple, while the female odors, always disagreeable in varying degrees and sometimes nauseating, are protective.

Speyeria idalia (Drury).—The odor of the male is uniformly strong and resembles that of the males of *Argynnis cybele* and *A. aphrodite*, but is sweeter and more flowery. Mr. Scudder compared it to musk, but it is to me more flowery than musk.

Argynnis cybele (Fabricius).—The males have a faint to strong spicy odor resembling sweet flag or sandal-wood which can always be detected and is sometimes strong enough to be evident when the insect is fluttering in the net. It is strong in one individual out of every four or five and is often exceptionally strong in very worn examples. Very fresh insects appear always to be nearly, sometimes indeed quite, odorless. It appears to take some time after the wings are fully formed and functional for the odoriferous secretion to become diffused sufficiently to give the characteristic fragrance.

Mr. Scudder specifically stated that both this species and the following are scentless. It is probable that he examined only individuals too recently emerged for the scent to have become effectively distributed.

In the females the wings are odorless, but the pair of short blunt stout soft orange appendages which on pressing the abdomen are extruded from between the last two segments dorsally gives off a powerful nauseating odor recalling that of the osmateria of the caterpillars of *Papilio polyxenes*.

The females of our fritillaries are larger and more conspicuous than the males and at the same time less shy with a less swift and less erratic flight. They also appear to be much longer lived, for by the end of August all the still fairly numerous individuals remaining are females busily engaged in searching out their food plants and seldom seen on flowers. It is a reasonable inference that in these butterflies both sexes are protected to an appreciable extent by the formidable abdominal glands of the females.

Argynnis aphrodite (Fabricius).—The odors of both sexes of this butterfly as found in this region exactly resemble those of the corresponding sexes of *A. cybele*.

Brenthis montinus Scudder.—Professor John H. Gerould writes me that he has noticed an odor in this species similar to that in the two preceding. I have made no personal observations on it.

Brenthis myrina (Cramer).—No odor was detected in either sex; but the females have the same odoriferous organs as are found in the females of related types which undoubtedly are the same in function.

Junonia cœnia Hübner.—In the large and handsome dark variety with the under surface of the wings dull pinkish red which is the commonest about Washington in the fields where the food plant (*Agalinis purpurea*) is abundant the males have a rather strong sweet odor which is sometimes evanescent. This variety has curiously soft wings and always feels as if recently emerged. It is sluggish, and rarely flies for more than fifty feet or so.

The variety occurring in New England is much smaller, distinctly brown above and buffy gray below. The wings are hard and brittle and most individuals caught are damaged in contrast to the other form in which broken specimens are relatively rare. It is exceedingly alert and active, a much stronger flier than the other, less easily visible on the wing and much more difficult to catch. Specimens from Washington are indistinguishable from those from Massachusetts. The males, so far as I can find, are scentless; at any rate the odor is much less pronounced than in the other type.

About Washington the small light active form is found sparingly with the other, from which it differs in keeping mostly well above the ground resting on the tops of the higher plants and quickly darting off on the slightest provocation. It is much more frequently to be seen on barren hillsides, about the city parks and streets, and generally in unfavorable localities where the other is not found.

One might reasonably infer that this well marked variety is a special form particularly fitted for long continued flight and therefore especially adapted for distributing the species.

Vanessa cardui in New England also appears to have a special form distinctively colored on the under side with corresponding habits. This form flies in a straight line usually from ten to fifteen feet above the ground keeping on till it is out of sight in contrast to the usual type which in its habits is much like *V. huntera.*

In *Feniseca tarquinius* it would seem that certain individuals are specialized as migrants. These fly slowly in a straight line across the fields usually a foot or so above the grass tops for long distances; in fact I have never seen them rest. Typically this insect's flight is most erratic suggesting a small and very active satyrid, with frequent rests.

Basilarchia archippus (Cramer).—Both the boys reported in this species a pronounced and disagreeable odor which the younger compared with that of *Anosia plexippus* females. It is not a little curious that this butterfly should both look and smell like this larger form. But the flight of the two is different and one can easily tell them on the wing at any distance.

Anosia plexippus (Linné).—The females have a rather strong and disagreeable odor resembling that of cockroaches or of carrots. The males have the same odor, but in them it is very faint and is overlaid with a faint very sweet odor like that of milkweed or red clover flowers.

Eurymus philodice (Godart).—The males have a distinct and uniformly strong odor resembling that of sweet grass or sweet hay. The females seem to be odorless.

Eurema euterpe (Ménétries).—The males, in spite of their diminutive size, have a pronounced fragrance similar to that of the males of the preceding species but sweeter and more flowery.

Papilio polyxenes Linné.—The males have a faint sweet odor resembling that of carrot flowers which is very pleasant. Apparently an identical odor is found in the males of the European *P. machaon.*

Two males examined in Washington had a strong sweet flowery odor of the same type.

Papilio glaucus Linné.—The males all have a sweet flowery odor varying from faint to fairly strong which resembles that of the males of *P. troilus* though it is never so pronounced. The females have a disagreeable odor pungent in quality resembling rubber cement or creosote which is very strong in some and apparently stronger in the females taken about Washington than in those taken in New England. The same odor can sometimes be detected in the males, though very faintly.

Papilio troilus Linné.—The males have a distinct and rather strong sweetish odor difficult to describe but exactly resembling that of Nabisco or Huntley and Palmer's honey biscuits.

Laërtias philenor (Linné).—From observations made in Washington it was found that the males have a sweet flowery odor similar to that of the males of *Papilio polyxenes* though not so strong. The females have a strong pungent and disagreeable odor.

Mr. W. H. Edwards reported a disagreeable odor in this species but did not give the sex of the individual examined. Mr. Scudder very carefully investigated a specimen fresh from the chrysalis and found no odor. Mr. Edward's example undoubtedly was a female. Mr. Scudder's, which was a male, was probably too fresh for the odor to have become detectable.

THE STRANGE WAY IN WHICH THE VISHNU-MOTH (*TRABALA VISHNU*) DEPOSITS HER EGGS IN THE SHAPE OF LARVÆ.[1]

By Eric Mjöberg.

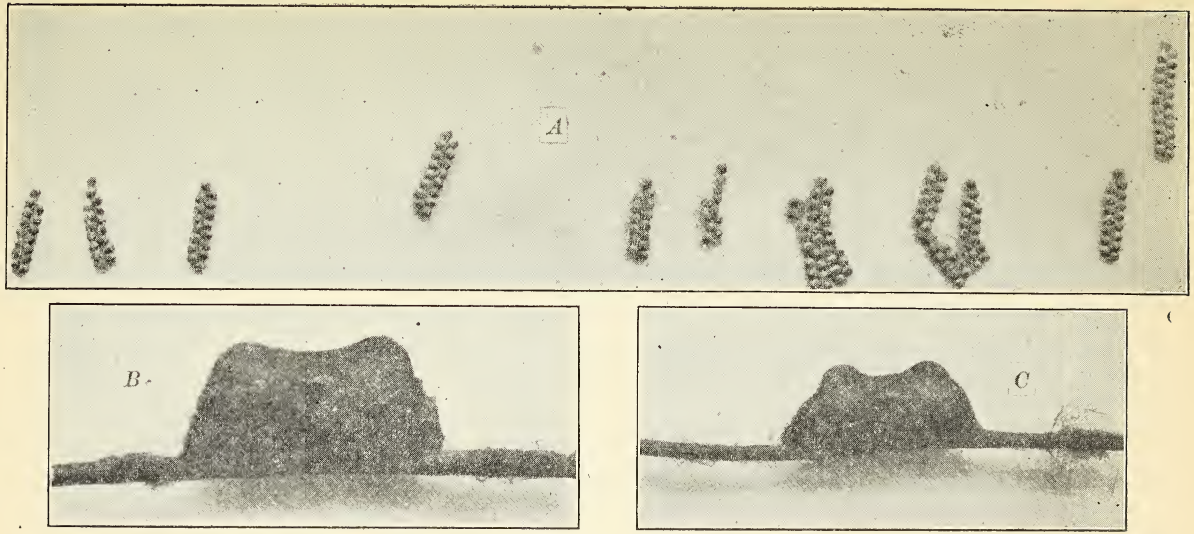
In the small residential town of Kuching, Borneo, an invasion of voracious caterpillars in the garden and house of one of the residents was reported to me in October 1924. Certain plants were entirely defoliated and a large number of large hairy caterpillars of the usual Lasiocampid type were seen crawling about everywhere, even entering the rooms of the house and causing much inconvenience and annoyance. Obviously a mass propagation due to favorable circumstances had taken place. Ordinarily *Trabala vishnu* is a moth of rare occurrence; even in the rich collections of the Sarawak Museum only some few specimens were to be found.

As the larva has already been described and figured, I shall not consider it in the present note.

A fertilized female was temporarily placed by me in an empty paper box and left over night. On opening the box on the following day I was very much surprised to see beside the moth, a considerable number of larvæ on the sides. I thought it very strange to begin with, but a somewhat closer examination soon revealed the fact that what I had taken for larvæ consisted of eggs laid in two parallel rows with an odd egg at the top. Furthermore, the mother had arranged it so that a darkly pigmented spot on each egg was always directed outwards with the effect that two dark longitudinal lines were formed, reminding one of the condition so often found in caterpillars. When I add that the mother had covered the egg strings with hairs from her own body, it is easy to understand that these completely conveyed the impression of being small hairy caterpillars.

On plate 1, A, a photograph of the eggs found in the box is reproduced. There are altogether 13 string, 8 laid separately and 5 more or less joined together. In nearly every string an

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 258.



MJÖBERG—OVIPOSITION OF VISHNU MOTH

A. Eggs of the Vishnu Moth (*Trabala vishnu*) laid in two parallel rows with one odd egg at the top, and covered with hairs by the mother, thus giving a complete impression of being hairy larvae. B. Cocoon of male. C. Cocoon of female.

odd egg is found at the top, representing a head. All are equally covered with short hairs and on every string there are two longitudinal rows of dark spots along the outer margin.

That the mother really has displayed a tendency to imitate the head of a caterpillar by placing one single egg on the top seems to be evidenced not only by the fact that in all strings there is an odd top egg but also that in strings no. 2, 5, 6, 7 and 10 (from left) there are two top eggs, one on top of the other one, whereas at the lower end of each string there seems to be no marked tendency to place an odd egg (except no. 3).

The longest egg string is no. 13 with 22 eggs. It is a strange fact that most of the other strings show two parallel rows of 7 eggs in each with 1-2 single top eggs.

In order to find out whether this peculiar way of depositing the eggs in the shape of larvæ was only a queer habit in this individual case or really a specific habit, I isolated six more fertilized females and awaited the result. In all cases the females laid their eggs in exactly the same way. Two of the females under observation were kept in very large cases, but the eggs were found to be laid in a strikingly singular way. One or two top eggs were always to be seen and the same arrangement with the dark spots forming two longitudinal lines was also observed.

We may therefore safely conclude that this peculiar way of depositing the eggs in larva-like shape is a characteristic of *Trabala vishnu.*

The advantage of this form of "mimicry," if we may use this term, is obvious. It is a well-known fact that hairy caterpillars are distasteful and discarded by most birds, the insects' greatest enemies. Only the cuckoos seem to form an exception to the rule. Undoubtedly the eggs laid in this way are better protected than if laid separately or in disorderly heaps as is the case with most Lasiocampids, and it seems to be fairly clear that the mother in this case by making the unprotected earliest state of the development so strangely similar to hairy distasteful larvæ, has solved the problem of protecting her offspring *ab ovo* in a more effective way.

DEATH FEIGNING IN *ANAX JUNIUS* AND AESCHNA SP.

By C. E. Abbott,
Elgin, Illinois.

In reviewing the literature on death feigning of insects, I was unable to find anything relating to this peculiar behavior in dragon-fly larvæ. The Severins have worked with two species of water-bugs, but this, and the work of Holmes on another aquatic Hemipteron, Ranatra, are the only references available on this phenomenon in aquatic insects. The theory of Holmes concerning the death feigning of insects is an interesting one. He regards it as an overdeveloped thigmotaxis.

The idea of working with Anax and Aeschna readily suggested itself because of the ease with which these insects were obtained and the fact that work was being done with them in quite another group of experiments. It was observed that, when the animals were taken from the water and placed on a solid object, they remained motionless, with the cloacal valves closed, and their legs pressed closely against their sides. To put the

INDIVIDUAL TESTS

Individuals

Trials	I	II	III	IV	V	VI	VII
1.	1 min. 30 sec.	1 min. 45 sec.	no response	2 min. 30 sec.	9 min.	14 min. 30 sec.	17 min.
2.	30 sec.	1 min. 45 sec.	2 min. 45 sec.	4 min. 30 sec.	5 min. 30 sec.	18 min.	9 min. 45 sec.
3.	18 min.	5 min.	5 min.	2 min. 15 sec.	10 min. 45 sec.	7 min. 30 sec.	22 min.
4.	7 min. 45 sec.	13 min. 30 sec.	3 min. 30 sec.	1 min.	4 min.	13 min. 30 sec.	2 min.
5.	2 min.	11 min.	5 min.	2 min.	1 min. 30 sec.	2 min.	3 min.
6.	9 min.	3 min. 30 sec.	12 min. 45 sec.	1 min. 30 sec.	6 min. 10 sec.	3 min.	

Duration of Successive Feints

Individuals

Trials	A	B	C
1.	2 min. 30 sec.	7 min.	12 in.
2.	1 “	6 “ 30 sec.	11 “
3.	30 “	4 “	1 “
4.	30 “	3 “	2 “ 30 sec.
5.	35 “	3 “	
6.		1 “	
7.		15 “	
1.	5 min. 30 sec.	5 min. 30 sec.	9 min. 30 sec.
2.	3 “	1 “ 30 “	4 “
3.	1 “ 30 “	3 “	13 “
4.	30 “	1 “	4 “
5.		45 “	4 “
6.		5 “	2 “
7.		3 “	1 “
8.		2 “	
9.		2 “	
10.		1 “	
1.	2 min.	6 “	6 min. 30 sec.
2.	1 “	2 “	3 “
3.	1 “	1 “	3 “
4.	30 sec.	1 “	1 “
5.	45 “	45 sec.	1 “
6.	45 “		30 “
7.	15 “		1 “
8.	45 “		
9.	45 “		
10.	45 “		

animal back into this condition, it was only necessary to gently stroke its sides. In experimenting, the larvæ were placed on wet sand. One group of tests was made simply to determine the length of individual feints, and another set was made to discover the duration of successive feints.

It thus appears that the duration of individual feints varies a great deal, and that the duration of feints in rapid succession tends to decrease. This is in accord with what is known of the phenomenon in other insects.

I wish to take this opportunity of thanking Dr. W. S. Marshall of the Zoology department for his co-operation and suggestions in this and other experimental work.

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SOME NOTONECTA FROM SOUTH AMERICA

By H. B. Hungerford,

University of Kansas, Lawrence, Kansas.

The lack of precise external structural characters in the Genus Notonecta has led to almost hopeless confusion of the South American species. Fieber, unable to limit the range of variation within a species proposed many varietal names. Kirkaldy[2] in his "Revision of the Genus Notonecta" disposed of a number of specific names by sinking them into synonomy This procedure has given a false impression of the relation of North and South American Notonecta. Kirkaldy, for illustration, considered the range of the most common North American *Notonecta undulata* Say to include Chile, South America. This was possible because he thought *N. virescens* Blanch. was only a variety of *N. undulata* Say. An examination of the genital capsules of the males will show plainly that they are distinct species. Other features less demonstrable but constant separate these species. *N. virescens* Blanchard is a good species.

Prior to Fieber's Rhynchotographieen Guérin[3] 1844 described *N. bifasciata* from "les bords de la Platta." Then the same year that Fieber's paper appeared (1852) Blanchard's *N. virescens* was described. It appears that this species from Chile was unknown to Fieber. Fieber in his 1852 paper first describes *N. nigra*, a large and readily recognized species, the types of which are still in Vienna. Under *Notonecta rugosa* (=*N. insulata* Kirby) after naming three varieties from Long Island, Baltimore and Pennsylvania, he adds the variety *basalis* from Brazil. Under *N. Variabilis* he describes 4 varieties, the first one from Brazil and Porto Rico, the second from Baltimore, and the third and fourth from Brazil. I have not seen specimens of the

[1]Fieber, Franz Xavier: Rhynchotographieen-Prag (From Acten der Königl. Gesellschaft der Wissenschaften, Vol. V, Pt. 7.)

[2]Kirdaldy, G. W.: Revision of the Notonectidae Part I. Introduction and Systematic Revision of the Genus Notonecta. Trans. Ento. Society of London. 1897.

[3]Guérin-Méneville, Félix Edouard: Iconographie du Règne Animal de G. Cuvier.. ..Paris-1829-1844.

common United States species which we call *N. variabilis* from Brazil and am inclined to believe that it does not exist there. If the first named variety of Fieber's *N. variabilis* is to be taken as the type, I should be inclined to the opinion that the name *maculata* which Fieber gave to his variety from Baltimore should be used as Fieber's name for our North American species. His description fits our insect very well. The size is too small to be applied to our common *N. undulata* Say which Fieber appears to have known only from the literature describing this insect under other names. It happens, however, that the name *N maculata* was employed previously by Fabricius. I suggest the name *Notonecta lunata* for the North American species which we have hitherto called *N. variabilis.* A figure of the male genital capsule is shown on Plate XXXI, Fig. 11 of Kansas University Science Bulletin No. XI.

Under *N. polystolisma* Fieber describes 5 varieties, four of them from Brazil and probably various color phases in the development of the color pattern of one species. One variety which he called *sellata* came from Buenos Aires and is most certainly *N. bifasciata* Guérin. Kirkaldy and Bueno call *N. polystolisma* Fieber a synonym of *N. bifasciata* Guérin.

There have come to my hand for determination several small species of Notonecta from South America. No one seems to have given these insects the close scrutiny necessary to separate the species. As will be seen by the drawings submitted, there are distinct structural characters. There are also characteristic color patterns, but much confusion can arise because of the teneral specimens taken in various stages of pigmentation. It also happens that in some of these species there are two color phases—the pale immaculate forms as well as the nearly black forms, a condition similar to that of the well known *Notonecta shooteri* Uhler.

Notonecta bicirca sp. nov.

Size: Length, 9 mm.; width, 3 mm. Some are a little larger and some a little smaller than the measurements given.

Color: General view shows head, prothorax and legs yellowish. Scutellum and two circles on hemelytra black. Closer inspection reveals posterior half of pronotum darkened by black thorax beneath, an elongate yellow spot on lateral margins of scutellum. Hemelytra yellowish-white covered with silvery hairs and with the following typical maculations: Submarginal band of black on base of corium; distal end of clavus black; base of corium; distal end of clavus black; broad transverse black band traversing distal third of corium and base of membrane and embracing a small orange-yellow spot at end of embolium and entirely surrounding a much larger nearly circular spot above. The general effect produced is that of two black circles surrounding orange-yellow spots upon the insects, the lateral orange yellow spots upon the margins of the wings and opening upon the embolial sutures being unnoticed.

Structural characteristics: The eyes farther apart at synthlipsis than in others of this group of species. Vertex: synthlipsis : : 10 : 4. Anterior width of pronotum : posterior width of pronotum : : 23 : 33. The genital capsule of the male is shown on Plate II, Figure 1.

Described from 50 specimens from Chile. Taken by Doctor Alfredo Faz. 15 of them from Santiago and the others from Termas Cauquenes. Holotype, allotype and some paratypes in author's collection. Others in United States National Museum.

Notonecta disturbata sp. nov.

Size: Length, 8 mm.; width, 2.9 mm.

Color: Of two color phases. One yellowish-white throughout. The other with yellowish-white head, anterior half of pronotum and legs; basal half of hemelytra and tip of membrane white; scutellum and remainder of hemelytra black.

Structure: The eyes fairly close at synthlipsis. Vertex: synthlipsis : : 10 : 2.3. The width of the eye at base less than width of vertex. Sides of pronotum convergent. Anterior width of pronotum: posterior width of pronotum : : 19 : 29. The genital capsule of the male is shown Plate II, Figure 2.

Described from specimen belonging to São Paulo Museum, Brazil.

Notonecta minuta sp. nov.

Size: Length, 7.2 mm.; width, 2 mm.

Color: General view shows head, pronotum, legs and basal third of hemelytra yellow. Scutellum and distal two-thirds of hemelytra black with tips of membrane yellowish. Upon closer study there are seen to be enclosed in the broad black area across the hemelytra four small irregular orange yellow spots of nearly equal size. On one of the three specimens there are ill defined yellowish spots near the base and at the tip of the scutellum.

Structural characteristics: Vertex : synthlipsis : : 9 : 2.1. The width of eye at base equal to the width of vertex. Interior width of pronotum : posterior width of pronotum : : 19 : 26. The genital capsule of the male is shown on Plate II, Figure 7.

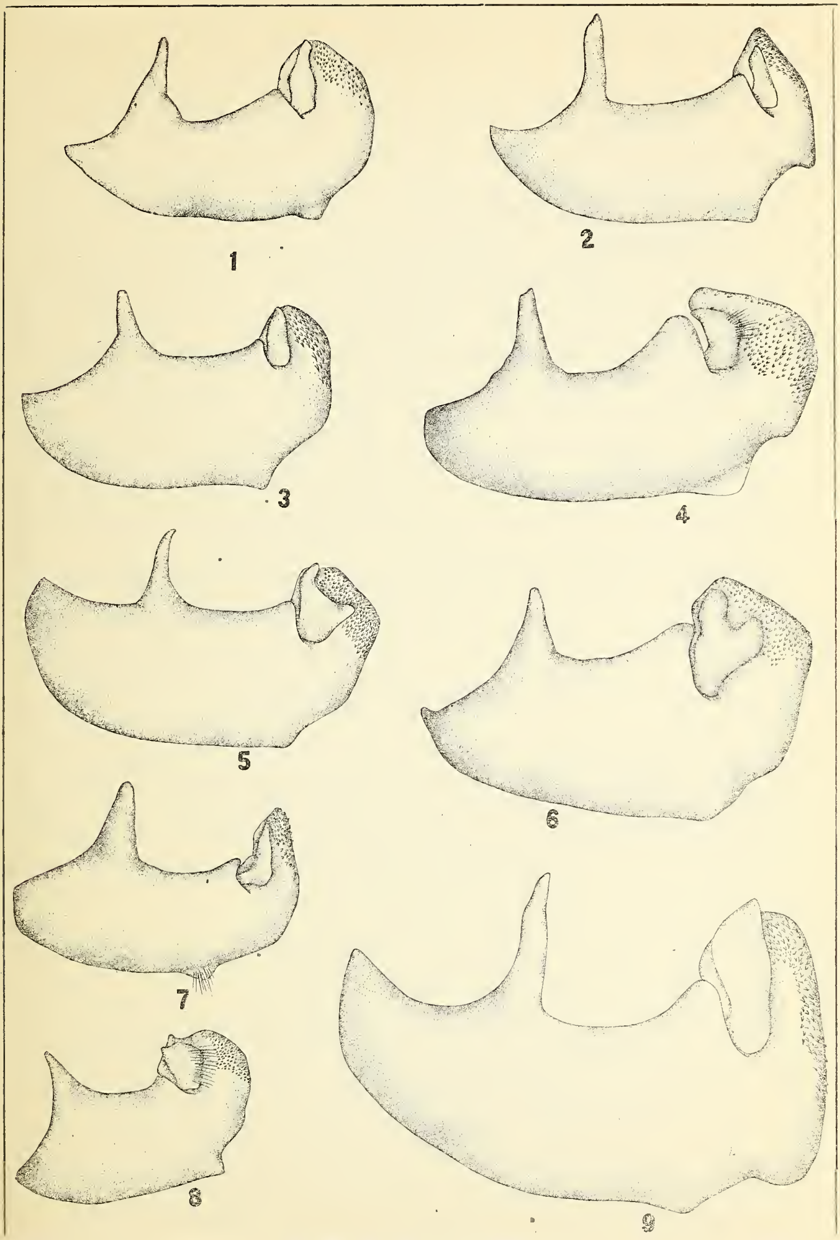
Described from specimens in the Carnegie Museum bearing the label, "Prov. del Sara, Bolivia, 450 m. J. Steinbach."

Notonecta pulchra sp. nov.

Size: Length, 8 mm.; width, 3-mm.

Color: Head, anterior half of pronotum, and legs yellow. Scutellum and hemelytra black save two pale spots at base of wings and an orange, irregular, transverse band at end of corium. Silvery hairs on hemelytra. A beautiful and striking species.

Structural characteristics: Vertex : synthlipsis : : 11 : 3. The vertex being broader than the width of eye at its base. The anterior width of pronotum : posterior width of pronotum : : 22 : 32. The genital capsule of male is shown on Plate II, Figure 3. Villa Rica by Mr. F. Schade. Holotype, allotype and many paratypes in author's collection. Paratypes also placed in United States National Museum.



HUNGERFORD—NOTONECTA

Notonecta polystolisma Fieb. var. **spatulata** var. nov.

Fieber described five varieties under this species, one of which is quite certainly *N. bifasciata*. The other four are from Brazil and appear to be stages of pigmentation of a single species. Three of them he describes as having the "Schild gelblich." The species which I have may be related to them, but since it does not fit any of his descriptions it seems best to give it at least a varietal name. In the twenty specimens I have before me the scutellum is typically black and none of them surpass 4 lines in length. The vertex : synthlipsis : : 10 : 3. The anterior width of pronotum : posterior width of pronotum : : 23 : 35. The genital capsule of male is shown on Plate II, Figure 9. Described from 20 specimens from São Paulo, Brazil. Holotype, allotype and some paratypes taken at Ypirango, S. A. by R. Spitz. Others from São Paulo, Brazil, by unknown collector. Holotype, allotype, and some paratypes in author's collection. Others in the Museum of São Paulo.

Notonecta bifasciata Guér.

I have this species from Paraguay and various places in Argentina. The genital claspers in the male are quite different from any of the other species of this size (see Plate II, Figure 5.) It appears to be a common and abundant species.

Description of Plate II.

Notonecta bicirca sp. nov. Chile. Figure 1.
Notonecta disturbata sp. nov. Brazil. Figure 2.
Notonecta pulchra sp. nov. Paraguay. Figure 3.
Notonecta bifasciata Guér. Argentina. Figure 5.
Notonecta minuta sp. nov. Bolivia. Figure 7.
Notonecta polystolisma Fieb. var. *spatulata* var. nov. Figure 9,

Figures 4, 6 and 8 are of previously named species but not of this series.

A NEW FOSSIL MOTH FROM FLORISSANT.

By T. D. A. Cockerell,

University of Colorado, Boulder, Colo.

Many years ago, a fossil insect, supposed at the time to belong to Trichoptera, was found by Mr. Geo. N. Rohwer at Station 14 in the Miocene Shales of Florissant, Colorado. By some oversight, it had not been studied until yesterday, when I took it out to show to some students as an example of a fossil caddis-fly. A little examination revealed unexpected characters, and upon close study it was found that we had no caddis, but a moth. With the higher power of the binocular it was easy to see the scales, which thickly covered the anterior wings. On one side the wings are spread, so that their outline can be clearly seen; but I cannot make out the venation of the hind wings, nor that of the anal area of the anterior pair. It is also difficult to see exactly the condition at the apex of the cellula intrusa, but I believe I have drawn it correctly, in which case it presents no unique features. The genus may be definitely referred to the Cossidæ, and the general aspect is not unlike that of species of *Zeuzera*, *Givira* or *Comadia*. The abdomen, which I have drawn thick and short, is evidently lacking the apical part, and it may well have been long as in most existing Cossidæ.

Adelopsyche new genus

Rather small, thick bodied moths, the anterior wings long, with subparallel margins, broadly rounded at apex, heavily scaled, without spots or bands, but probably finely speckled. Scales fairly broad, suboval or more elongate, apically bidentate. Veins strong, basally stout; R_1, leaving common stem about as far from radial cell as length of that cell; radial cell small, cuneiform, emitting the quite simple R_2 and R_3; from the end of the cell (in the sense of lepidopterists,) and above the median cell or cellula intrusa, arise R_4, R_5 and M_1, the first two (which are simple to the end) well apart, but R_5 and M_1 from a common point; median cell short, its lower apical corner emitting M_2; M_3, Cu_{1A} and Cu_{1B} (in sense of Tillyard) coming off as in related genera, Cu_{1A} distinctly nearer to M_3 than to Cu_{1B}.

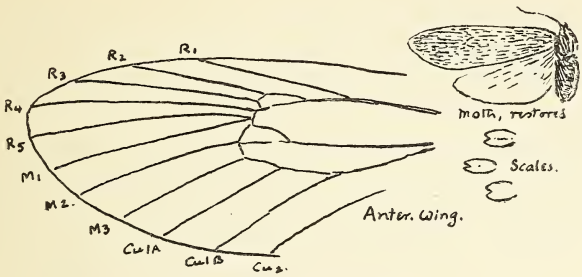


FIG. 1. ADELOPSYCHE FRUSTRANS SP. NOV.

Adelopsyche frustrans new species.

Anterior wing 15 mm. long and 4.5 broad, probably brown or dark gray in life; hind wing about 9.7 mm. long; width of thorax and abdomen, which are dark, nearly 4 mm.; legs not very robust.

In having the veins R_2, R_3, R_4 and R_5 all arising separately, this differs from the American genera (which are well figured by Barnes and McDunnough) and resembles the Australian genus *Macrocyttara* Turner (Trans. Ent. Soc. London, 1918, p. 169). It differs at once from *Macrocyttara* in having R_1 arising before the radial cell (as in *Givira* and other genera), and R_4 and R_5 arising below it. The separate origin of R_1 is considered by Jefferis Turner to be more primitive than the condition in *Macrocyttara.* Outside of *Macroscyttara,* the nearest allies of our fossil are *Cossodes* (Australia) and *Dudgeona* (Australia, India, Africa); these however are very distinct. The fossil genus *Gurnetia* (Cockerell. Ann. Mag. N. Hist. June 1921, p. 472), from the Isle of Wight, agrees in having the branches of the radius separate, while R_5 and M_1 come from beneath the radial cell. Cu_1 and Cu_2 of my figure of *Gurnetia* are Cu_{1A} and Cu_{1B} of Tillyard.

NOTE ON THE HYMENOPTEROUS FAMILY RHOPALOSOMATIDÆ.[1]

By Charles T. Brues.

During the course of a study of African Braconidæ, I find in a collection sent by E. C. Chubb, Director of the Durban Museum, a specimen of the Rhopalosomatid genus Paniscomima Enderlein.

A comparison of this species which proves to be the type of the genus, *P. erlangiana,* with the American Rhopalosoma enables me to indicate the relation between these two genera and to Morley's *Rhopalosoma abnorme* from India which very evidently represents another genus. It thus appears that this aberrant family includes three genera, each characteristic of a different zoological region, one from America, another from Africa and a third from India.

Paniscomima erlangeriana Enderlein

Zool. Anz., vol. 27, p. 465 (1904)

There is a single male from Widenham, Natal, December 14, 1914 (A. L. Bevis)

Enderlein based his genus Paniscomima on a single female from Somaliland and all of the characters which he gives to separate it from Rhopalosoma are not valid since he was obliged to rely on Westwood's description and figures. I find on a careful comparison of the present African specimen with specimens of *Rhopalosoma pœyi* Cress, collected in Haiti by Dr. Wm. M. Mann that several of Enderlein's differential characters (*loc. cit.*) do not really exist since the labial palpi, parapsidal furrows, tibial spurs and obsolete second recurrent nervure are essentially similar in the two. However as set forth in the following key, there are several differences which seem to be of sufficient weight to retain Paniscomima.

A comparison of Morley's description of the Indian *Rhopalosoma abnorme* (Trans. London Entom. Soc. 1910, p. 386) shows that it is undoubtedly entitled to generic rank. The strongly

[1]Contribution from the Entomological Laboratory of the Bussey Institution Harvard University, No. 256.

antefurcal nervulus is a very unusual character (shown clearly in Morley's figure also) and the absence of the strigil on the hind legs of the male is peculiar to the Indian form. The abdomen is described as subsessile with the first segment only twice (♂) or three times ♀; as long as broad at apex, a condition quite different from that in the American or African forms. In the latter character, however, the description and figure do not agree, but as the petiole is very carefully described, it seems probable that the figure is somewhat out of proportion. Morley overlooked *Paniscomima* and hence makes no comparison between it and his own species. These two are more closely similar in possessing simple claws, but the form of the abdomen, strigil and venation serve easily to distinguish them.

As stated elsewhere (Psyche, vol. 29, p. 107, 1922) I am unable to agree with Turner and Waterston who have placed Olixon Cameron in the Rhopalosomatidæ.

Key to the Genera of Rhopalosomatidæ.

1. Abdomen subsessile, the first segment two or three times as long as broad at apex; tarsal claws of female simple, not toothed beneath; spurs of hind tibiæ of male of equal length, their tarsi without strigil; nervulus strongly antefurcal. Type: *Rhopalosoma abnorme* Cameron
Hymenochimæra gen. nov.
Abdomen petiolate, the first segment four to six times as long as broad at apex; inner spur of hind tibiæ of female much longer than the outer, their tarsi with a well developed strigil; nervulus strongly postfurcal. . . . . .2.
2. Nervulus oblique, nearer to the basal vein than to the upper angle of the second discoidal cell; radial cell in hind wing truncate at base, the first section of the radiu sperpendicular to the costa . . . . *Paniscomima* Enderlein
Nervulus not nearer to the basal vein than to the upper angle of the second discoidal cell; radial cell in hind wing obliquely rounded at base, the first section of the radius curved below toward the apex of the wing
Rhopalosoma Cresson

THE DISTRIBUTION OF *MUSCINA PASCUORUM* MEIGEN IN AMERICA.

By Charles W. Johnson,

Boston Society of Natural History.

The last report on the distribution of this fly in North America was for 1923 (Psyche, vol. 31, p. 17, Feb. 1924).

During 1924 the fly was apparently quite scarce in the vicinity of Boston and no additional records bearing on its distribution were received. Mr. R. C. Shannon however reported one specimen (♀) from Plummers Island, Md., Nov. 11, 1923 (Ent. News, vol. 35, p. 104, March 1924) and common in cupolas (all females) at South Poland, Maine, May 1924 (Proc. Ent. Soc. Wash., vol. 26, p. 146, May 1924).

During the fall of 1925 after the rains in September it again appeared in eastern Massachusetts and I began to receive reports of its entering houses in considerable numbers. During the first week in October a few appeared each day on the windows at the museum and at my home in Brookline. Mr. N. P. Woodward sent me specimens from Worcester, Mr. D. S. Lacroix reported it common at the State Cranberry Station, East Wareham. Mrs. Hathaway sent me specimens on October 10 from East Bridgewater. Dr. Francis Harper collected a number at Natick, October 16. Mr. W. L. Maxcy sent me a number from Still River, October 20 and Mr. F. W. Walker found it common in a cottage at Middleton, Nov. 15. My friend, the late Lewis B. Woodruff wrote me Oct. 19 that it was plentiful on his windows at Litchfield, Conn. Mr. N. K. Bigelow informs me that it is now common in parts of Ontario and sent me specimens collected at Port Hope, Sept. 5, 1925.

Dr. A. H. Sturtevant in a letter dated October 17, 1925 says— "I have just noticed that your friend *Muscina pascuorum* is now common on the windows here. I have never seen it in New York [City] before, but cannot guarantee that it has not been fairly common before since I do not check up carefully on Calypteræ."

Later he writes—"I found *Muscina pascuorum* in an attic at Morristown, N. J., Oct. 19, 1925, I have seen no males, but two females from New York and one from Morristown, that I dissected, all had active sperm in their receptacles. Evidently the females mate before they come indoors to hibernate."

The distribution of this species is probably much greater than has been recorded. It is readily overlooked as many of the species of Muscidæ are similar in appearance and have the same habit of entering houses as the weather becomes cool in the fall. Its life history in America is still unknown.

RECENT WORK BY GABRITSCHEVSKY ON THE INHERITANCE OF COLOR VARIETIES IN *VOLUCELLA BOMBYLANS*.[1]

By Clyde E. Keeler.

The large syrphid flies of the genus *Volucella* have long been in taxonomic confusion due to their great variation in Color. In Europe there are several forms which closely resemble certain species of bumble-bees and as the flies are parasitic in the nests of these bees, the color varieties have taken on considerable significance on account of their apparent mimetic resemblance to the specific bees on which they are parasitic.

Recently Gabritschevsky[2] has reported on a number of crosses between three varieties and has shown that they bear a Mendelian relation to one another something like that found by De Meijere[3] to exist between the forms of polymorphic *Papilio memnon* in Java.

While I do not share the belief that a Mendelian analysis eliminates the problems of mimicry and protective resemblance, by causing them to disappear, I do maintain that proof of such an hereditary status sheds much light in the proper direction of a solution and suggests a possible mode of attack upon allied problems in these fields.

As early as 1901 a mating pair of *Volucella bombylans* var. *bombylans* and *Volucella bombylans* var. *plumata* was reported by Verrall.[4] It is quite probable that there is free interbreeding between these as well as other color varieties of this species.

Gabritschevsky has worked with a very difficult material and has obtained results of great merit. However, he has hardly

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, no. 259.

[2]Gabritschevsky, E. Farbenpolymorphismus und Vererbung mimetischer Varietaten der Fliege *Volucella bombylans* und auderer "hummelahnlicher" Zweiflügler. Zeitschr. f. indukt. Abstamm. u. Vererbungslehre, Vo. 32, 1924, pp. 321-353.

[3]Meijere, J. C. H. de, Uber Jacobsons Züchtungsversuche bezüglich des Polymorphismus von *Papilio memnon* L. ♀ und über die Vererbung sekundarer Geschlechtsmerkmale. Zeitschr. f. indukt. Abstamm. u. Vererbungslehre,

[4]Verrall, British Flies, Vo. 8, p. 485. London, 1901.

done justice to himself or his material, for although he tabulates the data and shows that they may all fit a simple Mendelian scheme, yet he does not attempt to show the snugness of this fit. This I have tried to do, for one is not content with knowing that an hereditary formula may be applied successfully, but desires as well to know the probability of its being the most exact interpretation possible for the given facts. It is when too many multiple factors, lethals, normal overlaps, distorted chromosomes and the like must be resorted to to elucidate materials of great complexity and difficult handling, that many workers take leave of this form of analysis.

The data under consideration show results of matings between the three varietal forms, *bombylans*, *hæmorrhoidalis* and *plumata*. There are eighteen matings in which both parents are known and twelve in which the mother only was observed. According to the Mendelian scheme as given by Gabritschevsky there are twenty-one different genetic types of matings possible.

Among the forms considered there are two pairs of alternatives. Either the thorax and base of abdomen are black or they are yellow with a rusty red tinge on the central portion of the mesonotum. The fourth abdominal segment is either rusty red or white.

The black thorax and red abdomen are characteristic of *bombylans*. The yellow thorax and red abdomen distinguish *hæmorrhoidalis* from *plumata* which bears the yellow thorax and white abdomen.

The fourth possible combination, that of a black thorax and white abdomen does not appear in nature. This may be taken to mean that the presence of a black thorax tinges the abdomen regardless of those factors affecting it specifically. True it is that there is variation in intensity of the rusty red abdominal color in *bombylans*. Such a condition would give us reasons for at least three such variations according to whether the specific color factors which the animal contained were homozygous for red, for white or heterozygous for both.

In Kurst Stad (Russia) the three color varieties are distributed in the proportion of 50% b; 20% h; 30% p. If we assume distribution and equal interbreeding of all the genetic types (given in Gabritschevsky's Table II) we may expect animals appearing in the proportion of the three types shown in the table. If we convert the tabular figures into percentages we find that they give us an expectation of *about* 53% b; 14% h; 33% p. However, these ratios will shift from year to year in nature and instead of having equal numbers of six genetic types the second year to breed from there will be six types in the ratios (6+17+17) *bombylans*, 7 *hæmorrhoidalis*, 16+6 *plumata*, causing the gradual piling up of the heterozygous classes.

The percentages for the region near Moskow are also given. It is marked by a dearth of the dominant *bombylans*. These are 20% *bombylans*, 30% *hæmorrhoidalis*, 50% *plumata*. A shift caused by interbreeding could not take care of these ratios. True it is that the presence of even 20% *bombylans* will distort the relative appearance of *hæmorrhoidalis* and *plumata* types. If, however, we neglect this and compute the percentages for the two varieties of yellow thoraxed flies observed, we find that about 62.5% of them were p. and 37.5 were *hæmorrhoidalis*. When we consult the table mentioned above and classify the animals resulting from yellow thoraxed parents we find that we should expect 70% *plumata* and 29.1% *hæmorrhoidalis*.

The above is entirely a theoretical consideration. Actual numbers are not given in the text. Percentages for these two places only are given. It is unknown whether or not these percentages were based on fair samples of the population.

I prefer to use Mendel's type of formulæ for simplicity's sake.

Let Y = black thorax
y = lack of black thorax=yellow thorax
W = white abdomen
w = lack of White abdomen=red abdomen

Then a *bombylans* may be:

YYww		*YYWW*
Yyww	possibly	*YYWw*
		YyWW
		YyWw

A *plumata* is:

yyWw
yyWW

A *hæmorrhoidalis* is:

yyww

Bombylans and *plumata* may or may not breed true, but *hæmorrhoidalis* always does.

The simplest expianation is that the combinations of thorax and abdomen are closely linked or that the three color phases are allelomorphic.

If we classify the recorded matings by the types or classes of offspring produced we find that the results fall readily into one or more of the twenty-one theoretical combinations.

There is a single exceptional individual. It is in the case of a *hæmorrhoidalis* male appearing in what should be a *plumata* group only. It may be an individual variation resmbling *hæmorrhoidalis* or a case of mutation. Non-disjunction and contamination might account for its appearance. It might be a badly distorted ratio, for one possible mating could produce these in the proportion of 3:1. In a number of instances only a single type of mating can account for the results obtained. In others several combinations could have produced the observed classes in the same proportions. It is impossible to distinguish between homozygous and heterozygous dominants in either parents or offspring unless a very detailed genetic study could be successfully carried out.

If we consider that those matings which produced like results in the F_1 were identical, although in a few cases there is a chance to the contrary, we may combine these data. We may then calculate the expectancy under such conditions. The calculated sizes of the classes expected may then be compared with the numbers of individuals in each class actually obtained.

Upon comparing the expected values with the numbers observed, it is evident that there is a much better agreement than could possibly be found due to chance alone.

Let us now examine these results as I have analysed them by the statistical method.

TABLE I.

Matings Combined	Probable type of Mating	Expected	Found	Deviation divided by probable Error	Probable occurence of such deviations due to chance alone during 100 repetitions of the same experiment, other things being equal.
1, 2, 3, 4	3, 11, 12, 15, 17, 18	83.5:27.5	82:29	0.4	
5	1, 7, 8	17 5:17.5	19:16	0.7	
6, 7, 8	2	34.5:11.5	36:10	0.7	
10, 11	9	16:0	16:0	0.0	
12	5	17:17	11:23	3.0	4.3
9, 13, 14	13	25.5:25.5	25:26	0.004	
15	4	16:0	16:0	0.0	
16? 17? 18?					
19, 23, 24	18	46:46	52:40	1.8	22.47
20, 21, 25, 26, 27, 28	6, 20, 21	47:0	46:1	cannot be calculated	
22, 29, 30	19	46:46	46:46	0.0	

In this analysis I have accounted for some 540 individuals resulting from 27 matings. I have omitted three matings (Nos. 16, 17 and 18) in which we cannot be sure what the parents were genetically and in which we cannot recognize the ratios definitely.

The results from a mathematical standpoint are close approximations of those expected. The highest deviation from the expected for any group is barely three times the probable error. This, from a statistical point of view, is probably insignificant. The same deviation would be expected under normal conditions of chance 4.3 times in 100 repetitions of the same experiment, other things being equal.

It is to be desired that a test of this kind be applied to the American relatives of these flies, for it is quite probable that their differences may have a similar hereditary basis.

Conclusion.

The results obtained by Gabritschevsky in studying the relationships between *Volucella bombylans*, var. *bombylans*, *V. b. plumata* and *V. B. hæmorrhoidalis* agree very closely with ratios expected upon a mendelian interpretation, a condition hardly to be predicted from an undetailed perusal of the genetical data as presented by this experimentor.

Book Review.

Manual of Injurious Insects, By Glenn W. Herrick. Henry Holt & Co., New York City, 1925. $4.50.

This is a book of 489 pages including its index, with 458 text-figures. It deals mainly with the more abundant North American insects that affect agricultural crops although there are short chapters dealing with the parasites of poultry and livestock and a few words on the relation of insects to human and animal diseases. It includes also a rather elaborate consideration of insecticides and the machinery for applying them. Forest insects are entirely omitted.

The several pests are dealt with *seriatim*, classified according to the crops upon which they feed. For each species there are paragraphs entitled "Description: Injury; Life history, and Control measures," together with a figure of the insect or its work and a list of such useful practical literature as has been published by the Federal government and the various state agricultural experiment stations. Less common pests are listed by their common and scientific names with references to economic literature.

Professor Herrick's book forms a useful compendium and with its abundant references will also furnish a key to the literature for those who wish to learn more concerning certain species.

Due to the present unrest in nomenclature many unfamiliar generic and specific names appear in the text. Unfortunately some of these changes have been so rapid that the gender of the generic names has not even been noticed and we see such barbarisms as *Eriosoma lanigera*, *Eccoptogaster rugulosus*, etc. Although great attention seems to have been given to the use of most "up to date" names, the brown-tail moth still appears as *Euproctis chrysorrhœa*, which well illustrates the difficulty experienced by all who attempt to keep up with the gyrations of the research worker in nomenclature!

C. T. Brues.

Exchange Notice.

Wanted. American Lepidoptera, especially moths, including *Sesia* and the Microlepidoptera. European Lepidoptera offered in exchange. Dr. A. Schmidt, Ungarisches National Museum, Budapest 80, Hungary.

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SOCIAL HABITS OF SOME CANARY ISLAND SPIDERS

By William Morton Wheeler.

Bussey Institution, Harvard University

During the summer of 1925, while I was visiting the Canary Islands with my friend, Dr. David Fairchild, as a guest of Mr. Allison V. Armour on his yacht, the "Utowana," my attention was attracted by the peculiar gregarious or social behavior of two species of spiders, *Cyrtophora citricola* Forskål and *Argyrodes argyrodes* Walker. The former was described and figured from the Canary Islands by Lucas as early as 1843 under the name of *Epeira cacti-opuntiæ*[1]. Simon[2] showed that this spider is the same as *Cyrtophora opuntiæ* Dufour, but in his later work[3] he adopts for it an earlier name, *Cyrtophora citricola* Forskål. He cites it as occurring in Corsica, Provence, Spain, Algeria, Sicily, Syria and the Island of Réunion "on cactus, aloes and more rarely on lentiscus." He also gives a brief but accurate account of its web and egg-cocoons, but says nothing about its social proclivities. In the former of the works cited (Vol. V, 1881 p. 16) Simon also mentions *Argyrodes argyrodes* as living "like a parasite on the web of *Cyrtophora opuntiæ*, more rarely on the web of *Epeira adianta*, *Argiope lobata* and *Holocnemus rivulatus*," and as inhabiting Corsica, Spain, Algeria, Sicily, St. Helena, Madagascar, etc.

Lucas merely records *C. citricola* from the Canary Islands, without mentioning particular localities. I saw both it and the *Argyrodes* on three of the islands, namely Teneriffe, Palma and Gran Canaria, but failed to find either of them on Lanzarote.

[1]In Barker-Webb and Sabin Berthelot: Histoire Naturelle des Isles Canaries ,1836-1844, p. 40 Pl. 6, Figs. 7, 7a.
[2]Les Arachnides de Frances I, 1874, p. 34.
[3]Histoire Naturelle des Araignées, 2nd edit. II, 1892-1895. p. 771.

The communal webs of the Cyrtophora are built over bushes or trees and often cover a considerable area. On Teneriffe I found a colony enveloping a long Pelargonium hedge in the garden of the Hotel Martianez at Puerto Orotava, and in front of the same hotel a huge web rising from the summit of a Lonicera hedge to the telegraph wires several feet above it. At Villa Orotava, in what was formerly the garden of the distinguished botanist Wilpret, there was a fine web about twelve feet high and four feet broad spread over the foliage of a cedar tree. On the island of Palma smaller webs were seen on the way-side Opuntia cacti near San Andres and Sauce. On Gran Canaria they were common in the banana plantations and on cacti at Telde, and on a beautiful myrtle hedge in the finca of Don Salvador Manriquez de Lara at Tafira. But the most extensive web was seen on this island near Puerto de la Luz. It completely enveloped a dense hedge of Opuntia fully one hundred feet long and six to eight feet wide. I estimated its area at somewhat more than 1000 square feet.

In all these cases the web was the joint work of dozens or, in the last instance mentioned, of thousands of Cyrotphoras. It consists of two parts, a very irregular structure or framework of long, coarse, yellow and somewhat glutinous threads, running in all directions and attached to the plants, and a variable number of suborbicular, horizontal webs, suspended side by side or one above the other in the frame work. These webs are three to eight inches in diameter and made of very even square meshes, of the size of those of mosquito netting, but consisting of exceedingly delicate, whitish silk. The Cyrphoras rest on the lower, convex surfaces of these webs. Individuals of all ages live together amicably and seem to feed in common on the prey that is caught in the webs, but the adult females, (15 mm. long) which are gray, with large, paired, silver spots on the dorsal surface of the abdomen, are usually few in number. The egg-cocoons are elliptical, about 15 to 20 mm. long, made of dense, coarse, gray-green silk, and are suspended vertically in or near the center of the whole structure. They vary from one to five in number and are attached to one another in a series, so that they resemble a string of minute sausages. The mother spider is usually found resting at the end of the lowermost cocoon.

The Argyrodes, which are black, with pale legs and extensive silver spots on the abdomen and are very much smaller than the adult Cyrtophoras (adult female only 4.5 mm.; adult male 3.5 mm.), were also present in all the webs which I examined. They seem to make no webs of their own but live in the coarse framework of the structure spun by the larger species. Like the latter, they are present in considerable numbers, of all sizes and of both sexes. They were seen feeding on midges and other small insects caught in the coarse yellow strands. When disturbed they quickly drop to the ground by letting out a thin silken filament, but the Cyrtophoras run off to the side and hide in the foliage of the plant supporting the web. The egg-cocoons of the Argyrodes resemble certain seed-capsules and are of the peculiar type seen in other species of the genus, being small subspherical or pear-shaped, yellowish brown, papery-walled structures. One pole of the capsule is prolonged into a stiff stem, or pedicel by which the capsule is suspended from the threads of the web and at the opposite pole there is a small circular, protruding rim.

The habits of *Cyrtophora citricola* and *Argyrodes argyrodes* thus resemble those of *Nephilla plumipes* and *Argyrodes nephillæ*, which Mr. Nathan Banks and I observed in Panama. In a volume soon to be published[4] I have described the behavior of these spiders and have cited the observations of others on similar gregarious or social habits in the species of Uloborus, Anelosimus, Epeira, Stegodyphus, Cœnothele, etc. in various parts of the world.

[4]Les Sociétés d'Insectes, Doin, Paris 1926.

THE EUROPEAN SUBGENUS ACTEDIUM (BEMBIDION) IN NORTH AMERICA.[1]

By P. J. Darlington, Jr.

In a box of Albertan *Bembidion* recently received for determination from Mr. F. S. Carr, the writer found two specimens of an apparently undescribed species belonging to the subgenus *Actedium* Mots., a group not heretofore recorded from this continent. *Actedium*, which was erected in 1864 (8) for two European species, was defined as follows: elytra subquadrate (presque carré); the striæ distinctly punctured, effaced toward the apex, not deeply impressed, the 7th visible, the third with two small foveæ; head and thorax punctate, the latter cordate with the basal impressions feeble. It may be added that the eyes are prominent, the humeri indistinctly angulate, the 8th stria close to the margin, and the mentum tooth entire and triangular. The two original species of the subgenus, together with a third described from Europe in 1870 (6) and the one described below, form a homogeneous group, the habitus being like that of a very stout *Lachnophorus*.

In comparing *Actedium* to our other groups of *Bembidion*, it seems best to mention the closely related European subgenus *Princidium* Mots. This was described in the same paper as *Actedium*, and was separated from it chiefly by having the form narrower and the elytral striæ entire. The two subgenera together are equivalent to the third group of Jacquelin-Duval's monograph, "De Bembidiis Europæis" (7).

It may be noted at this point that the several American species included in *Princidium* by Motschulsky, notably those now listed as *dilatatum* Lec., *honestum* Say, and *concolor* Kby., have all been referred to *Peryphus* Steph. by Casey (1). Of the two European species placed in Princidium, only one, *punctulatum* Drap., can be retained. The other, *ruficolle* Gyll., has a very different habitus and has the elytral foveæ on the third interval. Since no genotype has been assigned for *Princidium* thus far,

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 262.

the writer here designates *Bembidion punctulatum* Drap. as the genotype of that subgenus.

It may also be noted that the species of Jacquelin-Duval's groups four and five, which were associated with group three in his monograph because of the punctuation of the head, all have the elytral foveæ on the third interval, a character noted but not much valued by that author. Since the form described in this paper combines the habitus of *Actedium* with an elytral striation nearly as complete as in *Princidium*, the two subgenera may have to be united under the latter name, which has priority by a page.

The species of *Actedium*, and that of *Princidium* as restricted above, differ from all hitherto described American species of *Bembidion* by having the depressions in the posterior angles of the prothorax entirely obsolete, and by having distinct non-setigerous punctures on the head and the sides of the pronotum. A partial exception is found in *B. scopulinum* Kby., in which there is a tendency toward rugosity on the floor of the frontal sulci, and of which a considerable percentage of specimens have a few scattered punctures on the front. In *B. lævigatum* Say there are a few irregular frontal punctures, but these are setigerous and are not comparable. Several species of the *ustulatum* group have the base of the thorax, and more rarely an area near the apex, rugose; and this, too, is best developed in *scopulinum*. The sides of the thorax, however, are quite impunctate even in this species.

Except for its subdilated hind body and the unique characters noted above, *Actedium* is inseparable from *Peryphus* as the latter is employed by Casey (1); and it seems most closely related to that part of *Peryphus* containing the more convex species of Hayward's (4) *ustulatum* group. *Princidium*, which combines the habitus of a convex *Peryphus* with the technical characters of *Actedium*, brings those two subgenera even closer together. The gap remaining, however, seems too great, particularly as regards the structure of the posterior angles of the prothorax, to allow *Actedium* and *Peryphus* to be united at present. The two subgenera should, of course, be associated on our lists.

Before proceeding to the description, the writer must ac-knowledge his indebtedness to the authorities of the Museum of Comparative Zoology at Cambridge for the opportunity of examining specimens of all the European species mentioned in this paper, and of referring to the invaluable collections of Leconte and Hayward.

The following species, as already indicated, seems completely congeneric with the European *Bembidion* (*Actedium*) *kusteri* Schaum and *B.* (*Act.*) *pallidipenne* Illig.

Bembidion (Actedium) lachnophoroides n. sp.

Convex, posterior parts robust; head and thorax viridiaeneus; elytra smoky-yellow, with apex and a slightly post-median transverse fascia blackish, the latter slanting slightly forward from the suture. Head as wide as thorax at widest part, strongly alutaceous, rather sparsely punctured with very distinct punctures; frontal striae broad, shallow, and parallel, the floor longitudinally rugose; antennae stout, piceus with the basal joint paler, intermediate joints about twice as long as wide. Prothorax scarcely wider than an elytron, about one eighth wider than long, subcordate, narrower at base than apex, strongly alutaceous; median line well impressed, transverse impressions indistinct; disk impunctate at middle, slightly wrinkled transversely; sides with sparse, large punctures; base and apex strongly and longitudinally rugose; lateral margins narrow; hind angles not striate, slightly obtuse but not rounded, not prominent; basal impressions entirely obsolete except for the slightly broadened margin where the tactile seta arises. Elytra, alutaceous, together one half longer than wide, sides straight and subparallel in median third; humeri not prominent; striae moderately impressed, modertely punctured on basal two thirds; first, second, and seventh distinct at apex, others slightly abbreviated; seventh slightly less impressed on disk than sixth; third with two moderate foveae. Head and thorax piceous or reddish beneath; abdomen entirely flavo-testaceous; Legs entirely pale. Length (♂ ♀) 4.25 mm. Width (♂ ♀) 1.8-1.9 mm.

This species is most closely related to *B. kusteri* Schaum of Europe, but is distinct by the more complete elytral striation, the dark antennæ, the posterior rather than anterior elytral markings, and the pale abdomen. The last character, however, may be due to the immaturity of the types.

Both the ♂ holytope and ♀ allotype were collected by Mr. F. S. Carr at Medicine Hat, Alberta, Sept. 8, 1923. By arrangement with Mr. Carr the holotype will be deposited in the Canadian National Museum; the allotype is in my own collection.

The occurence of European groups, or even species, in North America is a common phenomenon of which *Actedium* is only an additional example (2, 3). The subgenus should be looked for in the gulf of St. Lawrence region and in Alaska, though it had not been recorded from Siberia up to 1896 (5).

The following papers have been referred to, by number, in the proceding pages:

1. Casey, T. L.—Bembidiinæ; Memoirs on Coleoptera, VIII, Lancaster, 1918, p. 46-85, for *Peryphus*.
2. Champion, G. C.—List of Coleoptera common to Britain and North America; Ent. Month. Mag., ser. 2, VI, 1895, p. 150-155.
3. Hamilton, John—Catalogue of Coleoptera common to North America and northern Europe and Asia; Trans. American Ent. Soc., XXI, 1894, p. 345-416.
4. Hayward, Roland—On the species of *Bembidion* of America north of Mexico; Trans. American Ent. Soc. XXIV, 1897, p. 32-143.
5. Heyden, Lucus von — Catalog der Coleopteren von Siberien; Deutche Ent. Zeits. (special no.), 1881; Nachtrag I, 1893; Nachtrag II, 1896.
6. Heyden, Lucus von—Reise nach Spanien; Berlin, 1870, p. 63.
7. Jacquelin-Duval. Camille—De Bembidiis Europæis; Ann. soc. ent. France, sér. 2, IX, 1851, p. 441-576; 1852, p. 101-236.
8. Motschulsky, T. Victor von—Enumération des nouvelles espèces, IV; Bull. Moscou XXXVII, 3, 1864, p. 181 (*Princidium*); p. 182 (*Actedium*).

A NEW GENUS OF CHALCIDOID HYMENOPTERA (CALLIMOMIDÆ)

By T. D. A. Cockerell,

University of Colorado.

Mr. Charles H. Hicks has for many months been studying the insects breeding in dead herbaceous stems. He finds that these will emerge in great numbers during the winter, in the warmth of the laboratory, and as a result he has obtained a a wonderful series of bees and other insects, some new, others permitting the association of sexes, and many connecting parasites with hosts. On Feb. 3, 1926, he bred the insect described below from a stem collected at Boulder, Colorado. It has since been determined to be parasitic on a bee of the genus *Stelis*.

Megormyrus new genus

Female. Elongate, parallel-sided, highly metallic, minutely sculptured, the head and thorax with only very short and thin pale hair; head transverse, broader than long, with large prominent eyes, which are finely, not densely, hairy; front minutely cancellate, transversely striatulate above the antennæ; ocelli large, in a triangle, lateral ocelli about as far from eyes as diameter of an ocellus; cheeks flattened, not at all bulging behind eyes; last joint of maxillary palpi very long; clypeus with some relatively large punctures near margin; mandibles broad, not metallic, the outer surface striate and with a few oval punctures; antennæ placed low down on face, 12-jointed, no ring-joint discernible; flagellum thickly minutely hairy, middle joints longer than broad; terminal cancellate; no parapsidal grooves; hind coxæ extremely large, with a minute reticulate sculpture; femora robust, but not greatly swollen; curved spur of anterior tibia much shorter than basitarsus; tarsi five-jointed, ordinary; wings well developed, hyaline, with a large circular dusky cloud below end of submarginal vein, and a couple of dusky streaks on lower margin at about the same distance from base; marginal vein about half as long as submarginal; postmarginal about or almost as long as marginal; stigmal moderate, clavate, with an upper lateral pointed projection; abdomen broad, with five tergites visible before the pointed hairy apex; fourth nearly as long as first three together, second much shorter than first or third; sculpture minutely cancellate or reticulate, produciug a dullish surface, but first segment highly polished; hind margins of second and third segments shining; no rows of strong punctures; no trace of a dorsal carina; venter convex, polished, with deep median groove for ovipostor, which is only very slightly exserted at apex.

Megormyrus amabilis n. sp.

Female. Length about 7 mm.; head in front obscure dull green, cheeks shining green; scape chestnut red, flagellum black, suffused with red about middle; thorax dorsally dull obscure greenish, but pronotum somewhat shining posteriorly, postscutellum brilliant purple, metathorax green with rosy patches, sides more brassy; hind coxæ shining green, with a brassy luster; legs (except the green coxæ) bright chestnut red; first abdominal segment highly polished, shining beautiful coppery red, second and third obscurely green, fourth very dark blue, fifth dark blue; venter shining. Stigmal vein 255 microns long; postmarginal about 800, from its end to wing tip about 640. Compared with *Ormyrodes* Brues, it differs by not being coarsely punctured, nor the abdomen excessively elongate; also by the lack of a dorsal keel on abdomen and shorter marginal vein. From *Monobœus* Förster it differs by the sculpture of the abdomen, hairy eyes, and general appearance. In Ashmead's table it appears to fall closest to *Monobœus*, but it is certainly not congeneric with *M. hegeli* Girault, described from Michigan. I have not access to the descriptions of Förster's two species, but as Mayr referred them to *Ormyrus*, they are evidently quite different from the insect now described. In the Colorado fauna, this actually seems closest to the remarkable *Ormyrodes petrefactus* Brues, fossil in the Miocene of Florissant. May we suppose that formerly this group of insects was more abundant, surviving today in a few isolated and peculiar types, and the widespread and more prolific genus *Ormyrus*? *Ormyrus*, mainly parasitic in cynipid galls[1] has about 45 species; *Monobœus* has three, *Tribœus* one. *Ormyrodes* was based on a species from South Africa; the very similar fossil *O. petrefactus*, from Florissant, is probably not truly congeneric.

[1]Not invariably, *O. sculptilis* Crosby being from *Asphondylia* and *Agromyza*.

WING VEINS OF BEES AS STRENGTHENING ELEMENTS.

Charles Robertson,

Carlinville, Illinois.

Lutz (1, 182-3) says that if the wing-veins of bees have a function it is probably to strengthen the wing. "However, the 'stingless honey-bees' of the tropics are fairly strong fliers, carry through the air heavy loads of pollen and other material, and are a very successful group, judging by their numbers and their wide distribution, but their wing-venation is so reduced that only a few moderately well-developed cells remain. It would seem from this that the need of an elaborate network of veins to strengthen the wings of bees is not very great, if, indeed, there be such a need." This seems to me an argument from an exceptional case.

The reduction of veins is associated with the importance of the veins as strengthening elements. In 2, 236, the reduction is stated to be associated with small size.

Families of small bees.—The submarginal cells are reduced to two in Panurgidæ, Dufoureidæ, Macropididæ, Prosopididæ, Pasitidæ and Megachilidæ. The Megachilidæ contain some middle-sized bees, but none equaling the largest of the 3-celled species. The typical forms are small, like *Prochelostoma,* the larger ones being developed from these and retaining the same two cells.

Obliteration or reduction to stumps in anamalous cases.

The second cubital cell.—This is usually the shortest and the transverse cubital veins 1 and 2 are so approximated that, on the presumption of strength, one of them can be dispensed with. Of 289 cases, one of these veins is obliterated in 286 while the 3d transverse cubital is obliterated in only 3. In *Perdita obscurata* the 2nd cubital cell is small and petiolate, indicating that in ordinary Perditinæ the two cells are the 1st and 3rd. In one specimen of *Pseudopanurgus compositarum* transverse cubital vein

2 is represented by a stump so close to the 1st that it would coalesce with it if produced upward. In a specimen of *Phor integer* this cell is petiolate. Of 130 specimens of *Parandrena andrenoides*, which is regularly 2-celled, two show on one side a narrow 2nd cubital cell closed at the top.

Long and short-tongued nest-makers.—Of 216 cases, a transverse cubital vein is obliterated in 215 short-tongued and only one long-tongued, showing that the reduction occurs in the small wings where they are less important elements of strength.

Long and short-tongued inquilines.—While only one long-tongued nest-maker has the veins reduced, 59 long-tongued inquilines have one of them obliterated. On the theory of strength, this may be explained on the ground that strong wings are less important to inquilines. Most inquilines are long-tongued. In the short-tongued Sphecodini, I find 13 specimens with one vein obliterated.

Transverse cubital 2 *obliterated.*—Since the first cubital cell is the longest in all of the 226 cases observed, this vein is the one which can be dispensed with without weakening. Usually obliteration of vein 2 leaves two cells of the same size. Vein 2 is obliterated in 226 cases and 1 in only 60. The 226 cases are Andrenidæ 169, Halictidæ (ex. Sphecodini) 33, Epeolidæ 11, Nomadidæ 6, Sphecodini 3, Colletidæ 3, Euceridæ 1.

Transverse cubital 1 *obliterated.*—Except that it makes the first cell a little larger, it can be dispensed with in second order. It is wanting in 60 cases, while tr. cu. 2 is wanting in 226. The 60 cases are Nomadidæ 40, Sphecodini 10, Halictidæ (ex. Sphecodini) 7, Epeolidæ 2, Andrenidae 1. The obliteration in Nomadidae and Sphecodini is peculiar. This, I think, is the vein wanting in *Prosopis*.

Other veins obliterated.—Transverse cubital 3 is obliterated in 3 cases, 1st recurrent in 1 and 2nd recurrent in 1. Altogether the transverse cubitals 1 and 2 are obliterated in 286 cases, while more useful veins are wanting in 5.

Curiosities.—In *Trachandrena claytoniæ* and *Dialonia antennariæ* tr. cu. 2 is wanting on 1 side, tr. cu. 1 on the other. In two cases, *Oxystoglossa confusa* and *Heminomada obliterata*, both are wanting on one side. In another case, *Holonomada placida*, they are wanting on both sides.

Veins increased.—In 3 cases the second cubital cell is divided by a vein which appears as a continuation of the 1st recurrent. In another case the upper part of the 3d cubital cell is separated from the lower by a cross vein. So that veins are increased in 4 cases and obliterated in 291.

Enfeeblement of veins.—Instead of proving that the need of strong veins is not great, the reduction in the stingless bees seems to be so unusual as to require an explanation. Comparing with related bees like *Bombus*, *Xylocopa* and *Eulema* would establish a presumption that the reduction is related to the smaller size. The loss of strength comes from a fading out, instead of an obliteration, of the veins. In *Curtisapis*, the third cubital nervure is enfeebled, while in almost all smaller Halictidæ 2 and 3, and the second recurrent, are weaker. In the small *Perditella boltoniæ* the second recurrent vein is almost obsolete. Enfeeblement is pretty regularly correlated with reduction in size.

I have seen bees unable to fly on account of the outer margins being broken. The strength of the nervures may determine how long the wings can be used. Individuals of Meliponidæ may be short-lived. Inquilines have a shorter flight than their hosts, make no nests and have less need for strong wings. They are the almost exclusive long-tongued bees which show anomalous reductions in the venation. In Australia the hive-bee is said to be driving out the native honey-bee. The stronger wings of *Apis* may have something to do with this.

Literature cited.

1. Lutz, F. E. 1924. Apparently non-selective characters and combinations of characters. Ann. N. Y. Acad. Sci. **29**: 181-232.
2. Robertson, C. 1910. Hosts of Strepsiptera. Can. Ent. **42**: 323-30.

DESCRIPTIONS OF A FEW NEW AMERICAN DIPTERA.

By Nathan Banks,

Museum of Comparative Zoology, Cambridge, Mass.

Stratiomyia occidentis sp. nov.

Related to *S. maculosa*, the male having pilose eyes and a black face. It differs from *S. maculosa* most prominently in lacking oblique yellow marks on the fourth segment, and the lateral marks are narrow, almost linear. The lateral appendages of the male genitalia are very much broadened at tip, about twice as broad as in middle, whereas those of *S. maculosa* are scarcely broadened at tip. The hair on the eyes is much shorter than that of *maculosa* and white (not yellowish). The hair on face and thorax is also whiter than in *maculosa*; the scutellum is about half yellow, the marks on the fourth segment do not approach each other, the fifth segment shows but one spot, much broadened behind; the venter is largely yellow, but black on base or lateral parts of segments; femora black, rest of leg tawny.

Length 15 mm.

The type is from Stockton, Utah, June (Spaulding), two other smaller males from Webber Lake, Calif., July (Osten Sacken.)

Odontomyia tumida sp. nov.

In general similar to *O. arcuata* in coloration and structure; the head yellow, with black mark over ocelli, and a curved dark mark each side in front from the eye, basal joint of antennæ pale; thorax rather more silvery pubescent above than in *arcuata*, pleura and sternum yellow, latter black in middle, legs wholly pale, the tarsi hardly darker near tip, scutellum yellow with short yellow spines; abdomen yellow above with four black bands, narrower than in *arcuatus*, and none of them reaching to the margin. It is distinguished from *arcuatus* by the profile of the face, which is fully twice as much swollen out beneath antennæ as in *arcuatus*, projecting forward the width of the eye;

from in front the lower corner of the eyes are as far apart as the length of inner orbit (in *arcuatus* very much closer.)

Calobata kennicotti sp. nov.

Black, face and cheeks silvery, front tawny except the dark triangle, not reaching as far forward as in *C. pallipes*, orbits silvery, occiput black; thorax black, clothed with white pubescence, especially prominent on pleura, on dorsum a bare shining black stripe each side above base of wings; abdomen black above and below, clothed above with prominent white hair, apical segment largely brown, genitalia pale; legs pale, mid and hind tibiæ beneath with dark mark at tip; wings hyaline, second vein ending in costa nearer to tip than to hind cross vein.

Length 5 mm.

Hudson Bay Territory (Kennicott). Separated from *C. pallipes* (*alesia*) by very different genitalia, as well as by marks of thorax. I have not seen *C. nasoni*, but that species is said to have on the genitalia a long filiform process; also to have a process between hind coxæ, and yellow humeri, and the markings on the thorax do not agree, and the venter is pale.

Leria (*Amœbaleria*) **helvola** var. **angustifrons** var. nov.

The types (♂) of helvola have very hairy dorsum and the anterior dorso-central bristles weak, and the front of head, viewed from above is very much broader than long (inner eye-margin). There is in the East another form in which the male has much shorter hair on mesonotum (hardly longer than in other species), the anterior dorso-centrals are much longer, and the front of the head, viewed from above, is but little broader than long (inner eye-margin). The specimens are rather smaller than the typical form. Specimens come from Dead Run, Va., Black Mt., N. Car., Washington, D. C., Ithaca, N. Y. and N. Y. (Osten Sacken).

Eutreta hespera sp. nov.

This is the western form that has passed as *E. sparsa.* It is distinguished by the pellucid dots of the wing, larger, often confluent, those on the posterior part much larger than in *E. sparsa*; there are also pale spots in the costal area, and the costa before the end of the first vein is marked several times with pale; nowhere do the spots tend to form in rows as in *E. sparsa.* The wings are about as broad as in *E. sparsa*, and the clear apex of about the same extent.

Length of forewing 5.5 mm.

From California Julien (Osten Sacken) and Compton (Cole), and Colorado, Manitou.

Eutreta angusta. sp. nov.

Resembles *E. sparsa*, but with narrower body and more slender wings; sides of the abdomen nearly parallel, last segment much longer than broad at base, and more tapering than in *E. sparsa.* Wings about twice as long as broad; the spots rather less scattered, but somewhat in rows, and a few in the costal area, and the costa before end of auxillary is partly pale, the mark at end of the first vein is very small, the clear apical margin is less extensive than in that species.

Length of forewing 4.2 mm., width 2 mm.

From Texas (Lefv.) and one specimen marked "R" and var.? by Loew.

These two species may be tabulated with *E. sparsa* as follows:

1. Costa before end of auxillary vein not marked with pale or but once . . . . *E. sparsa*
   Costa marked several times before end of auxillary vein . 2.
2. Wing about twice as long as broad . . . . *E. angusta*
   Wing much broader . . . . *E. hespera*

Eutreta simplex Thomas differs from all of these in lacking the black spots on the face.

NEW SPECIES OF NORTH AMERICAN DOLICHOPODIDÆ

By M. C. Van Duzee,

Buffalo, N. Y.

Hydrophorus maculipennis new species.

Male: Length 3.5 mm.; of wing 4 mm. Face wide, but little narrowed above, upper portion green with only a little pollen; lower part opaque with yellow pollen. Palpi black with pale hairs. Front opaque with brown pollen. Antennæ black, third joint small, nearly round; arista whitish at tip. Cheeks very narrow. Beard yellow, not very long or abundant, the black orbital cilia decend to the middle of the eye.

Dorsum of thorax shining blackish with thin brown pollen, which is more abundant on the sides and ends abruptly a little below the pleural suture; pleuræ bare, more greenish, the pollen white, contrasting strongly with that above; acrostichal and dorsocentral bristles very short, hair-like; propleuræ with one black bristle and some small, pale hairs above each fore coxa; scutellum with two pair of marginal bristles. Abdomen green with brown pollen above, white on the sides, the line between being sharply defined; hairs of the abdomen very minute, black, white only on lower edges of the sides. Hypopygium concealed, with a pair of quite large, black lamellæ projecting backward, they have a few pale hairs on upper edge.

Fore coxæ green, nearly bare, but with a few minute white hairs and several short, black, hair-like bristles on outer edge and one at tip; middle and hind coxæ black with white pollen. Femora and tibiæ green, their hair mostly black. Fore femora thickened, tapering to the tip, with one row of ten black spines extending nearly their whole length on lower anterior edge, lower surface with pale hairs. Fore tibiæ with the usual row of spines on lower surface extending their whole length. Middle and hind femora with several bristles below, their tibiæ with more numerous bristles below, the former with six, the latter with three bristles on anterior surface. Tarsi black with white pulvilli; fifth joint of middle and hind tarsi very slightly widened. Joints of fore tarsi as 29-14-11-7-10; of middle ones as 33-22-17-10-12; those of posterior pair as 35-23-17-12-16. Calypters yellow with white cilia. Halteres blackish with the stem partly yellow.

Wings grayish, tinged with brown in front of second vein; a dark brown, nearly round spot on the cross-vein and on the middle of last section of fourth vein, this section being nearly straight; veins wholly black, not at all yellow at root of wing.

Described from one male taken at Newport, Oregon, June 8, 1925, by E. C. Van Dyke.

Type in the California Academy of Sciences.

Hydrophorus nigrinervis new species.

Male: Length 3.2 mm.; of wing 4.2 mm. Face wide below, narrowed above, wholly covered with white pollen. Palpi black with black hair. Front opaque with brown pollen. Antennæ black, short, third joint nearly round in outline; arista thick with a bristle-like tip, a little longer than the antenna. Beard scanty, white; the black orbital cilia do not reach down to the middle of the eye. One pair of postverticals. Cheeks extending narrowly below the eyes.

Thorax and abdomen bright metallic green; pleuræ and sides of abdomen dulled with white pollen; propleuræ with one black bristle on each side above fore coxæ; scutellum with two pair of bristles; hair on the dorsum of the abdomen black. Hypopygium black with white pollen, its hair white; its appendages extending downward, as long as height of hypopygium with several long, white hairs at tip.

Fore coxæ green with white pollen and hair; no black bristles at tip; middle and hind coxæ black with white pollen. Femora and tibiæ green, their hair black; fore femora thickened on basal portion, narrowed at tip, with two, closely approximated rows of spines below, one of which extends their whole length; fore tibiæ with a row of short, erect spines on whole lower edge; middle femora with a row of short bristles on lower posterior edge of apical two thirds and three small ones on lower anterior edge near the tip; posterior femora with a row of six small bristles on lower anterior edge of apical half and three on posterior edge near the tip; fore and middle tibiæ each with five to seven small bristles below. Tarsi black with white hair; middle and hind basitarsi with a row of minute black spines below. Joints of fore tarsi as 31-14-14-10-11; of middle pair as 51-24-20-14-13; those of posterior tarsi as 43-31-24-16-12. Calypters yellow with white cilia. Halteres yellow.

Wings grayish hyaline, without spots on the veins; veins black, not yellow at root of wing; last section of fourth vein nearly straight; third vein bent a little backward at tip.

Female: Length 3.5 mm.; of wing 5 mm. Pollen of face more brown on upper portion, yellow on lower part, becoming white along the orbits, the pollen scarcely concealing the ground color. Fore femora with a single row of spines below in the middle for half their length. Otherwise about as in the male.

Described from two males and one female, taken at Komloops, British Columbia, July 30, by N. Criddle.

Type in the Canadian National Collection.

Hydrophorus albomaculatus new species.

Female: Length 5 mm. of wing 6 mm. Face wide, its sides nearly parallel, opaque with white pollen. Palpi black, their pollen and hair white. Cheeks wide, extending as far down as the tips of the palpi. Front opaque with brown pollen. Antennæ black; first joint as long as the last two taken together; third nearly square in outline; arista thick, as long as the antenna. Beard abundant, long, white; the black orbital cilia decend to apical fourth of the eye; postvertical bristles in a row of four on each side, extending to the orbital cilia.

Thorax blackish with three lines along the rows of bristles which are more gray with pollen; humeri and narrow lateral edges of the dorsum white pollinose; three black propleural bristles above each fore coxa and long white hairs above and below these bristles; scutellum with four pairs of marginal bristles, the outer pair small; there are several small pale hairs on the pleuræ above middle coxæ. Abdomen black, thickly covered with white pollen, in the type there are many dots where the ground color shows through, its hairs white and conspicuous.

Coxæ, femora, tibiæ and tarsi black with more or less white pollen. Fore coxæ with moderately long, white hair. Fore femora thickened, lower anterior surface with a stripe of numerous, quite long, irregular bristles, extending their whole length. Anterior tibiæ with quite long pale hair on the front surface; all tibiæ and tarsi with minute white hairs below, which are longer on anterior and posterior basitatsi, the latter bent and with several long, black, bristle-like hairs above. Joints of fore tarsi as 46-25-20-14-18; first two joints of middle tarsi as 78-39; joints of posterior pair as 64-43-35-26-22. Calypters, their cilia and the halteres pale yellow.

Wings dark grayish; in front of third vein, except at tip, between third and fourth veins to a short distance before the cross-vein; a roundish spot at anal angle, a spot between fourth and fifth veins before the cross-vein and a small spot between third and fourth veins near their tips whitish, these spots conspicuous without a lens; veins blackish, except sixth vein which is snow white towards its tip; last section of fourth vein somewhat arched.

Described from one female, taken at Aweme, Manitoba, July 12, 1925, by R. D. Bird.

Type in the Canadian National Collection.

Hydrophorus flavipennis new species.

Male: Length 4.5 mm.; of wing 4 mm. Face wide, scarcely narrowed above, green with silvery white pollen, which is most conspicuous around the edge of lower portion. Palpi black with white hair. Front metallic coppery, dulled with grayish pollen. Antennæ black, third joint small, nearly round in outline; arista black with apical half yellowish white. Beard long and abundant, snow white; I can see only about five black cilia on upper orbits.

Thorax green, dorsum with a narrow brown line each side of the acrostichal bristles, and two less distinct lines on each side of these; it has a very little gray pollen; pleuræ with white hair above middle coxæ; propleuræ with long white hair above each fore coxa, but without a black bristle; dorsocentral bristle next to the scutellum large, the rest very small; scutellum with two pair of bristles. Abdomen coppery with the hind margins of the segments black, its hairs white, short on the dorsum, long on the sides. Hypopygium concealed, with a pair of long black appendages projecting downward with a small tip turned forward, fringed with small white hairs.

Fore coxæ dark green, their long hair and the pollen silvery white; middle and hind coxæ black. All femora and tibiæ dark green with white hair; fore femora thickened, their tips narrowed; they have eight short, blunt spines before the middle on lower surface, the first placed a considerable distance from base of femora; posterior femora with a conspicuous bend near the base, the concave side down, beyond this bend they are a little thickened. Fore tibiæ with a row of minute spines on their whole lower edge; middle tibiæ with two minute black bristles above near the base, posterior pair with several very small ones on upper surface. Tarsi black with white hair, first four joints of middle and hind tarsi with minute black spines below; fifth joint of middle tarsi slightly widened. Joints of fore tarsi as 25-18-13-9-12; of middle ones as 38-18-13-8-12; those of posterior pair as 50-25-20-12-14. Calypters and halteres yellow,. the former with white cilia.

Wings with a yellowish sheen on anterior half, posterior half more gray; costa and veins bright yellow, veins on posterior half usually more brownish.

Female: Length 4.5 mm.; of wing 5 mm. Face and front very wide, covered with yellowish pollen, the bronze ground color showing through, except on lower portion, the face long, reaching nearly to the lower corner of the eyes; the black cilia reach down to the middle of the eye; pollen on the dorsum of the thorax more dense than in the male, fore coxæ with shorter hair; fore femora with two rows of spines below for nearly their whole length; posterior femora not bent at base; all tibiæ and middle and hind femora with a few scattering black bristles. Wings, hairs of the abdomen, legs and feet as in the male.

Described from one male and six females which I have taken, the male and two females (type and allotype) taken at

Wainfleet, Ontario, July 20 and 26, 1924; two females at Ridgeway, Ontario, July 24, 1910; one at Buffalo, October, 18, 1910, and one female at Needles, California, February, 18, 1915.

Type in the author's collection.

Hydrophorus lividipes new species.

Male: Length 4 mm.; of wing 5 mm. Face wide with silvery white pollen, the blue-green ground color showing through a little on upper portion. Palpi black with abundant black hair. Front opaque with brown pollen. Antennæ black, short; third joint scarcely as long as wide. Beard rather long, yellowish; the black orbital cilia extend down nearly to the lower margin of the eye. Cheeks wide, extending lobe-like below the eyes, about as long as the palpi.

Dorsum of thorax and its pollen brown; pleuræ green with white pollen, bare, one propleural bristle on each side and several pale hairs below them; two pairs of scutellar bristles. Dorsum of abdomen brown with slight green reflections and brown pollen; its sides shining green with only a little white pollen on lower edges; hairs on first segment long and white; on the others short, black. Hypopygium and its pollen brown, its appendages small, extending downward, scarcely as long as wide, with a little point at tip extending forward, fringed with short hair.

Fore coxæ green, anterior surface with white hair and pollen and a row of about five small black bristles of equal length on outer edge of apical half; middle and hind coxæ black with white pollen. All femora and tibiæ dark blue-green with black hair, each with several small bristles below. Anterior femora thickened, narrowed towards their tips; I can see only one row of spines on lower surface, which are on the anterior edge and placed rather far apart (there may be another row), they also have pale hair on lower surface, fore tibiæ with pale hair on the sides. Tarsi black with brown pollen; first joint of middle and hind pairs with very small spines below, the latter also have pale hair on lower surface. Joints of fore tarsi as 36-17-15-12-13; of middle ones as 44-27-21-15-16; those of posterior pair as 48-30-23-15-15. Pulvilli of all tarsi large, pale in color. Calypters yellow with reddish border and white cilia. Halteres blackish, stem yellow in the middle.

Wings grayish, strongly tinged with brown in front of third vein as far as tip of second; veins without spots; last section of fifth vein straight, third considerably bent back near the tip; veins wholly black.

Described from a single male taken at Aweme, Manitoba, April 8, 1925, by N. Criddle.

Type in the Canadian National Collection.

Hydrophorus argentifacies new species.

Male: Length 2.7 mm.; of wing 3.5 mm. Face wide below, narrowed above, silvery white, slightly brown just below the antennæ, in certain lights it is tinged with green because of the ground color. Palpi black with gray pollen and pale hair. Front green with brown pollen, antennæ black, short, third joint nearly round in outline. Beard yellow, the black orbital cilia decend to about the middle of the eye. Cheeks narrow, truncate below.

Dorsum of thorax and its pollen brown; pleuræ and abdomen green, dulled with white pollen, the latter with black hair, except on lower edge of the sides; propleuræ with one black bristle and several white hairs on each side above fore coxa; sides of pleuræ bare; scutellum with two pair of marginal bristles. Hypopygium black, its appendages short, rounded, about as long as wide, with only short hair on apical edge.

Fore coxæ green with yellowish hair on anterior surface, no black bristle at tip; middle and hind coxæ black with gray pollen. Femora and tibiæ green with black hair, except on anterior tibiæ. Fore femora thickened on basal portion, narrowed at tip; they have a few short spines below, apparently in a single row (cannot see them very well in the type), their tibiæ with the usual row of spines below; middle and hind femora without a bristle below, except a small one near the tip, posterior tibiæ without, middle ones with one small bristle below, tarsi dark brown; fifth joint of middle ones black and slightly widened. Joints of fore tarsi as 30-16-15-10-12; of middle ones as 43-18-15-10-8, fifth joint 5 wide; posterior tarsi with their joints as 43-24-19-11-10. Calypters yellow with white cilia. Halteres yellow, knobs darker, but scarcely blackened.

Wings grayish, darker on anterior half; cross-vein bordered with brown a very little; last section of fourth vein straight; third vein bent backward a very little at tip.

Female: Length 3 mm.; of wing 4 mm. Face wider, dark gray. Front opaque with brown pollen; hair on fore coxæ a little more yellowish than in the male. Fore femora with a row of four quite long bristles below and a stripe of very short spines on lower anterior surface; fifth joint of middle tarsi not widened; last section of fourth vein with a very faint cloud at its middle; halteres wholly yellow. Joints of fore tarsi as 32-17-13-9-12; of middle ones as 47-26-17-11-13, those of posterior pair as 41-32-21-12. Otherwise about as in the male.

Described from one pair, taken at Treesbank, Manitoba, September 16, 1925, by N. Criddle. They are in the Canadian National Collection.

TWO VAGRANT GRASSHOPPERS AND A MOTH.

By A. P. Morse,

Peabody Museum, Salem, Mass.

Schistocerca vaga Scudder

Scudder's appellation "wandering," applied to this species, is verified by the recent capture of an adult living female in Salem, Mass., Jan. 28, 1926. It was found in a shipment of cauliflower from California by Leonard Kobuszewski, a clerk in Tassinari's market and fruit-store, Essex St., Salem.

Neoconocephalus triops Linné

Three weeks later, Feb. 19, 1926, a living male of this species was found in a lot of spinach from Texas at the same place by the same person. This species has been taken in New England twice before under similar circumstances (see my Manual of the Orthoptera of New England, p. 358).

Ceramidia viridis Druce.

On April 1 following, a specimen of this black moth was found in bananas, probably from Costa Rica, by Mr. George Tassinari. Mr. C. W. Johnson, to whom I am indebted for its determination, tells me that an example of this species has previously been taken at Nantucket.

All three specimens have been placed in the local collection (Essex County, Mass.) of insects of the Peabody Museum, Salem.

UNDESCRIBED SPECIES OF DICRANOPTYCHA FROM EASTERN NORTH AMERICA (TIPULIDÆ, DIPTERA).[1]

By Charles P. Alexander,

Amherst, Mass.

While revising the species of the crane-fly genus *Dicranoptycha* in my collection, a few species that had not been described were noted and their diagnoses are given in this paper. The material upon which the descriptions are based was largely included in the writer's collection and in a very extensive series of these flies collected in Indiana, Tennessee, North Carolina, Georgia and Florida by Prof. J. Speed Rogers of the University of Florida. Specimens of *Dicranoptycha septemtrionis* were taken by Dr. Crampton and by Mr. M. C. Van Duzee. I express my sincere thanks to all of the above named gentlemen for their cooperation in this matter.

The crane-flies of the genus *Dicranoptycha* are eminently characteristic of open Austral woodlands, often occurring far from running water. The immature stages of certain species, at least, are spent in dry soil in habitats such as the above. Recent papers by the writer on the Eastern species are included in the following references: Entomological News, 30: 19-22; 1919. Pomona Journal of Entomology and Zoology, 11: 67-74; 1919. Cornell University Agr. Expt. Sta., Memoir 38: 829-830; 1920.

The structure of the male hypopygium offers the best characters for the differentiation of some of the otherwise very similar species. In general, the basistyles are unarmed and do not offer good specific characters. The two dististyles are broadly joined at base, the outer more or less heavily chitinized and armed in various ways with teeth and erect setulæ. The shape of this style and its armature is of prime importance in defining the various species. In *D. tigrina* Alex., *D. minima* Alex. and *D. pallida*, sp. n., there are no denticles on the outer margin of the style. The inner dististyle is more fleshy and differs in shape in

[1]Contribution from the Department o Entomology, Massachusetts Agricultural College.

the various forms. At the base of the mesal face of the basistyle but not connected with it, nor, apparently, connected with the tergite, lies a pale flattened rod that is termed herein the *lateral process*. From its position it appears to be an *interbasal process* but from its location in membrane rather removed from the basistyles, I hesitate to call the structure an interbase. The shape of these lateral processes differs much in the various species. The aedeagus and surrounding apophyses vary greatly and offer remarkable characters. The largest aedeagi are found in *D. sobrina* O. S. and *D. megaphallus*, sp. n. In most of the other species, the organ is relatively small and insignificant. The gonapophyses are greatly produced and bifid at their tips in *D. tigrina* Alex.

Dicranoptycha australis sp. n.

Male.—Length 9-9.5 mm.; wing 8.5 mm.

Female.—Length about 8-8.5 mm.; wing 8-8.3 mm.

Generally similar to *D. sobrina* O. S., differing especially in the hypopygial characters.

Basal two segments of antennæ obscure yellow, the flagellum abruptly dark brown. Head and thorax light gray, the præscutum with a very ill-defined grayish brown median stripe. Pleura light gray. Legs with the coxæ sparsely pruinose; trochanters obscure yellow; femora and tibiæ obscure yellow, with darker setæ; terminal tarsal segments passing into dark brown. Wings with the costal fringe (♂) relatively short and inconspicuous; membrane strongly suffused with brownish yellow, the costal region clearer yellow; veins brown. Venation: *Rs* shorter than the elongate cell *1st* M_2, sometimes angulated and spurred at origin.

Abdominal tergites pale to medium brown; segment seven blackened; eight dark brown; hypopygium and sternites pale. Male hypopygium with the outer dististyle relatively small, gradually narrowed and gently curved to the long acute apical spine; outer surface with short, dense, erect setæ; distal half with microscopic appressed serrulations. Inner dististyle stout, the apex suddenly enlarged, provided with coarse setæ. Aedeagus relatively small and inconspicuous, the apex rounded. Lateral processes with the apex of each not evenly rounded but directed slightly lateral, the mesal edge rounded, the lateral edge nearly straight to appear like a pruning-knife.

Habitat.—South-eastern United States.

Holotype, ♂, Gainesville, Florida, April 15, 1922 (J. S. Rogers); No. 43.

Allotype, ♀, Ocmulgee Valley, Bibb Co., Georgia, June 3, 1923 (J. S. Rogers); No. 4.

Paratopotypes, 6 ♂ ♀; paratype, 1 ♂, with the allotype.

Type returned to Professor Rogers.

Dicranoptycha septemtrionis sp. n.

Generally similar to *D. sobrina* O. S.; mesonotum dark brown, sparsely dusted with gray; pleura pruinose; femora and tibiæ yellow, the terminal tarsal segments dark brown; wings tinged with yellow, with a faint brown tinge; abdominal tergites brown, segments seven and eight dark brown; male hypopygium with the outer dististyle rather strongly curved, the blackened apex microscopically serrulate on all surfaces; ædeagus small and inconspicuous, about equal in size to the lateral process.

Male.—Length 7-7.5 mm.; wing 8.5-9 mm.

Rostrum brownish gray, the palpi drak brown. Antennæ with the basal segments light yellow, the flagellar segments gradually passing into brown. Head yellowish gray.

Pronotum dark, dusted with gray. Mesonotal præscutum dark brown, sparsely dusted with gray, especially on the humeri; scutellum and postnotum gray dusted. Pleura pale, the dorsal pleurites darker, the entire surface sparsely pruinose. Halteres pale, the knobs weakly infuscated. Legs with the coxæ and trochanters yellow; femora and tibiæ yellow; basitarsi yellow, the tips and remainder of the tarsi dark brown. Wings with a yellowish tinge, weakly suffused with brown, the costal region clearer yellow; veins pale brown, those of the costal region more yellowish. Costal fringe (♂) relatively short. Venation: *Rs* longer than cell 1*st* M_2, the latter rectangular; *m-cu* shortly beyond the fork of *M*.

Abdominal tergites brown, segments seven and eight dark brown, segment nine slightly paler; remainder of hypopygium yellow; sternites brownish yellow. Male hypopygium with the outer dististyle relatively short, rather strongly curved to the acute tip, with about the distal half to third of the style blackened; base of style with microscopic setulæ that become longer, more conspicuous and suberect outwardly, the surface of the style in the blackened portion microscopically serrulate on all surfaces. Inner dististyle longer, fleshy, with conspicuous setæ, the style gradually narrowed to the blunt apex. Aedeagus small and inconspicuous, subequal in size to one of the lateral processes, the latter broad at base, thence gradually decreasing to the narrowly obtuse apex.

Habitat.—North-eastern United States.

Holotype, ♂, Greenfield Mt., Franklin Co., Massachusetts, September 6, 1925 (G. C. Crampton).

Paratopotypes, ♂ ♀, August 23-September 6, 1925 (C. P. Alexander); paratype, ♂, Niagara Falls, New York, September 6, 1911 (M. C. Duzee).

Type in the writer's collection.

All of the records for *D. sobrina* O. S. in my "Crane-flies of New York," Part I, Cornell University Agr. Expt. Sta. Mem. 25: 797; 1919, pertain to this new species. Material was sent to various collections in 1925 with the determination of *D. sobrina.* The species flies late in the season and all of those seen alive by the writer occurred near sluggish streams of water, usually at the foot of wooded hillsides.

Dicranoptycha megaphallus sp. n,

Male.—Length about 8 mm.; wing 9.2 mm.

Generally similar to *D. sobrina* O. S., differing conspicuously in several features, notably the short costal fringe of the male and the spinulose outer dististyle of the male hypopygium.

The head and thorax of the type are greasy and the coloration is discussed in general terms only. Antennæ with the scapal segments light yellow, the flagellum darker. Head dark, any normal pruinosity destroyed. Thorax dark colored, undoubtedly pruinose in fresh specimens; sternopleurite paler than the remainder of the pleura. Halteres pale, the knobs slightly darkened. Legs with the coxæ and trochanters obscure yellow; femora yellow, including the fore femora; tibiæ and tarsi yellow, the terminal tarsal segments passing into dark brown. Wings with a grayish yellow tinge, the base and costal region clearer yellow; veins brown, more yellowish in the costal region. Venation: *Rs* shorter than cell 1*st* M_2, the proximal end of the latter more arcuated; *m-cu* a little less than its own length beyond the fork of *M*.

Abdominal tergites brown, the lateral margins narrowly paler; segments six and seven dark brown, eight and nine, with the hypopygium, yellow; sternites yellowish brown. Male hypopygium with the outer dististyle relatively long and slender, the distal half or less blackened and armed with small but conspicuous spinules, those on the outer face more nearly erect; basal half of style on outer face with short, dense, erect setulæ. Inner dististyle broad basally, narrowed apically, the tip a little expanded. Aedeagus very large, on slide appearing rectangular, the tip subtruncate, pale. Lateral processes evenly rounded at tips.

Habitat.—Tennessee.

Holotype, ♂, Allardt, Fentress Co., at light, altitude 1650 feet, June 10, 1924 (J. S. Rogers); No. 11.

Type returned to Professor Rogers.

Dicranoptycha pallida sp. n.

Generally similar to *D. winnemana* Alex., in the pale coloration; legs yellow, the tips of the tibiæ and the basal segments of tarsi narrowly darkened; wings with a strong yellow tinge; costal fringe (♂) short; abdomen (♂) with only the eighth segment darkened; male hypopygium with the outer dististyle smooth on the outer convex face; ædeagus small; a single small, median gonapophysis.

Male.—Length about 7-7.2 mm.; wing 7.2-7.8 mm.

Female.—Length 9-9.5 mm.; wing 8-8.5 mm.

Rostrum and palpi dark brown. Antennæ with the basal segments obscure yellow, only the outer flagellar segments more infuscated. Head brownish yellow.

Mesonotum shiny brownish yellow, the pleura light gray pruinose. Halters pale, the knobs slightly infuscated. Legs with the coxæ slightly pruinose; trochanters obscure yellow; femora yellow, with conspicuous erect setæ; tibiæ and tarsi light yellow, the tips of the individual segments weakly infuscated; terminal tarsal segments uniformly infuscated. Wings with a strong brownish yellow suffusion, the costal region clearer yellow; veins dark yellow. A few trichiæ at ends of both anal veins. Costal fringe (♂) relatively short. Venation: *Rs* considerably longer than cell 1*st* M_2.

Abdominal tergites brownish yellow, segment eight conspicuously dark brown; ninth tergite and the hypopygium light yellow; sternites paler yellow. Male hypopygium with the outer dististyle of moderate length, gently curved to the acute tip, the outer margin entirely smooth, the inner margin with only a few weak denticles on the distal quarter before the spinous apex; vestiture of style barely visible, under high magnification appearing as microscopic setulæ. Inner dististyle stout, gradually decreasing in diameter outwardly, clothed with conspicuous slender setæ, those at the apex only a little stouter. Aedeagus small, relatively slender. A single gonapophysis, the tip of which is bent ventrad toward the ædeagus. Lateral process with the apex evenly rounded.

Habitat.—Kansas.

Holotype, ♂, Lawrence, Douglas Co., altitude 900 feet, August 1, 1918 (C. P. Alexander).

Allotopotype, ♀, July 16, 1918.

Paratopotypes, 10 ♂ ♀, July 16-August 1, 1918.

Type in the writer's collection.

This is the species (Kansas material only) discussed in earlier papers by the writer as being *D. winnemana* Alex. (Ent. News, 30: 19-21; 1919—Pomona Journ. Ent. and Zool., 11: 67-74; 1919—Cornell Univ. Agr. Expt. Sta., Mem. 38: 829-830; 1920).

SPIDERS EATING SNAKES.

In a communication to the Biological Society of Sao Paulo, Brazil, July 8, 1925, Drs. Brazil and Vellard give an account of a spider which eats snakes, frogs and lizards in preference to insects. I am indebted to Dr. Amaral from Brazil who is now in Cambridge for translation of part of this paper.

The spider, *Grammostola acteon* Pocock, is one of the large Aviculariidæ commonly known as "tarantula." The body of a male is 60 mm. in length, the thorax 24 mm., the abdomen 36 mm., the legs 60 to 72 mm. The female is somewhat larger with shorter legs.

One of these spiders, kept in confinement, refused for some time to eat insects which were offered to it. One day a small frog was put in with it and the spider at once pounced upon it, crushed it with its jaws and fed upon it. The same experiment with other individuals and other kinds of frogs showed that the spiders preferred the frogs to insects. Small snakes were then given to them, and they took these as readily as they did also small lizards.

When a *Grammostola* and a young snake are put in a cage together the spider tries to catch the snake by the head and will hold on in spite of all efforts of the snake to shake him off. After a minute or two the spider's poison takes effect, and the snake become quiet. Beginning at the head, the spider crushes the snake with its mandibles and feeds upon its soft parts, sometimes taking 24 hours or more to suck the whole animal, leaving the remains in a shapeless mass.

In a large cage with snakes 25 to 45 centimeters long, frogs and insects, the spiders will generally neglect the insects.

The *Grammostola* does not feed with much regularity. One individual took 48 hours to suck a frog 6 cm. long. Two days later it ate a small snake, *Crotalus terrificus*, on the third day a frog, *Cyclorhamphus*, and the next day a snake, *Bothrops jaracara*, after which it was two weeks before it ate again.

J. H. Emerton.

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NEW OR LITTLE-KNOWN AUSTRALASIAN CICADAS OF THE GENUS *MELAMPSALTA*, WITH NOTES ON SONGS BY IRIS MYERS.[1]

BY J. G. MYERS,

1851 Exhibition Scholar for New Zealand, 1924.

The purpose of the present paper is threefold; firstly to describe a few new species brought to light by further collecting in the river-beds and mountains of the South Island, secondly to record the songs of several forms not known to us firsthand in 1924 (*v.* Myers and Myers), and thirdly to present taxonomic notes on a number of Australian and one New Caledonian cicada which indicate the nearest relationships and the probable origin of the cicada fauna of the Dominion. It is reserved for a later paper to trace the supposed lines of evolution of the nineteen cicadas now known in New Zealand, and to show how the descendants of one immigrant form are believed to have colonised the various ethological stations offered by the diversified New Zealand countryside.

A plea is made for the completer use of the male genitalia in cicada systematics. The ædeagus at least should be dissected out and mounted for microscopic examination. After considerable-trial I prefer not to use KOH at all, but to dissect directly in water, either fresh or relaxed material. The lateral pieces of the ædeagus are often so tenuous as to be distorted if not destroyed by caustic, while the whole structure is relatively so great that direct dissection and careful removal of muscles is a speedy and easy task. If necessary the pygophor may be returned to its natural position after the ædeagus and one or both copulatory hooks have been removed.

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 265.

After the usual dehydration the ædeagus and copulatory hooks are mounted in balsam on a slip of celluloid pierced by the pin of the insect to which they belong. We may follow Mr. F. W. Edwards' method with mosquito hypandr a and leave them entirely bare of cover-slip, or we may use a cover either of glass or of celluloid. If it becomes necessary to use the genitalic material thus mounted, in a projectoscope or in a photo-micrographic apparatus, one has prepared a stock of cards of the size and shape of a microscope slide, and with a strip of stout paper of exactly similar dimensions pasted on them by both ends. A circular hole of appropriate size is punched through both paper and card and the celluloid mount is then slipped in between paper and card so as to extend across the hole. The resulting combination can be handled in all respects like an ordinary glass microscopic slide.

A complete synonymy of these and other species will be given in my forthcoming list of the Cicadidæ of the world. It has been elucidated for the New Zealand species in a paper now in the press (*Trans. New Zealand Institute*, 1926). Only sufficient references are quoted here to establish the nomenclature adopted. An examination of all the types of New Zealand cicadas accomplished last summer in Europe, has led to several disturbing but necessary changes in the names of the commoner species.

Melampsalta sericea (Walk.)

Cicada sericea Walk., 1850, List Homopt. Brit. Mus., p. 169.
C. nervosa Walk., *op. cit.*, p. 213.
Melampsalta indistincta Myers, 1921, Trans. N. Z. Inst., vol. 53, p. 245, pl. 46, figs. 7, 8.

The above synonymy is based on a study of the types in the British Museum. The insect now labelled as type of *sericea* is a female, while that of *nervosa* is a male. *Sericea* is the Maorian representative of a homogeneous group of species found also in New Caledonia and in Australia, and reaching its highest development in the arid and semi-arid regions of the latter continent. The New Caledonian species, *M. melanesiana* is described below. The Australian representatives include the following, of which the types were examined in the British Museum, while in some cases the genitalia of closely similar specimens were dissected. I owe hearty acknowledgements to the British Museum authorities and especially to Mr. W. E. China for giving me all possible facilities.

A very useful specific character in this group lies in the development of a shining boss like a Lecaniine Coccid (e. g. *Saissetia*) at the base of each operculum. This swelling is markedly different in texture and often in colour from the adjacent chitin.

Melampsalta labyrinthica (Walk.): the type is a female, but a male placed as conspecific by Distant had the *Saissetia* swelling distinctly marked. Australia.

M. quadricincta (Walk.): the type is from King George's Sound, S. W. Australia, and all truly conspecific examples are from Western Australia. The swelling at base of operculum is very conspicuous and well-developed. A series of specimens of somewhat larger size from Yallingup, W. Australia (R. E. Turner coll.) shows a slightly wider head but agrees in male genitalic structure and in opercular characters.

M. sp.?: two males from W. Australia, arranged under *quadricincta* have the opercular swellings less distinct and are in other respects different, but cannot be described without comparison with types in Australia.

M. latorea (Walk.): the type has the opercular swelling very distinctly developed. Most of the examples in the British Museum are from W. Australia and the species is almost certainly synonymous with *quadricincta* from the same region, but the male genitalia must be dissected to establish this.

M. waterhousei Dist.: the type has the opercular swelling ill-developed.

M. labyrinthica (Walk.): the type is a female but a male placed as conspecific has the opercular swelling distinctly marked. Australia.

M. mackinlayi Dist.: the type is a female but a male placed as conspecific has no signs of the opercular swelling. Queensland.

M. stradbrokensis Dist.: the type has indications of the opercular swelling but not very distinct. This species, from

Stradbrooke Island, is darker than most of the other members of this group.

Of this list, *quadricincta*, *nervosa*, *M.* sp.?, with *melanesiana* and the New Zealand alpine cicada, *cassiope* Huds., were placed by Distant under the synonymy of the first-named. The name *quadricincta* is therefore to be expunged from New Zealand lists. *Sericea*, of which *nervosa* is a synonym, is nearest to *melanesiana* and to *quadricincta*. To the latter it is closer in facies and in width of head, but the two are distinct in opercular structure since *sericea* has no signs of the swelling so highly developed in *quadricincta*. To *melanesiana* it is related in opercular structure, the swelling being very feebly developed in the New Caledonian species, but the facies is different largely on account of the wider head of the latter. *Sericea* is fairly distinct from both in male genitalic characters.

Needless to say, the synonymisation of *cassiope* with *nervosa* or with any other species of this group has no foundation in morphology or even in appearance. But *M. viridicincta* Ashton (1912, p. 78, pl. 7, fig. 5) from Perth, W. Australia, certainly belongs to this group, and judging from the description is almost certainly a synonym of *quadricincta*.

The genitalia of several forms from the group under discussion are figured.

Melampsalta melanesiana sp. n.

♂. Head very short and very wide—wider than anterior part of pronotum and equal to widest part of pronotum. Mesonotum comparatively narrow. Abdomen long oblong, somewhat laterally compressed. (This compression may be due to drying, but related species do not dry thus). Not hairy. Seventh sternite long, somewhat truncate apically. Venation normal for the genus. Fore femora with the usual three spines beneath. Aedeagus as figured (4). Hind tibia with five spines not counting the apical ones Opercula short and well-separated with practically no signs of the shining boss at the base.

Color black with greenish and testaceous markings as follows,—greenish markings.—anterior border and posterior triangular spot of vertex, hind border and longitudinal lanceolate mark on pronotum, four fasciæ and most of cruciform elevation and visible portion of metanotum; testaceous markings,—very narrow fore border of pronotum, two oblique fasciæ on each side of pronotum and posterior edge of abdominal segments, margin of frons, rostrum except tip, and most of anterior two pairs of legs. Ventral surface in general fuscous, with thoracic sterna black, and pleura, opercula and hind legs very pale greenish.

Length to tip of last tergite, 18.0 mm.; length of head, 1.5; width between eyes, 2.9; length of pronotum, 2.6; length of mesonotum, 4.0; length of tegmen, 21.4; greatest width of tegmen, 7.7; ratio of length of 2nd antennal segment to that of 3rd, 1.7:1; ratio of width between eyes to length of vertex, 2.9: 1.5, or 0.52.

Described from 5 males, Plaine des Lacs, New Caledonia (coll. P. D. Montague), and placed by Distant in the British Museum collection under *quadricincta* and thus recorded (Dist., 1920, p. 459).

Holotype: Plaine des Lacs, N. C., 20th February. 1914. British Museum.

Paratopotypes: 3 males, February, 1914.

Paratype: 1 male, Kuakué, New Caledonia, 14th May, 1914.

This species is not at all likely to be confused with any of the other New Caledonian species of *Melampsalta*. There is but little variation in size in the series examined and still less in color. The largest is 19 mm. long, and the smallest (from Kuakué) 15 mm.

The holotype and all other material are in the British Museum, save two paratopotypes in my collection.

Melampsalta oromelaena sp. n.

Form stout, widest at third abdominal segment. Head much narrower than pronotum. Seventh sternite very short, widely rounded apically, very slightly indented. Venation normal for the genus. Veins fuscous, black apically. Whole body very hairy with long black hairs and short white decumbent pubescence, the latter especially marked in female and producing in that sex a generally grey appearance. Hind tibiæ with five spines exclusive of apical ones. Opercula very short, crescentic, barely hiding the underlying cavities. Axillary membranes distinctly white. Aedeagus as in figure 8.

Color jet-black, male immaculate save for opercula which are largely whitish, and the following testaceous markings,—an almost imperceptible edging to abdominal tergites except the basal two or three, a narrow edging above antennal scrobe, sides of face, posterior margins of abdominal sternites. Female with wing-veins paler, apex of vertex, sides of pygophor and most of venter pale testaceous; also testaceous are two marks on each side of disc of pronotum, its posterior margin very narrowly, most of cruciform elevation and a narrow posterior margin to mesonotum. A silvery median longitudinal line on abdomen formed by white pubescence. Fore femora olivaceous striped with black.

Dimensions in mm. (first figure, male, second, female).—Length to tip of last tergite, 19.0; 20.1; length of head, 1.7; 2.3; width between eyes, 2.5; 3.0; length of pronotum, 2.5; 3.0; length of mesonotum, 3.9; 4.7; length of tegmen, 18.8; 21.0; greatest width of tegmen, 7.0; 8.1; ratio of second antennal segment to third, in length, 1.6:1 (♂ ♀); ratio of width between eyes to length of vertex, .70; .77.

Holotype, male, Mt. Cleughearn, Hunter Mountains, Southland, New Zealand, 3,000 feet, 25th June, 1917, A. Philpott. (Myers collection).

Allotype, female, same data as holotype. (Myers collection.)

Paratopotypes, 2 males, 3,000 feet, 22nd January, 1914, A. Philpott.

Paratypes, 2 males and 4 females Mt. Cook, 4500 feet, 11th March, 1923, R. J. Tillyard. One male of these is only 15 mm. long, but agrees in ædeagal structure and in other respects. The females are much blacker than the type and what pale markings they possess are not testaceous but drab.

Females referred without certainty to this speces.—Two from Lake Wakatipu, 3,600—4,000 feet, February, 1911, G. V. Hudson; one from Ben Lomond, 20th December, 1913, A. Philpott; one from Arthur's Pass, 3,000—4,000 feet, February, 1920, G. V. Hudson.

In the present fragmentary state of our knowledge of the mountain cicadas of New Zealand, it is very difficult to separate the females of some of the species of which the male genitalia are remarkably distinct The most useful character so far used is the ratio of the length of the vertex to the width between eyes.

Oromelœna is a high mountain form nearest to *nigra*, but distnguished by its larger size and different ædeagus (fig. 8).

Melampsalta mangu F. B. White.

F. B. White, 1879, Ent. Mo. Mag., vol. 15, p. 21.

M. quadricincta (part) Myers, (nec Walk.), 1921, Trans. N. Z. Inst., vol. 53, p. 246, (pl. 45, figs. 3, 4, are not this species but true *cassiope*).

Buchanan White evidently had two species before him, comprised in four examples from "Porter's Pass, Canterbury, about 3,500 feet," collected by Wakefield. The bulk of the description seems to refer to the common alpine cicada named by Hudson, *Cicada cassiope*, but hitherto placed in the synonymy of the quite unrelated Australian *M. quadricincta* (Walk.) as we have noticed previously. But the only remaining material of *M. mangu* in the Buchanan White collection is a female in poor condition, labelled "*mangu*," presumably in White's handwriting and with the locality, "Porter's Pass," but lacking a date. It is reasonable to suppose that this is one of the original four, and therefore by elimination to be considered the type of *M. mangu*. It is not conspecific with *cassiope*, but with a form of which we have a series from the Dun Mountain, and which we were about to describe as new. Buchanan White's specimen differs only in the fact that the hind tibiæ have a dark ring near the middle, but the leg coloration in *Melampsalta*, especially the mountain forms, seems very variable.

The large and altogether black species mentioned by White at the close of his description, is probably conspecific with *oromelœna* sp. n., just described.

The following is a re-description of the type of *mangu*.—

Much worn, blackish with reddish yellow markings as follows,—a longitudinally grooved spot on middle of posterior margin of vertex, one on each side on the ledge overhanging the antennæ, a faint median longitudinal line on disc of pronotum, almost whole of cruciform elevation except anterior entrant angle, a very narrow edging to abdominal tergites, almost invisible dorsally, a large smooth patch on side of eighth segment, an irregular marking along side of pygophor, most of ventral surface and legs. The legs are striped in typical fashion with black, differing from my Dun Mt. examples only in possessing a blackish ring on midde of hind tibiæ.

A few colorless long hairs, especially on head and posterior part of abdomen. A fairly dense covering of fine close golden prostrate pubescence, save on salient points like disc of mesonotum, whence it was probably rubbed off.

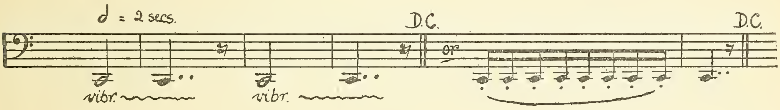
Fore femora both badly damaged, but apparently as in Dun Mt. specimens, with which the type agrees also in the spines of the hind tibiæ. Eyes pale. A yellowish spot at base of second antennal segment apparently not present in Dun Mt. examples. Wings very murky—possibly the insect was killed too soon after emergence. Veins all brownish, not dark. Rostrum reaching middle coxæ. Frons tumid with the striæ filled with golden pubescence, looking like stripes on the jet-black ground color.

Dimensions in mm.—Length to tip of last tergite, 18.4; length of head, 2.3; width between eyes, 2.7; ratio, .84; length of pronotum, 2.5; length of mesonotum, 4.0; length of tegmen, 18.0; greatest width of tegmen, 6.7; ratio of lengths, 2nd to 3rd antennal segments, 1.4:1.

The males of the Dun Mountain examples, as usual in *Melampsalta*, are darker than the females, the chitin color being almost immaculate black, but the general color is greyish owing to the covering golden pubescence. The insect rests on bare rocks in the fell field and is extremely hard to see. We have examined the following material.—

A series of both sexes in the collections of the Cawthron Institute and of myself, all taken on the Dun Mountain, Nelson 14th December to 23rd January at elevations from 3,000 to 4,000 feet. A single female is doubtfully referred to this species from Mount Tapuaenuku, 3,000 to 4,000 feet (coll. G. V. Hudson, 14th February, 1890). From the Dun Mountain material I have selected a male plesiotype (in my collection) and figured the genitalia. I expressly refrain from declaring this the allotype of *mangu*, for material from the type locality of the latter species may prove my identification, based on the single female, to be incorrect.

The song of *Melampsalta mangu.*—The song of the insect which we have identified with Buchanan White's *M. mangu* is extremely low-pitched—so low as to be almost imperceptible to some ears until attention is called to it. It has a very dull, toneless quality, and sounds rather like a buzzing wing vibration. It consists of a series of slow *vibrato* phrases of two notes of the same pitch at a rate of approximately one note in 2 seconds. The first, longer note of the phrase sounds, when one is nearer to the insect, more like a series of discrete staccato notes. Because of the vague muffled quality of tone the insect is almost unlocalisable by sound. Partly because it is over two octaves lower in pitch, and partly because of the tonal quality accompanying this, the song of *M. mangu* is utterly unlike that of any other New Zealand cicada so far heard.



Melampsalta campbelli Myers

1923, Trans. New Zealand Inst., vol. 54, p. 430.

The male, discovered since the above was written, may be described as follows,—Head considerably narrower than pronotum. Abdomen somewhat oblong. Seventh sternite very short and wide, narrowing and sinuate apically. Venation normal for the genus. Head and thorax especially, moderately hairy with long black hairs. (The female holotype was worn and smooth). Opercula moderately large with shining black slightly elevated area at base. Aedeagus as figured (12).

Coloration much as in female described in 1923, but on the whole much darker, especially on the abdomen, which is largely black, the tymbals pale. Seventh tergite posteriorly margined with olivaceous and eighth very widely with red and tipped with shining silver pubescence. A median longitudina dorsal line formed by patch of this pubescence on nearly every tergite and an edging to the third to eighth tergites laterally, conspicuous in dorsal view but less so from lateral aspect. Veins red, darker apically, the tegmen suffused very strongly with olive-brown. Axillary membranes of tegmen and of hind-wing and much of anal area of latter china-white.

Dimensions in mm. (the second figure in every case is that of paratype female).—Length to tip of last tergite, 15.0; 15.5; length of head, 1.5; 1.9; width between eyes, 2.4, 2.4; ratio, .63; .80; length of pronotum, 2.4; 2.4; length of mesonotum, 3.0; 3.0 length of tegmen, 15.0; 14.0; greatest width of temen, 5.5; 5.4.

Allotype, male, Otira, New Zealand, 1,700 feet, 5th January, 1923, Iris Myers. (Series taken)

Other material has been examined as follows —Examples from Mt. Cook, 2,500 feet, 8th March, 1923, R. J. Tillyard; from Waiau, Southland, 19th January, 1914, A. Philpott; from White Rock, North Canterbury, December, 1918, S. and C. Lindsay.

All these specimens agree in being much darker than the types and with less suffusion in the tegmen, at least than in freshly caught examples. For these reasons the males from Waiau and from White Rock were not previously recognised as conspecific with the females on which the description of the species was based.

A freshly caught female is less brilliant than the holotype, which had evidently bleached out much of the darker color, together with the suffusion of the tegmina.

The song of *Melampsalta campbelli.*—This song is faint, slow and of a muted quality rather resembling that of *M. scutellaris*, of which it is occasionally reminiscent also in rhythmic structure (C) though quite distinct. The cicada was first heard (at Otira in January, 1923) singing when the sun was hidden by clouds. A long note, lasting 6 seconds, was followed by a monotonous, disjointed series of staccato notes of uniform pitch, at a rate of 1 per second. The sun suddenly came out and song (A) became more spirited, resolving itself into song (B), slightly rasping, varied in volume and rhythm, with a rise and fall in pitch of a major third, or sometimes a major fifth as in phrase (C) which was an occasional variant of the preceding phrase. This had a vocal quality which may be expressed as "oo-er-ih."

Unfortunately the song was heard unexpectedly at a time when no exact means of determining pitch was at hand. It was judged to lie somewhere in the octave between C 256 vs. and C 512 vs.

Melampsalta hamiltoni sp. n.

Very short and squat, especially in the female. Vertex narrow, slightly produced. Antennæ unusually long. Seventh sternite of male short, truncate, almost rectangular. Venation normal for the genus; veins fuscous, black apically; in the female basally pale brown. Hind tibiæ with five spines exclusive of apical ones. Opercula extremely short, failing to cover the underlying cavity. Aedeagus as figured (11).

Color uniform dark grey in both sexes, due to paler hairs and especially to an even extremely short golden pubescence obscuring a jet-black chitin color. Even the opercula are black (in other spp. usually paler than rest of body). Fore femora uniform black. Venter black except for suggestions of paler markings on segmental margins, thoracic pleura and apices of hind tibiæ. Axillary membrane of tegmen basally yellowish.

Dimensions in mm. (second figure that of female).—Length to tip of last tergite, 15.5; 15.0; length of head, 1.9; 2.2; width between eyes, 2.5; 2.6; ratio, .76; .84; length of pronotum, 2.3; 2.3; length of mesonotum, 3.4; 3.6; length of tegmen, 15.4; 15.4; greatest width of tegmen, 5.2; 5.2.

Holotype, male, Arthur's Pass, New Zealand, 2,500 feet, 19th December, 1922, Iris Myers. (Myers collection).

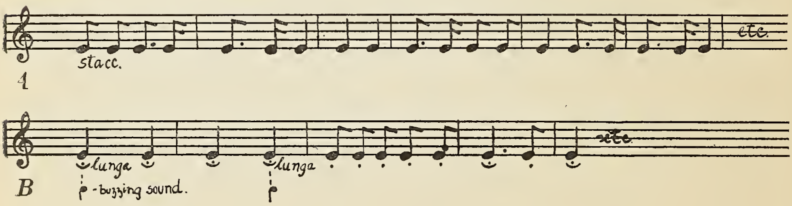
Allotype, female, same station, 24th December, J. G. Myers. (Myers coll.)

Paratopotypes, series of males and one female, H. Hamilton, Myers.

Paratypes, 2 males, White Rock, North Canterbury, 26th November, 1922, S. Lindsay.

This very interesting species, apparently confined to unstable river-beds, is dedicated to Mr. H. Hamilton, who discovered the species at Arthur's Pass before we collected it there. It is very cryptically colored on the grey river-bed shingle and is one of the most difficult of all New Zealand cicadas to locate.

The song of *Melampsalta hamiltoni.*—When first heard from a distance this song sounds very like a fainter edition of the song of *M. muta.* Closer acquaintance reveals distinct differences, though a resemblance in pattern and in tonal quality still remains. The song of *Hamiltoni* is pitched slightly lower, the rhythm of the short rather staccato notes is more broken, though the tempo is very similar, being from two to three notes per second. A striking difference, however, is that quite often in the song (*v.* B) a series of long drawn out notes is accompanied by a peculiar low buzzing sound, perhaps made by the wings, though this has not yet been ascertained.



Melampsalta cassiope (Huds.)

Cicada cassiope Hudson, 1891, Trans. N. Z. Inst., vol. 23, p. 54.
Melampsalta quadricincta Myers (nec Walk.), 1921, Trans. N. Z.

Inst., vol. 53, p. 246, pl. 45, figs. 3, 4. (Exclusive of synonymy).

With the disposal of *quadricincta* Walk. and *mangu* Buchanan White, this species, the most widely distributed and best known of New Zealand mountain cicadas, fittingly takes once more the name given it by Mr. G. V. Hudson, than whom no one has contributed more towards a knowledge of the mountain insects of the Dominion.

The description and figures of *quadricincta* (Myers, nec Walker) in Myers (1921), apply correctly to *cassiope*, but the synonymy and distributional records are to be disregarded. The male genitalia of a specimen compared with the type material are figured (14). A strong pinkish suffusion of the body is a constant character.

The mountain cicadas of the South Island are now so numerous, and often very difficult to separate by general appearance that I have thought it worth while to figure the aedeagus and related structures in them all. With no exception the male genitalia supply excellent distinguishing characters.

The song of *Melampsalta cassiope.*—This consists of a resonant, birdlike prolonged lower note which may be vocalised as a vibrating "chur-r-r," rising in a slur to a faint, very much higher note, like a shrill squeak. The second note sounds distinctly like "-i-i-m" the whole phrase of the song giving the effect of "chur-r-r-----im" unmistakably.

The song is always slow and consists solely of a repetition of these two notes, both prolonged. The time of prolongation of each note varies so that there is no fixed rhythmical relation between them; for example in the sample given the first "churr" was observed to last 1 second, the "im" 2¼ seconds, the second "churr" 4 seconds, the "im" 8 seconds, the third "churr" 10 and the "im". 2. The song produces a peculiar spatial effect, the insect being localised much nearer on the low note than on the high one.

Melampsalta muta (Fabr.)

Tettigonia muta Fabricius, 1775, Syst. Ent., p. 681.
Melampsalta muta Kirby (part), Distant (part), Hudson (part), Hutton, Kirkaldy, nec Myers.
Melampsalta cruentata, authors including Myers (nec Fabricius), 1921, Trans. N. Z. Inst., vol. 53, p. 244, pl. 46, figs. 9-11.

This is perhaps the most variable cicada known. The elucidation of its manifold forms has been far from assisted by the century old misidentification of the type. *Muta* is a dominant species which has been and perhaps still is in an extremely plastic condition, mutating (?) right and left and occupying most of the less extreme ethological stations suitable for Cicadidæ.

It has been possib'e to collect very large series of this species from widely distant localities. This has led to the securing of complete chains of intermediates between the extreme forms and thus to a demonstration of specific identity. No attempts to split off segregates worthy of specific rank have so far been successful. Always a collecting excursion in an intermediate station, either geographically or ethologically, has brought to light connecting links. These annectent forms have shown themselves intermediate even in song, perhaps the most stable single character in cicadas.

We divide the species therefore into the following three varieties, for which names are already available.—

Var. a. **muta** (Fabr.) (as above).

Synonyms.—*Cicada rosea*, Walk., 1850, List Hom. Brit. Mus., p. 220.
C. angusta Walk., 1850, *op. cit.*, p. 174.
C. bilinea Walk., 1858, *op. cit.*, Suppl., p. 34.
C. muta Huds., and vars. *flavescens*, *cinerascens*, *rufescens*, 1891, Trans. N. Z. Inst., vol. 23, p. 51.

Var. b. **subalpina** (Huds.), 1891, Trans. N. Z. Inst., vol. 23, p. 51.

Synonyms.—*Melampsalta subalpina* (Huds.), Myers and Myers, 1924, Rep. Austr. Ass. Adv. Sci., (1923), p. 428.

Var. c. **cutora** (Walk.), (*Cicada*), 1850, List. Hom. Brit. Mus., p. 172.

Synonym.—*Melampsalta muta* var. *subalpina* Myers (nec Hudson), 1921, Trans. N. Z. Inst., vol. 53, p. 257. (From Kermadec Islands).

Just as *subalpina* connects *cutora* with var. *muta*, so *cutora* shows that *ochrina* is almost certainly derived from *muta*, though the result is sufficiently distinct to merit specific rank. Superficially *cutora* is more like *ochrina* than like *muta*, but the series of transitional forms between the latter and *cutora* is complete, while intermediates in any sense between *cutora* and *ochrina* (*muta* Myers, 1921, nec Fabr.) have not been found.

In 1921 (p. 244) I wrote, "It is interesting to note that this [*muta* Fabr.] is the only species not endemic. Goding and Froggatt ('Monograph of Australian Cicadidæ') record it from Adelaide and Victoria." We know now that this cicada is entirely confined to New Zealand. No authentic foreign specimen is known. Ashton (1912, p. 25) remarks that *M. angusta* God. and Frogg. *nec* Walk. is a synonym of *M. binotata* God. and Frogg. Their *angusta* is thus the male and their *binotata* the female of a species quite distinct from *angusta* Walk. which is a synonym of the Maorian *M. muta* (Fabr.).

In conclusion I should like to thank all the collectors mentioned in these pages for giving me the opportunity of studying their material.

Explanation of Plate III.

(Figures 7-14 inclusive are magnified exactly half as much as figures 1—6).

1. *Melampsalta quadricincta* (Walk.). ædeagus and copulatory hook of a specimen from Swan R., compared with type.
2. *Melampsalta melanesiana* sp. n., copulatory hook.
3. *Melampsalta quadricincta* (Walk.), ædeagus of example from S. W. Australia.
4. *Melampsalta melanesiana* sp. n., ædeagus.
5. *Melampsalta sericea* (Walk.), ædeugus and copulatory hook of form from Hawkes Bay.
6. *Melampsalta sericea* (Walk.), ædeagus of typical form.
7. *Melampsalta mangu* Buchanan White, ædeagus and copulatory hook of example from Dun Mountain.
8. *Melampsalta oromelæna* sp. n., ædeagus and copulatory hook.

9. *Melampsalta nigra* Myers, ædeagus and copulatory hook of topotype.
10. *Melampsalta lindsayi* (Myers), ædeagus and copulatory hook.
11. *Melampsalta hamiltoni* sp. n., ædeagus and copulatory hook
12. *Melampsalta campbelli* Myers, ædeagus and copulatory hook.
13. *Melampsalta iolanthe* (Hudson), ædeagus and copulatory hook.
14. *Melampsalta cassiope* (Hudson). ædeagus and copulatory hook.

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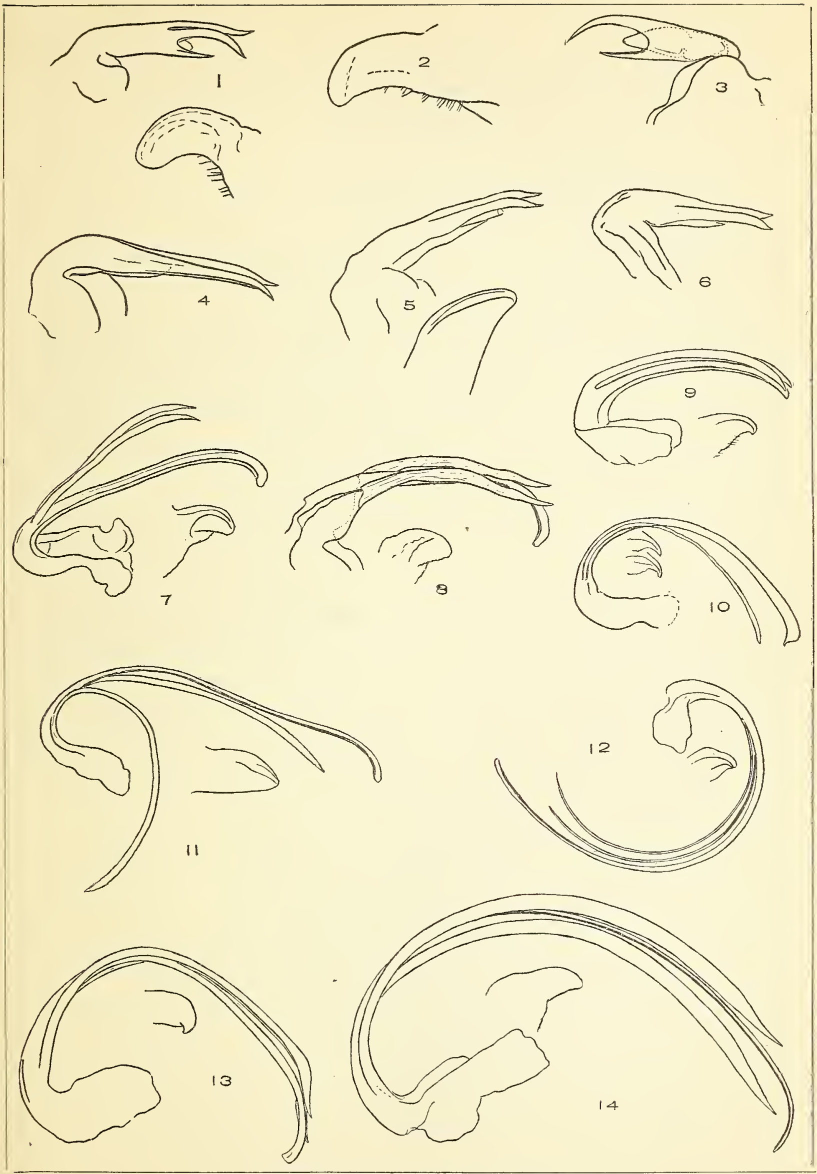

MYERS-AUSTRALASIAN CICADIDAE

THE AFFINITIES OF GRYLLOBLATTA INDICATED BY A STUDY OF THE HEAD AND ITS APPENDAGES

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Since specimens of *Grylloblatta* are extremely rare and valuable, I am deeply indebted to Mr. Eric Hearle and to Mr. H. S. Barber, for their kindness in supplying me with the material used in the preparation of this paper. The following discussion is based upon the study of *Grylloblatta campodeiformis* Walk., and *Grylloblatta barberi* Caud., with which I have been able to compare sketches of the parts of the only other known Grylloblattid, *Galloisiana nipponensis* Caud., through the kindness of Mr. A. N. Caudell.

The affinities of *Grylloblatta* indicated by the study of its terminal abdominal structures have been discussed by Walker 1919 and 1922; and the writer (Crampton 1915, 1917, 1923, 1924 and 1926) has discussed the evidence of its affinities indicated by a study of its antennæ, maxillæ, head, thorax and ovipositor. I believe that *Grylloblatta* is practically a living Protorthopteron very closely related to the common stock from which sprang the Tettigonioid and Grylloid Orthoptera, and the closest affinities of *Grylloblatta* are with the Tettigonioids. Outside of the true Orthoptera, the next of kin of the Grylloblattids are the Dermaptera, and the Phasmids are somewhat more remotely related to them. The Grylloblattids (with the rest of the Orthoptera) Dermaptera and Phasmids were descended from a common Protorthopteroid stock which also gave rise to the Embiids, whose line of descent parallels that of the Grylloblattids rather closely, but the nearest relatives of the Emblids are the Plecoptera. The Protorthopteroid ancestors of the Orthoptera (including Grylloblatta) Dermaptera and Phasmids were descended from Protoblattoid forms, from which the Blattids and Isoptera have departed but little. In the following discussion I would point out the evidences for this view afforded by a study of the head and its appendages in *Grylloblatta*.

The head capsule of *Grylloblatta* as shown in Fig. 2, gives no support to the view of Imms, 1925, for example, who maintains that *Grylloblatta* is one of the Cursoria, since the head of Grylloblatta is very similar to that of the Orthopteron *Gryllotalpa* in its general outline, the position of the eyes the location of the antennæ, and numerous other features. *Gryllotalpa*, however, and the other Grylloid Orthoptera have ocelli, so that in lacking these structures, the head of *Grylloblatta* resembles that of certain Tettigonioid Orthoptera such as *Ceuthophilus*, as is also true of other features of the head in these insects. On the other hand, the head of *Grylloblatta* is not like that of such Cursoria as the Blattids, Mantids, etc. and the evidence from this source would indicate that *Grylloblatta* is either a true Orthopteron, or possibly a relict of the extinct Protorthoptera-like ancestors of the Grylloids and Tettigonioids.

In tracing the type of head capsule exhibited by the Grylloblattids to its prototypes in the lower Orthopteroids clustered about the base of the line of descent of the Orthoptera, it at once becomes evident that the head capsule of *Grylloblatta* is so like that of the Dermaptera that the head of *Grylloblatta* should be referred to as Dermapteroid or Forficuloid. Thus, in a typical Dermapteran head, there is a pale anteclypeus, like the region labelled *ac* in Fig. 2; the antennæ are located near the bases of the mandibles, as in Fig. 2; the eyes are located far down the tempora (*tm* of Fig. 2); temporal sutures (*ts* of Fig. 2) demark the temporal regions *tm* from the parietal regions *pa*; the arms of the frontal suture *fs* are widespread as in Fig. 2; there are no ocelli present, and many other features of the Dermapteran head-capsule clearly indicate that the head of *Grylloblatta* (Fig. 2) is Dermapteroid. The evidence of the head-capsule would thus indicate that among the lower Orthopteroids, the Dermaptera are the next of kin of the Grylloblattids, and the correctness of this view is borne out by the evidence of the thoracic sclerites and many other features.

The head capsul of the Phasmids such as *Timema* approcahes the Grylloblattid and Dermapteran type in most of the features mentioned above, but the Phasmid type although clearly derived from the same source, apparently follows a path of specialization leading to extreme development along the line of massing the parts in the anterior region of the head, thus leading away from the common ancestral type from which the Grylloblattids and Dermaptera arose. The relation of the eyes and antennæ, etc., to the bases of the mandibles is likewise very similar in the Embiids and the forms mentioned above; but the Embiid type is evidently leading away from these Orthopteroids—although it, also, was evidently derived from Protorthopteroid prototypes.

The study of the head capsule thus bears out the evidence from other sources indicating that the Grylloblattids, Dermaptera and Phasmids are closely related, and sprang from a common Protorthopteroid ancestry; and these in turn were evidently derived from Protoblattoid ancestors. The Blattids, Mantids and Isoptera are the nearest living representatives of these Protoblattoid ancestors, and of these the Isoptera are in some respects the nearest living representatives of the Protoblattoid forms giving rise to the Protorthopteroid ancestors of the Grylloblattids, Dermaptera and Phasmids, so that we would expect to find among the Isoptera some types of head capsule suggesting the prototypes of the Dermapteroid head characteristic of the Grylloblattids, Dermaptera and Phasmids, and such is indeed the case. The resemblance, however, is more striking when one compares a Grylloid head, rather than the Grylloblattoid type, with a typical Isopterous head, since the head-contour, relation of the eyes, antennæ, bases of the mandibles, etc., are more nearly alike in the Grylloids and Isoptera, than is the case in the Grylloblattoids and most Isoptera. The thoracic sclerites of the Grylloblattoids and other Orthopteroids are very like those of the Isoptera, and the evidence from this source would lend support to that of the head capsule in indicating that the Isoptera are very like the Protoblattoid ancestors of the Orthopteroid group of insects.

While the head of such Blattids as *Cryptocercus* is rather suggestive of the precursor of the Orthopteran type of head, and the head capsule of such primitive Mantids as *Eremiaphila* exhibit certain features likewise suggestive of the starting point of the evolution of the Orthopteran type, the head of a typical Blattid or Mantid does not resemble that of a typical Orthopteron as much as the head of a typical termite does, and the thoracic sclerites of the Blattids and Mantids are not as similar to those of the Orthoptera as the thoracic sclerites of the Isoptera are, so that in general, the Isoptera are nearer to the ancestors of the Orthopteroids than the Blattids and Mantids are, although in the character of their terminal abdominal structures, the Blattids and Mantids approach the Orthopteran type more closely.

In the slenderness of the lacinia and galea, the maxilla of *Grylloblatta* (Fig. 1) resembles that of *Gryllotalpa* and the Dermaptera, but the stipes of *Grylloblatta* is not divided into the

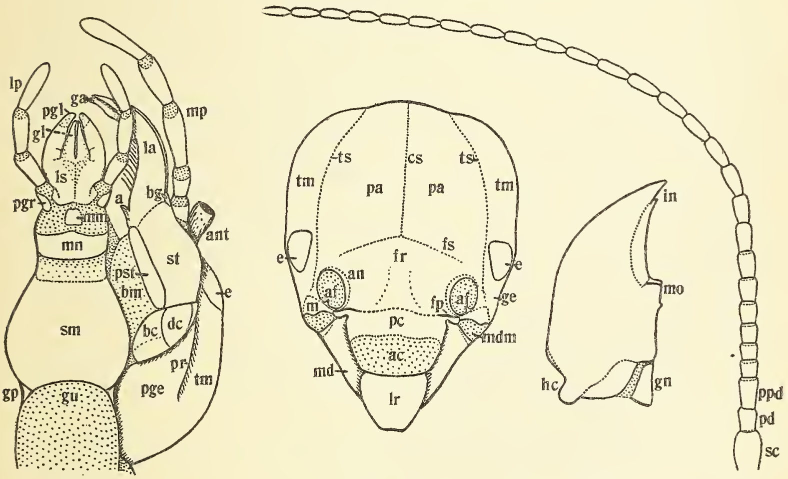

Fig. 1 Fig. 2 Fig. 3 Fig. 4

Fig. 1, Ventral (posterior) view of labium, maxilla, and sinistral half of head.
Fig. 2 Frontal view of head capsule.
Fig. 3, Ventral (posterior) view of dextral mandible.
Fig. 4, Antenna.

peculiar subdivisions present in these two Orthopteroids. The maxilla of a typical Isopteron or Blattid would readily serve as the starting point for evolving the types of maxillæ occurring in the Grylloblattids and Dermaptera; and the Isoptera seem to be somewhat nearer than the Blattids are to the Orthopteroids, in the character of their maxillæ.

The character of the labium of *Grylloblatta* (Fig. 1) clearly shows that this insect is Orthopterous or Orthopteroid, since it is only in the Orthoptera that I have found a separate and distinct, well-chitinized mentum of the type shown in Fig. 1, *mn.* The labium of *Grylloblatta* lacks the transverse gular plate characteristic of all Dermaptera; and the type of labium exhibited by the Orthopterous insects might be derived more readily from Isopteroid or Blattoid precursors.

It is rather surprising that the maxillæ and labium of the Phasmids which I have examined are not as similar to these structures in *Grylloblatta* as the maxillæ and labium of the Embiids are. This, however, is doubtless due to the fact that my material is not as suitable as it might be to indicate the real relationships involved, and there are certain features of the submental region of the Phasmid labium, for example, that indicate a much closer relationship to the Orthoptera should be expected in the Phasmids than in the Embiids.

The mandible of *Grylloblatta* (Fig. 3) is very like that of such Orthoptera as *Gryllotalpa*, and resembles the type occurring in the Embiids quite closely. The mandible of *Grylloblatta* is not as much like that of the Phasmids and Dermaptera as one would expect, but it resembles the Dermapteran type as much as any. The resemblance to the Isopteran or Blattid type is not very marked, so that the evidence of the mandibles it not of great phylogenetic value.

The antenna of *Grylloblatta* (Fig. 4) is remarkably like that of *Embia* not only in the number of the segments composing it, but also in the relative sizes of the individual segments. The antenna of *Grylloblatta* is also very like that of such Phasmids as *Timema* and this type of antenna was apparently inherited from a common Protorthopteroid source. Among the true Orthoptera, the type of antenna found in the Acridids (Locustids) and their allies approaches the Grylloblattid type more closely than is the case with the antennæ of the Tettigonioids and Grylloids, which is rather surprising in view of the fact that *Grylloblatta* is more closely related to the Tettigonioid and Grylloid Orthoptera than it is to the Acridids and their allies. The Grylloblattid type of antenna approaches that found in certain primitive Dermaptera and Isoptera more closely than it does the Blattid or Mantid type of antenna, and the antennæ of certain Grylloids and Tettigonioids are much more like the antennæ of the Blattids and Mantids than is the case with the antenna of *Grylloblatta*, although in a few Blattids, I have found a suggestion of the Grylloblattid type of antenna.

It is quite possible that there were two tendencies in the Protoblattoid ancestors of the Orthopteroid insects. One tendency was to retain the multiarticulate type of antenna with many annular segments in the basal region of the flagellum while the segments in the distal region of the flagellum tended to become more cylindrical. This tendency, exhibited by most Blattids and Mantids, affected the development of the Grylloid and Tettigonioid types of antennae. The second tendency among the Protoblattoid ancestors of the Orthopteroid insects was toward a reduction in the number of antennal segments, and to increase the proportion of cylindrical segments, while only a few segments in the basal region of the flagellum remain short, or approach the annular type to any degree. This tendency affected the Phasmid, Dermapteran, and Grylloblattid descendants of the Protorthopteroids more than any others.

In the main, the evidence of the head-capsule and its appendages is in harmony with that from other sources which supports the views as to the interrelationships of the Orthopteroid and Isopteroid insects proposed by Crampton, 1924; and according to these views the insects in question were grouped as follows:

Section Orthopteradelphia (Orthopteroid insects, sensu lato)
    Superorder Panisoptera (Isopteroid insects)
        Orders Protodictyoptera (Protoblattids—fossil)
            Dictyoptera (Blattids and Mantids)
            Isoptera
    Superorder Panorthoptera (Orthopteroid insects, sensu stricto)
        Orders Protorthoptera (Fossil)

Orthoptera (Saltatoria and Grylloblattids)
Dermaptera
Cheleutoptera (Phasmids)
Superorder Panplecoptera (Plecopteroid insects)
Orders Protoplatyptera (Hadentomoidea—fossil)
Platyptera (Embiids)
Plecoptera

The Plecopteroid and Orthopteroid insects were descended from Protorthopteroid forebears which arose from the Protoblattoid ancestors of the Isopteroid insects, so that the ancestral types in the common Protorthopteran-Protoblattid stem gave rise to the lines of descent of the Isopteroid, Orthopteroid, and Plecopteroid insects which comprise the Orthopteroid insects in the broad sense of the term. The Palæorthoptera such as *Synarmoge*, serve to connect the common Protorthopteran-Protoblattid stem with the Palæodictyoptera, which are very like the ancestral-types giving rise to the winged insects in general.

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ABBREVIATIONS

a.. . Basal process of lacinia
ac. . Anteclypeus
af. . Antennifer
an. . Antennale (basantenna)
ant. Antenna (basal segment)
bc. . Basicardo
bg. . Basigalea
bm.. Basimaxillary membrane
cs. . Coronal suture
dc. . Disticardo
e. . . Compound eye
fr. . . Frons
fp. . Frontal pits (frontocavæ)
fs. . . Frontal suture
ga. . Galea
ge. . Gena
gl. . Glossa
gn. . Gnathite
gp. . gular pit
gu. . Gular region of membrane
hc. . Hypocondyle (gnathocondyle
in. . Incisors
la. . Lacinia
lp . . Labial palpus
lr. . . Labrum
ls. . . Labiostipes
m. . . Mandibulare (basimandibula
md.. Mandible
mdm. Mandibular membrane
mm. Medimentum
mn.. Mentum
mo. . Mola
mp.. Maxillary palpus
pa. . Parietals
pc. . Postclypeus (epistoma)
pd. . Pedicel
pge . Postgena
pgl. . Paraglossa
pgr.. Palpiger
ppd. Postpedicel
pr. . . Postgenal ridge
pst. . Parastipes
sc. . . Scape
sm. . Submentum
st. . . . . Stipes
tm. . Tempora
ts. . . Temporal suture

NOTE8 ON SOME TINGITIDÆ FROM CUBA (HEMIPTERA)

By Carl J. Drake
Ames, Iowa.

The writer has recently received from Mr. J. G. Myers, Bussey Institution, Harvard University, a small collection of lace bugs from Cuba. This collection contains eight species, one of which is undescribed.

Monanthia monotropidia (Stål)

Many specimens, Soledad, Feb. 13 (nymphs), March 6 and March 28 1925, (adults and nymphs) on *Cordia Gerascanthus* L. This is one of the most common tingids in the West Indies and Central America.

Teleonemia scrupulosa Stål

One example, Mina Carlota, Trinidad Mts., March 21, 1925, on *Latana camara.*

Teleonemia sacchari (Fabr)

Two specimens, Mina Carlota, Trinidad Mts., March 21 and 23, 1925, on *Latana camara.*

Acanthocheila sigillata Drake & Bruner.

Female, Soledad, Feb. 13, 1925. This is the second record of this species in Cuba. The types were taken on *Pisonia aculeata* in Cuba.

Leptodictya bambusae Drake

Many specimens, Soledad, Feb. 13 and 28, 1925. This is the most common species of the genus in the West Indies. It feeds on bamboo, but a series of specimens (nymphs and adults) from Mexico were taken on sugar cane.

Corythucha gossypii Fabr.

Several specimens, Guines, March 18, 1925, on *Ricinus communis*. This is a common insect throughout the West Indies, Mexico, Central America and Florida. It breeds upon several different species of plants, cotton being one of the preferred hosts.

Corythucha spinosa (Dugès)

Two specimens, Mina Carlota, Trinidad Mts., March 21, on *Latana camara*.

Leptopharsa myersi, n. sp.

Head very short, black, largely concealed by the short hood; spines moderately long, whitish, the anterior pair porrect, the tips not touching; posterior pair and median spines directed forward touching the surface of the head. Antennæ moderately long, whitish, the tips of the fourth segments black; segment I a little stouter than II and about one and a half times as long; segment III nearly three times as long as IV; segment IV considerably longer than I and II taken together, clothed with a few long hairs. Rostral groove becoming quite wide on the meso- and metasternum, closed behind, the rostrum reaching to the middle of the metasternum. Bucculæ broad, closed in front. Body beneath black, the rostrum and rostral laminæ whitish. Pronotum black, shining, narrowed anteriorly, unicarinate, coarsely pitted, strongly swollen, nearly semi-globose; carinæ whitish, each composed of a single row of very minute cells; paranota narrow, carinæ-like, whitish, gradually becoming slightly wider anteriorly, three or four distinct cells on each side in front; triangular portion not tumid behind, distinctly notched at the apex, the apex and posterior margin whitish. Hood moderately large, transverse, covering a large portion of the very short head, whitish, the areolæ very small.

Elytra moderately broad, broady rounded at the tips, pale testaceous, with broad fuscous band in front of the middle of costal area, most of the nervures of subcostal, discoidal and sutural areas (except apex) fuscous, the areolæ transparent; broadest at the transverse fascia; costal area broad, triseriate, the areolæ moderately large. Discoidal area elevated (with sutural area), short, not reaching the middle of the elytra, testaceous at the base and apex, the areolæ semi-opaque; subcostal area broad, composed of five rows of areolæ at its widest part, the areolæ small, subequal in size to those of discoidal area; sutural area with one very large cell near its apex.

Length, 2.45 mm.; width, 1.3 mm.

Holotype, female, Mina Carlota, Trinidad Mts., March 24, 1925, in writer's collection. *L. unicarinata* Champ., and *L. myersi* are very much unlike the type of the genus of *Leptopharsa*. The characters of the pronotum and the color of the elytra and paranota readily separate these species.

THE SYNONYMY OF *ACTINA VIRIDIS* (SAY).

By Charles W. Johnson,

Boston Society of Natural History

For some time it has been evident that the old species, *Beris viridis* Say, was being subjected to rather reckless treatment. The description by Say is good, and the character "scutel with four yellow spines" has always readily separated it from the other species formerly referred to *Beris*. In 1848 Walker described *Beris quadridentata*. As the name indicates it would apply only to the male, having four yellow spines on the scutellum and not to the female with six spines. *B. quadridentata* was placed in the synonymy under *B. viridis* Say by Osten Sacken (Catl. p. 44, 1878).

Dr. G. Enderlein in 1920 (Mitt. Zool. Mus., Berlin, 10:209), recognized and redescribed *B. quadridentata* Walker, making it the type of a new genus *Hemiberis*, although in the same publication (page 192) he recognizes *Actina viridis* (Say). Dr. Enderlein's description of *H. quadridentata* (Walk.) is based on a single male from Wisconsin and agrees in every respect with the male of *A. viridis*. His generic conclusion was evidently made solely upon comparison with species of *Hoplacantha* Rond., *Hemiberis* in the male having the eyes separated and the posterior metatarsi thickened.

Under the title "The generic position of Beris viridis Say, "(Canadian Ent., vol. 56, p 24, 1924), Mr. C. H. Curran proposes a new genus *Allactina*, genotype *Beris* (*Actina*) *viridis* Say. In the generic diagnosis he says:—"scutellum with six large spines," a character which does not apply to *B. viridis*. There is also the following discrepancy in the comparison of genera,—"In addition, the eyes of the male in this species are broadly separated, while they are contiguous in all the species I have seen of both *Beris* and *Actina*." Eyes of the male not contiguous is one of the leading characters that separates *Actina* from *Beris*. The above brings up a question. Should the name *Allactina* be applied to the genotype or to the species with six spines on the scutellum. As the intention was to propose a generic name for *B. viridis*, I am inclined to think that—"six large spines" was probably written by mistake.

Dr. O. A. Johannsen under "*Beris quadridentata* Walker" (Bull. Brooklyn Ent. Soc., XX, 214, 1925) says:—"In the British Museum there are several specimens under this name. Two specimens a male and a female, have been selected as the types. These, however, are not conspecific. The male is *Beris viridis* Say, having four scutellar spines, as indicated by the specific name, but the female specimen, also bearing a type label has six spines. The synonomy noted above as pointed out by Osten Sacken, makes the generic designation *Allactina* Curran, a synonym of *Hemiberis* Enderlein "

As to the genus *Actina*. With eight specimens of the genotype (*A. nitens* Latr.) before me, I find no character of sufficient importance to separate *B. viridis* from this genus. The additional posterior vein from the discal cell in *A. nitens* is only rudimentary and is entirely absent in two specimens, while in two others the vein forming the outer part of the discal cell is wanting. It seems therefore apparent that the synonomy of this species should stand as follows:—

Actina viridis (Say).

Beris viridis Say, Long's Exped., App., 368, 1824.
Beris quadridentata Walker, List Dipt., I, 127, 1848.
Actina viridis Aldrich, Cat'l., 174, 1905
Hemiberis quadridentata Enderlein, Mitteilungen Zool. Mus. Berlin, 10: 209, 1920.
Allactina viridis Curran, Can. Ent., 56: 24, 1924.

The species is widely distributed. I have before me 65 specimens collected from Codroy, Newfoundland, to St. Paul, Minn., and south to the Black Mts., N. C. The only noticeable variation is in those from the more northern localities, especially in the males. Specimens from East Cape Anticosta Island, collected July 7, 1881 by Mr Samuel Henshaw, are slightly smaller and have the legs dark. All of the femora are brownish-black, only the extreme basal part of the tibiæ are yellow, the tarsi are also dark except the posterior metatarsi, which are also brownish toward the outer end. The female, however, has only the tips of the femora, the outer two-thirds of the tibiæ and the tarsi (except the posterior metatarsi) dark brown. I propose the varietal name of *obscuripes* or the six specimens from Anticosta Island. Holytype and three paratypes in the Museum of Comparative Zoology. Allotype and one paratype in the Museum of the Boston Society of Natural History. Two males from Low Bush, Lake Abittibi, Ontario, June 11, 1925 (N. K. Bigelow), have the femora blackish, except for narrow basal and apical bands of yellow. A third male, however, from the same locality has the femora yellow.

Concerning the Types of Mallophora Rex and Cheysomela Bromley

In the June 1925 number of Psyche Vol. 32, p. 190, Mr. S. W. Bromley described two new species of *Mallophora*, in part, on material from the collection of The Academy of Natural Sciences of Philadelphia. He however, did not designate any type specimens, and as the material returned to the Academy was labeled types, I take this opportunity to record his type fixation as follows:

Mallophora rex Bromley. Type, male; Southern Pines, South Carolina, August 26, 1909. [Academy Collection, No. 6297].

Mallophora chrysomela Bromley. Type, male; Atlanta, Georgia, June 30, 1906, [Academy Collection, No. 6298].

E. T. Cresson, Jr.

TILLYARD'S WORK ON INSECT PHYLOGENY.

By J. G. Myers.

On 30th April the entomologcal seminary of the Bussey Institution, together with a considerable number of other Boston entomologists was privileged to hear Dr. R. J. Tillyard, Entomologist and Chief of the Biological Division of the Cawthron Institute, Nelson, New Zealand, lecture on his study of fossil insect and on the phylogeny of recent forms. At the same time the excellent photographs and d agrams shown as lantern slides, and still more the actual specimens of most of the important fossil forms enabled specialists present to form their own opin'ons as to the correctness of the lecturer's conclusions.

Dr. Tillyard was led, on venational considerations alone, to select or study the scorp'on-flies as affording a central type which might serve as a guide to the relationships of several more specialised and larger orders of Holometabola. Comparative morphology proved inadequate as a sole means of elucidating these relationships but the rich finds of ate Palaeozoic (Upper Permian) and early Mesozoic (Upper Triassic) insects in Australian rocks supplied at once an extremely valuable series to help bridge the gap between the Carboniferous fossils of Europe and North America and the Liassic remains of England and Germany. This hiatus in the palaeo-entomological record was almost completely filled by the discovery of a wealth of forms in the Lower Permian of Kansas.

Until Dr. Tillyard's work there was little palæontological evidence as to the origin of the more highly specialised and dominant groups of modern insects—Lepidoptera, Diptera, Hymenoptera, Coleoptera, Hemiptera. The first contribution on the Permian and Triassic insects of Australia confirmed the very close relationship subsisting between Trichoptera and Lepidoptera and established the probable origin of the Diptera, Lepidoptera, Trichoptera, Neuroptera and Mecoptera from a Mecoperoid stem. A very convincing and practically complete venational series was shown by slides and specimens to culminate in modern lepidopterous and dipterous types. An interesting backward extension of the series afforded by the discovery of true Mecoptera in the Kansan Lower Permian places the origin of holometaboly back at least half a geological period. The Upper Carboniferous *Metropator*, a fossil from the earliest horizon yet known to furnish insect remains, is now believed to be a true Mecopteron, leading to the possibility that complete metamorphosis may have evolved even earlier and that the ancestors of the present Panorpoid Holometabola may have been not merely Mecopteroid but actually Mecopterous.

Perhaps the most interesting link in the phylogeny of the Neuroptera is afforded by the Lower Permian *Protomerope*, in which the strong series of costal veinlets, the form of Sc and the abundant branching of Rs and of M lead at once to the condition exhibited by primitive Neuroptera.

The Australian fossils threw no light on the relationships of the Hymenoptera. There were indications that this order was related to those composing the "Panorpoid complex," but no definite venational types from which the hymenopterous condition could be derived. It remained for the Kansan Lower Permian to supply more definite information as to the origin of this order. In the beautifully preserved fossils for which has been founded the new order, Protohymenoptera Tillyard, the venation and texture are distinctly Hymenopteroid and yet show, especially in the number and position of the cross-veins, some evidence of Mecopteroid relationships. The divergences are, however, greater than the resemblances and the Protohymenoptera, with their supposed derivatives the Hymenoptera, are believed to have sprung from another stem than that which gave rise to all the other Holometabola. If, as the ecturer suggested, the hitherto enigmatical *Sycopteron symmetricum* Bolton from Commentry, France, belong also to the Protohymenoptera, then the origin of the Hymenoptera must be put back to the Upper Carboniferous.

The acceptance of *Protohymen* and its relatives as near to or identical with the ancestors of the Hymenoptera leads inevitably to the replacement of the complicated MacGi livray (1906) interpretation of the wing-venation in this order by a much simpler scheme comparable with that already suggested in the Homoptera by the Tillyard modification of the Comstock-Needham system The chief change concerns Cu. The vein formerly known by this name becomes Cu_1 while the stem called by Comstock 1A + 2A is Cu2 + 1A. The corresponding change in Homopterous horismology has now been accepted by every authoritative worker in the sub-order while the present modification seems to meet the approval of most of the Hymenopterists who have been able to examine the fossils. The differences in venation between Protohymenoptera and Hymenoptera may all be traced to specialisat on accompanying the evolution of a wing-coupling apparatus

In spite of the fact that as far back as the upper Trias of Australia true Coleoptera were the dominant insects, the origin of the order long remained obscure. True beetles occurred also in the upper Permian and with them primitive forms resembling Coleoptera but with flattened elytra furnished with a straight sutural margin and complete venation. These insects, constituting the new order, Protocoleoptera of Tillyard, were evidently nearly related to the ancestors of the Coleoptera, but their own affinities are very uncertain.

Outside the Holometabola the Hemiptera (*sens. lat.*) have long formed perhaps the most isolated of insect orders. The Heteroptera truly recognisable as such are recorded first in the Triassic, where they were already differentiated into quite-specialised gymnocerate and cryptocerate types. Fossils connecting this sub-order with more primitive forms are as yet unknown. With the Homoptera, however, the case is far different. Although the Protohemiptera, represented by *Eugereon* and by *Mesotitan*, are nothing at all to do with the Hemiptera, the Palæohemiptera have proved so definitely hemipterous that they are now apportioned among various fossil and recent familes of auchenorrhynchous Homoptera. Most of the upper Permian Homoptera are distinctly either auchenorrhynchous or sternorrhynchous. *Pincombea* is, however, in virtue especially of its well-developed clavus, possibly annectent, although predominantly sternorrhynchous. More generalised forms discovered in the lower Permian of Kansas have taken true Homoptera much further back in geological time and have indicated the steps in the evolution of the clavus. The original position of the wings at rest in these primitive Hemiptera was almost certainly stegopterous. The folding of the wings flat on the back was accompanied by the shortening and widening of the clavus and the thinning of the membrane distal of a line drawn transversely from the tip of the clavus to a point on the costal margin, that is, of those portions of the fore-wings which overlapped in the resting position. Thus was developed the hemielytral condition reaching its culmination in the typical heteropterous fore-wing. Conversely the lengthening and narrowing of the clavus led to the evolution of the type which reaches its highest development in the tegmen of the Homoptera Auchenorrhyncha.

The venation of the most primitive of the Homoptera from the Kansan lower Permian is derivable from a condition similar to that seen in Copeognatha from the same beds. Thus for the first time we have palæontological evidence for the view originally advanced by Börner from a consideration of the head structure and mouth-parts, that the Psocids and Hemiptera are related groups and that the latter with the Thysanoptera were derived from mandibulate ancestors by way of a Psocoid intermediate type. In the same complex obviously belong also the Anoplura, which are, however, much more closely related to modern Psocids through the Mallophaga.

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SOME NEW NEOTROPICAL ANTS

By W. M. Mann

U. S. National Museum, Washington, D. C.

Descriptions of the new species given in the following paper are presented at this time so their names may be used in connection with new species of myrmecophilous beetles. One interesting new form, which has been collected from the stomach of a toad by members of the Bureau of Biological Survey, is also included.

Eciton gracellæ, new species.

Worker.—Length 2.75-4 mm.

Head a little longer than broad, broadest in front of middle, sides moderately convex, posterior corners narrowly rounded, border shallowly concave. Eyes very distinct, situated a little behind the middle of front of sides. Mandibular blades finely and bluntly denticulate. Antennal scapes extending a little beyond the eyes, all funicular joints longer than broad. Thorax rather slender, in profile evenly convex. Epinotum on a lower plane than the promesonotum, its surface shallowly impressed at basal half, very feebly convex behind, twice as long as broad and one and one half times as long as the declivity, into which it very broadly rounds. Petiole in profile a little longer than high, convex above, with the antero-ventral spine strong, elongate, curved and acute at apex, extending backward; from above longer than broad, with feebly convex sides, postpetiole in profile as long as high and convex above; from above a little longer than broad, with nearly straight sides. Legs long, rather slender, claws simple.

Shining. Mandibles rather coarsely striate. Head and body sparsely, moderately, coarsely punctate, except on the impressed anterior portion of epinotum and on the meso- and metapleuræ which are densely punctate and subopaque.

Fine, elongate, erect yellowish hairs abundant on head, body and appendages, on the gaster mixed with shorter and subappressed hairs.

Gaster dark brown to black, remainder bright brownish red.

Type locality.—Ototonilco, Jalisco, Mexico.

Cotypes.—Cat. No. 29045 U. S. N. M.

Described from nine workers taken from a file running through the grass in an orange grove, and named in honor of Señorita Graciella Mercedes Maderiaga, the child who found them.

Eciton (Acamatus) peninsulare, new species.

Worker major. Length 3.5 mm.

Head about one fifth longer than broad, slightly broader in front than behind, with broadly and shallowly concave posterior border and rounded corners. Eyes not discernible. Mandibles with several rather stout, separated teeth basally and one larger one forming an angle between the base and the blades. Antenna stout, scape broadened and somewhat compressed apically, extending about three eighths the distance to occipital corners; funicular joints 2 to 8 a little broader than long, 9 and 10 as long as broad, apical about as long as the two preceding joints together. Thorax rather stout, compressed laterally, nearly flat above; epinotum more than half as long as pro- and mesothorax together, its base on the same plane as the mesonotum and separated from it by a narrow, though strong impression, declivity distinctly shorter than the base and broadly rounding into it. Petiole in profile only slightly longer than high, convex above, antero-ventral tooth moderate in size and blunt at tip; from above subquadrate, about as long as broad; postpetiole from above transversely oval and one third broader than the petiole; antero-ventral tooth stout and blunt at tip. Claws simple.

Shining. Mandibles with short, coarse striæ; head and body with distinct, widely separated punctures, coarsest and most abundant on the mesonotum, finest on the gaster.

Suberect, fine yellowish hairs rather sparsely distributed on head, body and appendages.

Color pale to rather dark brownish yellow.

Worker minor. Length 1.5 mm.

The smallest specimens in the colony differ in having the head one and two thirds times as long as broad, with straight sides (convex in the larger workers) and more deeply excavated posterior border and the meso-epinotal impression feebly impressed.

Type locality.—La Palma Davila, Lower California.

Cotypes. Cat. No. 29046 U. S. N. M.

Described from a series of 33 workers taken by the writer from a cluster beneath a stone. Among them were numbers of a Staphylinid beetle, which I have recently described as *Pulicomorpha coccum.*

Eciton peninsulare is related to *Eciton californicum* Mayr, but much smaller in size and distinct in the absence of eyes, the more elongate head, as well as the smoother, more shining and sparsely punctate integument.

Eciton (Acamatus) sumichrasti Norton.

Female.—Length 11.5 mm.

Head from the front about as long as broad, slightly broader in front than at occipital border, sides feebly rounded, occipital border emarginate, occiput and vertex with large impressed areas; vertex and front with a median longitudinal groove that becomes stronger anteriorly and terminates at posterior border of clypeus. Ocelli lacking; eyes of a single, white facet, situated a little behind middle of sides of head. Mandibles slender, thickest at middle, nearly straight, their tips obtusely pointed. Median, triangular portion of clypeus longer than broad, anterior border very feebly emarginate. Frontal carinæ anteriorly rather acute above, posteriorly broad and convex. Antennal scapes robust, clavate, about half as long as head; funiculi more slender than scape, the first joint as broad as long, the others distinctly longer than broad, the terminal slender, connate and nearly as long as the two preceding joints together. Thorax long, very gradually widened from front to rear, in profile about three times as long as deep, slightly rounded in region of pronotum, flat behind, the dorsal surface of mesonotum shallowly, though distinctly impressed at middle. Propleuræ shallowly and broadly impressed. Promesonotal suture very indistinctly indicated by an impressed line; mesometanotal suture not discernible. Meta-epinotal impression distinct. Basal portion of epinotum much longer than the flat declivity, into which it broadly rounds; dorsal surface a little broader than long, strongly and broadly impressed at middle, the impression deepest posteriorly, sides behind middle subgibbous. Petiole from above transverse, not as broad as epinotum, sides very feebly divergent behind, anterior corners broadly rounded, posterior corners projecting and obtusely angulate, posterior border strongly emarginate, dorsal surface concave at middle, with rather strong convexities at sides of concave portion, then sloping and indistinctly impressed toward lateral borders; seen from the side the node is much higher than long, arcuate in front and above and emarginate on posterior outline, with the anterior portion of sides convex and the posterior concave. Gaster elongate oval. Hypopygium and pygidium submembraneous at borders, which in the former are nearly straight and in the latter triangularly excised. Sting not visible. Legs rather short, slender. Claws simple.

Gaster shining, the rest nearly opaque. Head, thorax and epinotum densely and finely punctate, the head more shallowly than the rest, and in addition with scattered, coarser punctures most conspicuous on the epinotum. Petiole densely and shallowly punctate and more shining. Gaster with distinct, irregular, separated punctures, each of which bears a moderately long, stiff, finely pointed yellow recumbent hair. Mandibles and anterior border of clypeus sparsely punctate.

Erect hairs yellow, fine and abundant on head, thorax and petiole and appendages.

Dark ferrugineous red, appendages paler, antennæ yellowish.

Described from a female found with a cluster of workers beneath a stone on the edge of the Barranca de Oblatos at Guadalajara, Jalisco, Mexico.

Alfaria bufonis, new species.

Worker.—Length 5 mm.

Head one fourth longer than broad, as broad behind as in front, sides feebly convex, occipital corners broadly rounded, border shallowly concave. Clypeus slightly convex, broadly rounded at anterior border. Frontal area very distinct, the surface immediately in front strongly, transversely impressed. Antennal scapes slender basally, clavate toward apex, surpassing occipital corners by a distance nearly equal to their width at tip. Eyes small, round, convex, situated at middle of sides of head. Promesonotum widest in front of middle, sides very feebly rounded, surface slightly convex; inferior corners obtusely angulate. Epinotum separated from mesonotum by a distinct though narrow transverse groove, its basal surface on a lower plane than the mesonotum, as long as the declivity, broadened behind; slightly convex in profile. Petiolar node in profile longer than high, convex above, with a sloping anterior face; from above longer than broad, with sides rounded behind and nearly straight in front. Gaster similar to that of *Alfaria simulans* Emery.

Subopaque. Head, thorax and abdomen with coarse, irregular punctures, approximate and with the surface between appearing as a reticulum on the head and especially the pronotum, less approximate on dorsal surface of petiole and abdomen and widely separated on metapleuræ, the entire surface with a silk-like sheen; front of head at middle with a subtlely striate area; frontal lobes and mandibles rather coarsely striate; antennal scapes and legs with distinct, separated shallow punctures and dense microscopic striolæ.

Fine and silky, yellowish hairs moderately abundant on head, body and appendages.

Dark brown to black, with a red-brown tinge, mandibles and appendages lighter.

Type locality.—Choapam, Oaxaca, Mexico.

Type.—Cat. No. 29047 U. S. N. M.

Described from a single worker taken from the stomach of a toad (*Bufo valliceps* Weig., U. S. N. M. 46967) collected by Nelson and Goldman, July 28, 1894.

The type lacks the antennal funiculi and portions of the legs, but is otherwise in good condition, with the pilosity well preserved. *Alfaria simulans* Emery, the nearest species, differs in its shorter and stouter antennal scapes, in the entire absence of an impression between meso- and epinotum, in its larger size and lighter color.

Leptogenys (Leptogenys) peninsularis, new species.

Worker.—Length 7.5 mm.

Head, excluding mandibles, more than one and one half times as long as broad, a little broader in front than behind, with feebly arcuate sides, broadly rounded occipital corners and straight border. Clypeus carinate at middle, the anterior projecting triangular portion as broad as long and subacuminate at tip, the median lobes at middle of sides of front border low and rounded. Mandibles distinctly shorter than sides of head, seen from the front nearly straight, broadened apically, inner border of basal portion subcultrate and terminating in an inner small, broad lamellate triangle, blades strongly concave. Antennal scapes surpassing occipital angles by about three-eighths of their length, second funicular joint one and one-half times as long as the first, remaining joints shorter and slightly thicker toward apex, the terminal as long as the two preceding joints together. Eye about as long as its distance to border of clypeus. Pronotum as broad as long, broadest behind middle, sides convex, dorsal surface slightly convex. Mesonotum slightly longer than broad, with straight sides and posterior border. Meso-epinotal impression moderate. Epinotal base nearly straight in outline and about twice as long as the flat declivous portion, into which it broadly rounds. Petiolar node higher than long, anterior surface broadly convex, posterior surface flat, dorsum broadly rounding into anterior and narrowly into posterior surface; from above longer than broad, slightly widest behind, with sides feebly arcuate. Abdomen elongate; sting strong. Legs long and slender.

Head and thorax subopaque, finely and densely reticulo-striolate, the striæ transverse on posterior part of head, median portion of pronotum and on the meso-and epinotum; petiole with more subtle striation and gaster shining, with fine separated punctures. Mandibles sparsely and coarsely punctured and very finely striolate.

Fine, erect hairs rather sparse on head, body and legs; appressed yellow pilosity rather thin on head, thorax and abdomen.

Color ferrugineous.

Type locality.—Comondu, Baja California.

Cotypes.—Cat. No. 29048 U. S. N. M.

Described from 36 workers collected by the writer from colonies found beneath stones by the stream that waters the valley at Comondu. In size, structure of the head and mandibles and in sculpture and pilosity and coloration, *Leptogenys peninsularis* is widely different from any of the described neotropical species.

Erebomyrma nevermanni, new species.

Worker.—Length 1.25 mm.

Head, excluding mandibles, a little longer than broad and about as broad in front as behind, with evenly arcuate sides, rounded occipital corners and very feebly concave border. Mandibular blades with four rather strong teeth. Median portion of clypeus convex, bordered at sides by narrow carinæ terminating at sides as triangular teeth, feebly emarginate at anterior border. Frontal carinæ delicate, continued to rear occipital border. Antennal scape extending slightly more than two-thirds the distance to occipital corners, slenderly clavate, first funicular joint stout, about as long as the three following together, joints 2-8 small, strongly transverse, club nearly as long as the remainder of funiculus, with the penultimate joint less than half as long as the terminal. Eyes minute, situated a little in front of middle of sides of head. Thorax robust. Pro-mesonotum feebly convex above, humeri subangulate, anterior border with a narrow elevated margin, sides feebly arcuate and converging to the posterior border which is a little more than half as broad as the anterior.

Mesoëpinotal impression strong. Base of epinotum somewhat transverse, longer than the declivity and narrowly rounding into it; with a pair of acute triangular spines, nearly as long as their distance apart at base. Petiolar peduncle nearly as long as the node, which in profile is conical and as high as long, and from above elongate oval. Postpetiole longer than broad and twice as broad behind as in front, sides nearly straight, in profile much longer than broad, convex above. Femora slender basally and clavate apically; tibiæ stout.

Gaster and postpetiole, mandibles and legs shining, the remainder feebly shining. Mandibles sparsely punctate. Clypeus and middle of front smooth, remainder of head rugulose-punctate and with sparse striæ which are longitudinal on front, reticulate on occiput and diagonal on cheeks. Promesonotum sculptured like the head, with the striæ irregularly longitudinal. Epinotum and meta- and epipleuræ and petiolar peduncle cribrately punctate. Petiole, postpetiole, gaster and legs smooth.

Hairs long, erect and very fine, moderately abundant on thorax and abdomen, shorter and semirecumbent on head and appendages.

Rather pale reddish brown; legs, tip of antennæ and often the petiole and gaster yellowish.

Type locality.—Hamburg Farm, Reventazon, Santa Clara, Costa Rica.

Cotype.—Cat. No. 29049 U. S. N. M.

Mr. F. Nevermann found the colony in a rotten log, in company with *Euponera* (*Trachymesopus*) *stigma* Fabr.

Erebomyrma longi Wheeler, from Texas, differs in having the head longer and, in profile, much thinner, the humeri are not angulate, the anterior border of pronotum, not margined, the epinotal spines shorter and the post petiole transverse, as well as in its finer sculpture and paler color.

Strumigenys (Tingimyrmex), new subgenus.

Head elongate, not strongly excised behind. Mandibles short, remote at base, with a series of microscopic teeth at apical third. Antennal scrobes deep and broad and extending length of head. Pronotal humeri with lamellate spines, postpetiole very large and broad. Clypeus, scrobes, posterior border of head, anterior border of thorax, sides of epinotum, upper and lower surfaces of petiole and lower surface of postpetiole with broad, thin, semitransparent lamellæ.

Genotype.—*Strumigenys* (*Tingimyrmex*) *mirabilis*, new species.

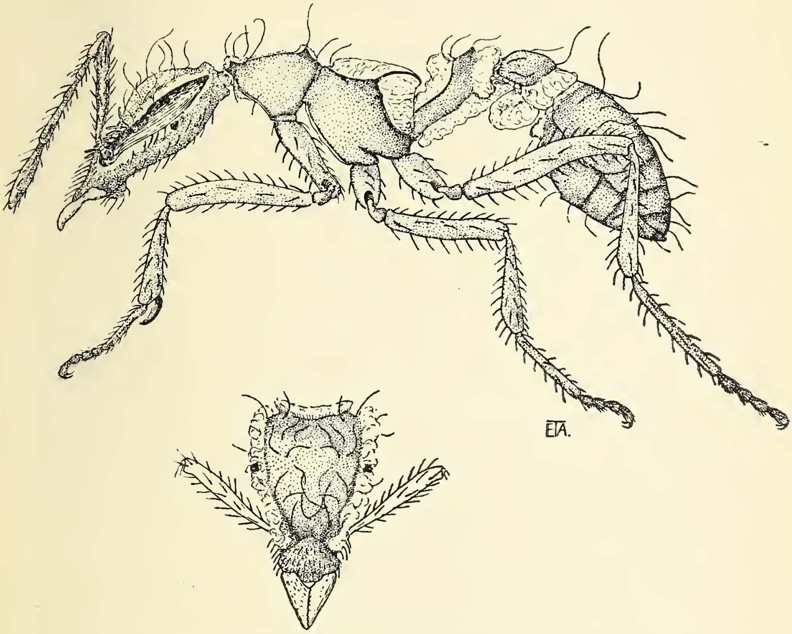

Fig. 1. *Strumigenys* (*Tingimyrmex*) *mirabilis*, new species, worker.

Strumigenys (Tingimyrmex) mirabilis, new species (Fig. 1).

Worker.—Length 2.25 mm.

Head, excluding mandibles, nearly two times as long as broad and about twice as broad at occiput as in front, sides posterior to eyes nearly straight and parallel, in front of eyes convergent, then very feebly sinuate and slightly divergent to anterior border; occipital corners angulate, border shallowly emarginate; vertex rather strongly convex. Clypeus broadly convex, arcuate at anterior border. Mandibles a little more than half as long as head, slender, acuminate. Antennal scapes slender basally, somewhat thickened at apical half, attaining occipital corners; first funicular joint thicker and scarcely shorter than the second, which is a little more than three times as long as broad and subequal to the third, fourth joint two thirds as long as the terminal, which is subfusiform and pointed at tip. Eyes small, very convex, situated on lower margin of antennal fossa, well behind middle. Pronotum nearly flat, broadest in front, sides moderately arcuate, anterior angles with thick, blunt spines longer than broad, posterior angles with elevated, broad, lamellate triangular teeth, the bases of which continue as elevated side margins to the strongly sloping mesonotum. Epinotum slender, the base shorter than the declivity and rounding into it, strongly margined at sides, the margins prominently expanded and angulate between basal and declivous portions, nearly parallel on the declivity, nearly convergent anteriorly on the base, making that portion from above triangular in shape and less than twice as long as broad. Petiolar peduncle slender, longer than the node; node in profile with a rather concave dorsal surface, as long as the sloping anterior surface and much shorter than the posterior surface; from above transverse, prominently angulate at sides, subangulate in front, exposed posterior outline arcuate. Postpetiole nearly as broad as base of gaster and more than three times as broad as petiole, less than twice as broad as long, evenly convex above, anterior border straight, sides arcuate, posterior border in three subequal parts, the lateral lines feebly and the median distinctly emarginate. Legs long and rather slender.

Exposed areas smooth and shining, dorsal surface with sparse, exceedingly long and flexuous hairs, mingled on the head and thorax with shorter, coarser and strongly curved erect hairs; legs with stiff, moderately long, curved, semirecumbent hairs.

Pale brown, appendages lighter, gaster darker.

Type locality.—Huachi, Beni, Bolivia.

Cotype.—Cat. No. 29050 U. S. N. M.

Described from a series of workers found by the writer beneath a stone.

In writing the description, a cleared specimen has been used to make out the outlines, which in parts are concealed by plates of thin semi-transparent chitin, the development of which is extreme in this species. This is not unlike yellowish mica with reticulate lines through it, and not only margins the clypeus, scrobes, occipital border of head and anterior border of pronotum, but occurs as high thin plates on the epinotal margins and the dorsal and ventral surface of petiole at middle and is acutally spread over the surface in places, especially on the clypeus and front of head (except the median portion of vertex).

These plates are chitinous in nature, as are the spongiform processes, and Dr. N. E. McIndoo, who kindly examined some specimens for me, writes as follows:

"In regard to the nature of the spongy material on the peduncle and other parts of a new species of ant from Bolivia, I believe that it is chitinous, and not a waxy secretion, for the following reasons. When an alcoholic peduncle had been cleared in xylene and mounted in balsam, and then observed under an oil-immersion lens, the porous or spongy material had the same shade of light yellow as that of the hairs and other chitinous parts; and the external wall of this material was continuous with the external wall of the chitinous integument. After the same peduncle had been treated with cold caustic potash for 18 hours, the spongy material was not destroyed. This is a sure test for the presence of chitinous structures. Considering the above and also that no pores are visible in the integument of this peduncle, it would appear that this material is formed when the hairs and chitinous integument are formed, and not at a later time."

A NOTE ON *BERIS ANNULIFERA* (BIGOT).

By Charles W. Johnson.

Boston Society of Natural History.

This seems to represent an extremely variable species. Specimens with all the femora and tibiæ yellow, have been referred to *B. morrisii* Dale, a European species, which has however quite a different genitalia. I have not seen a typical *morrisii* from America. Numerous specimens from New England and Canada agree with Bigot's description although "Georgie" is given as the type locality. In a series of fifty-two specimens I am unable to find characters of specific value, but there seem to be three quite marked varieties, based on the general color of the legs. Notwithstanding the fact that intermediate forms exist, it seems well to consider these varieties rather than to have Bigot's description the only means of determining this variable and widely distributed species.

Beris annulifera (Bigot).

Oplacantha annulifera Bigot, Ann. Soc. Ent. France, 1887, p. 21.

Legs yellow, the posterior femora with a more or less prominent sub-apical band of brownish black, tarsi black with the base of the metatarsi yellowish. Its distribution is as follows: Bretton Woods, N. H., June 24, Oquossoc, Me., July 2, (C. W. J.), Lake Nipigon, July 4 and Lake Abittibi, Ontario, June 23 (N. K. Bigelow), English River and Athabasca River, (Kennicot) N. Calif., (Mus. Comp. Zool.) Alaska, (Coquillett).

Around the base of Mt. Washington, N. H., there are associated with the typical form the two varieties described below. There is also considerable variation in the venation. The two veins extending from the tip of the discal cell may be quite widely separated, close together, or fused and petiolate. A few specimens have an angle and stub—a vestige of a fourth vein arising from the discal cell. The latter variation is best shown in a series from Lake Nipigon, Ontario, collected by N. K. Bigelow.

Beris annulifera var. **luteipes** var. nov.

Beris morrisii of authors, not Dale.

Femora, tibiæ and posterior metatarsi entirely yellow, the front and middle metatarsi yellow except the tip, the remaining tarsal joints blackish.

Holotype and *allotype* Seattle, Wash. (O. B. Johnson); Denver, Col. (Oslar); Kearney, Ontario (M. C. Van Duzee); Lake Nipigon, Ontario, (Bigelow), collection of C. W. Johnson. Glen House, and Bretton Woods, N. H., St. Johnsbury, Vt. (Boston Soc. Nat. Hist.).

This form is more prevalent in the females than in the males.

Beris annulifera var. **brunnipes** var. nov.

All of the femora and tibiæ dark brown, the extreme tips of the femora and basal third of the tibiæ yellow, the tarsi entirely dark brownish black.

Holotype and *allotype*, Parroquet Island, Labrador, July 21, 1887, "Arethusa coll." (S. Henshaw). In the collection of the Boston Society of Natural History. Paratypes from the same locality in the Museum of Comparative Zoology. There are also specimens from Bretton Woods, N. H. in the Society's collection, and from the mountains east of Codroy, Newfoundland, July 19, (P. G. Bolster) in the author's collection.

HETEROPTERA IN OCEAN DRIFT.[1]

By J. G. Myers.

The presence of occasional terrestrial insects or their remains, in beach drift is a phenomenon of little ethological significance; but the occurrence on some rare occasions, under circumstances but little understood, of considerable windrows extending sometimes for miles along the beach and often consisting of little else but insects, is a matter for legitimate speculation.

In 1915 Torre Bueno published extensive records of Heteroptera found in drift on lake and ocean shores, and in 1917 Parshley made further observations on this phenomenon. Mr. P. J. Darlington makes a practice of examining such drift on the Massachusetts coast for Coleoptera, and he has kindly given me four small collections of Heteroptera from this material. Though the species present are not extremely numerous, the circumstances of season and composition render them worthy of record as modifying certain conclusions of previous writers on this obscure subject.

In the lists which follow, the species marked B were present also in Torre Bueno's material, while P indicates those observed by Parshley.

Nahant, Mass., 19th May, 1926.

Pentatomidæ

1 *Podisus maculiventris* (Say) B

1 *Podops cinctipes* (Say) BP

Aradidæ

6 *Aradus robustus* Uhl. (3 males and 3 females).

2 *A. quadrilineatus* Say

1 *A. falleni* Stål

Lygæidæ

1 *Cymus angustatus* Stål P

1 *Drymus crassus* Van D.

[1]Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 268.

6 *Eremocoris ferus* (Say) BP (The most abundant species, Bueno, 19th July)
2 *Cryphula parallelogramma* Stål
Gerridæ
1 *Gerris rufoscutellatus* Latr. B
Miridæ
1 *Lygus pratensis* (L.)

Ipswich, Mass., 22nd May, 1926.

Pentatomidæ
1 *Meadorus lateralis* (Say)
Aradidæ
5 *Aradus robustus* Uhl.
1 *Aneurus inconstans* Uhl.
Lygæidæ
5 *Eremocoris ferus* (Say) BP

Nahant, Mass., 13th June, 1926.

Cydnidæ
2 *Amnestus spinifrons* (Say) B (Most abundant species, Bueno, 3rd Oct.)
3 *Galgupha nitiduloides* (Wolff)
1 *G. atra* (A. and S.)
Pentatomidæ
1 *Podops parvula* Van D.
1 *P. cinctipes* (Say) BP
Aradidæ
1 *Aradus similis* Say
Lygæidæ
1 *Ozophora picturata* Uhl.
1 *Blissus leucopterus* (Say)
3 *Eremocoris ferus* (Say) BP
Tingidæ
1 *Corythucha juglandis* Fitch
Miridæ
1 *Capsus ater* (L.) P
1 *C. ater* var. *semiflavus* (L.) P
2 *C. ater* var. *tyrannus* (Fabr.)

Ipswich, Mass., 20th June, 1926.

Pentatomidæ
1 *Menecles insertus* (Say)
Lygæidæ
1 *Eremocoris ferus* (Say) BP
Miridæ
5 *Capsus ater semiflavus* (L.) P
3 *C. ater tyrannus* (Fabr.)

As to the season, it is interesting that Parshley's three records of the phenomenon in question occurred between 21st June and 1st August, while Bueno's observations, extending over a considerable number of years, were made in July, September and October. Mr. Darlington's first two lists are then apparently the first to be compiled in spring.

With regard to supposedly collaborating circumstances, Parshley noticed that "in each case there was a light on-shore breeze with fair weather, and in none was the occurence preceded by an unusually violent off-shore wind, though on the day before the last a moderate land-breeze was observed." Bueno notes that on at least one of the occasions when he collected ocean drift there was "a heavy sea breeze." In the present cases Mr. Darlington recognizes certain weather conditions as necessary for renumerative drift collecting; but these conditions seem to depend more upon warmth and bright sunshine acting as stimuli to extensive flights, than of direction of wind. The wind on 19th May for instance was quartering, but blowing rather more on- than off-shore; while on the 22nd, the direction of the breeze was practically parallel to the beach. On both these occasions, and in fact on all days when collecting was well rewarded, according to Mr. Darlington, the weather was hot and insects were observed flying in the sunshine.

As an example of the form in which the material is found, the drift on 19th May was said to consist of a broken windrow extending for about half a mile. The most common constituent insect was a Bibionid, which made up more than all other species combined. Next most abundant were Coleoptera and thirdly Heteroptera.

Finally, as to the Heteroptera represented in beach-drift, Bueno records 66 species, of which 22 were in Lake Michigan drift and 49 in ocean debris (with 5 common to both situations). Parshley adds over 30 more species, while the present lists include 17 forms not previously recorded. It is therefore obvious that we are still far from knowing how many eastern North American Heteroptera may occur in this plight, but the extreme variety of the records so far published renders it likely that any species may be so found. In Bueno's material the Pentatomids (*sens. lat.*) were far the most plentiful, with Lygæidæ next in abundance. After considering the representation of other groups Bueno concludes that "the relative abundance of the families is what should be expected, in view of the fact that the Cimicidæ [Pentatomoidea] are abundant in numbers and strong fliers and that the Myodochidæ [Lygæidæ], next to the Miridæ, are the largest of the Heteropterous families and most abundant as to individuals." In Mr. Darlington's lists, however, while the Lygæidæ are strongly represented by 6 species with 21 examples, a preponderance brought about by the frequency of the littoral *Eremocoris ferus*, the Aradidæ, insects by no means frequent in the field, have 5 species with 16 specimens—an unexpectedly high representation, and one out of all proportion to their relative abundance as gauged by ordinary methods of collecting. Mr. Darlington states that on 19th May, Aradids were at least as numerous in the drift as all other Heteroptera put together. On later occasions their relative numbers decreased. Since the collections made are likely to represent more truly the number of species present than the proportion of individuals I list the families in order according to the former criterion,—Lygæidæ, 6 spp., Pentatomidæ and Aradidæ 5 spp. each, Miridæ 4 forms, Cydnidæ 3 spp., Gerridæ and Tingidæ, 1 each. Judged on both criteria the Aradidæ come second on the list.

From the fresh and indeed frequently living condition of the stranded insects, the presence of Heteroptera in beach drift is a sure indication that each species concerned has indulged, perforce or *sua sponte*, in flights over the water. Parshley remarks that the "phenomenon is not to be explained in connection with the spring and fall flights when the air seems alive wi insects on the wing, as it has been observed at various other seasons, and for the same and other reasons such flights do not seem to be nuptial in character." He offers the suggestion that "on a clear day with a slight, on-shore breeze the surface of the ocean reflects sunlight with a peculiar sparkling brilliancy which might conceivably attract insects already flying above the land in unusual numbers because of some favouring combination of atmospheric conditions."

The outstanding feature of the present case is the unexpectedly strong representation of such cryptozoic woodland insects as the Aradids. That these bugs, in common with many social, semi-social or gregarious insects living in the same cryptozoic habitat, exhibit the phenomenon of a definite autumnal flight seems well ascertained in some species. Thus, with *Aradus australis* Erichs. in New Zealand, February appears to be a flying period during which these insects may be found in the most unlikely places, in houses, on windows in cities and often in large numbers in spiders' webs. Indications of a similar habit occur in *Ctenoneurus hochstetteri* (Mayr), a New Zealand Mezirine which has been observed flying at midday in brilliant sunshine. Bueno found two species of *Aradus* and one of *Neuroctenus* in ocean drift on 19th July.

That there is a definite spring flight of North American Aradids has been shown by Parshley (1921, p. 4). I have taken at Blue Hills, Mass., *Aradus quadrilineatus* in the open on 13th. of May. This species is included in our present ocean-drift list, as is also *Lygus pratensis* (L.), of which Mr. George Salt saw extensive flights in the vicinity of Boston during the earlier part of May. The preponderance of Bibionid flies in the first drift recorded in the present paper is obviously associated with the spring-flights so characteristic of these flies and so familiar to all who collect at that season. It seems therefore altogether probable that the occurrence in large numbers, of insects in general and of Heteroptera in particular in ocean-drift is related more often and more exclusively than Parshley believes, with definite spring and autumn flights. It is at least likely that Aradids form a considerable portion of such débris only during the spring and fall flights.

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Scott, H.

1926. Coleoptera in the sea. Ent. Mo. Mag., LXII, p. 115. (Records large numbers of Staphylinids struggling in the sea 2 3-4 miles from the Suffolk coast, and adds a note by J. J. Walker on great swarms of Coccinellids washed up on the Kentish shore during the great irruptions of these insects in 1869).

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PHENOLOGY OF INQUILINE AND NEST-MAKING BEES.

By Charles Robertson

Carlinville, Illinois.

Cases observed with a flight of only 1-10 days are excluded as fragmentary. Comparisons should be made with **6**, 105-9.

Colletes and Epeolus.—*Colletes* flies 224 days, Mar. 20-Oct. 30, six together June 20-29 and Aug. 26-Sept. 5. It shows a maximum of 46.6 per cent June 21, 53.3 per cent flying in July and August. *Epeolus* flies 148 days, May 29-Oct. 23, four together Aug. 29-Sept. 5. Its flight is 76 days shorter than that of *Colletes*. *C. inæqualis* lacks only 3 days of completing its flight of 81 days, Mar. 20-May 31, before *Epeolus* begins. Evidently it is not infested by any *Epeolus*.

E. interruptus, May 29-June 19, is evidently an inquiline of *C. æstivalis*, May 8-July 1. It may, however, belong to *C. brevicornis*, May 29-June 29, or to both. *E. bifasciatus*, June 12-Oct. 3, is probably an inquiline of *C. latitarsis*, June 13-Oct. 1, and perhaps also of *C. willistonii*, May 28-Sept. 5; *E. pusillus*, Aug. 26-Oct. 23, of *C. americanus*, Aug. 18-Oct. 30; *E. autumnalis*, Aug. 29-Oct. 13, of *C. compactus*, Aug. 26-Oct. 21. The former pair are small, the latter large. *C. armatus*, Aug. 17-Oct. 7 may be infested also by *E. autumnalis* or by *E. coreopsis*, Aug. 20-Sept. 5.

Grænicher (**3**) says *Argyroselenis minimus* is an inquiline of *C. eulophi*, which flies 146 days, May 28-Oct. 30. I have taken *A. minimus* but once, July 8.

Mecaghilini and Cœlioxys.—The Megachilini, 14 species, fly 165 days, May 11-Oct. 22, all together for 8 days, July 3-10. Six species of *Cœlioxys* fly 161 days, May 12-Oct. 19, all together for 42 days, July 4-Aug. 14.

Megachile brevis, May 15-Oct. 22, may be infested by *C. octodentata*, May 12-Oct. 19 (I think it has been recorded in Ent. News) and *M. mendica*, May 16-Oct. 11, by *C. sayi*, May 21-Oct. 4. *Xanthosarus latimanus*, May 28-Oct. 20, is infested by *C. rufitarsis*, July 4-Oct. 19, according to Grænicher (**2**), and I have seen the inquiline enter the burrows. *Oligotropus campanulæ*, June 25-Sept. 14, is probably infested by *C. modesta*, June 25-Aug. 28, both small species. The flight of *C. texana*, June 25-Aug. 14, and *C. germana*, June 25-Sept. 3, are covered by the flight of *Megachile generosa*, June 11-Sept. 28, *M. sexdentata*, June 14-Sept. 10, and *M. petulans*, June 17-Sept. 20. According to Shuckard (7) *Cœlioxys* infests Megachilini with modified front tarsi. There are not as many inquilines as would be expected otherwise.

Osmiinæ and Stelidini.—The Osmiinæ fly 211 days, Mar. 21-Oct. 18, with a maximum of 75 per cent June 16, 90 per cent flying in June. May 21-25, 28 and June 6-11, 70 per cent are flying. The Stelidini fly 163 days, May 9-Oct. 18, all together May 7-14.

Alcidamea simplex, 85 days, May 3-July 26, and *Microstelis lateralis*, 43 days, May 9-June 20, are host and inquiline (Crawford 8, **5**)., *Neotrypetes carinatus*, 144 days, May 28-Oct. 18, and *productus*, 138 days, June 3-Oct. 28, the females mixed and counted for both species, are evidently infested by *Stelidium trypetinum*, 135 days, June 6-Oct. 18. In **6**, 109, *productus* should be *carinatus*.

Bombinæ and Psithyrus.—*Bombus americanorum*, Mar. 5-Nov., and *P. variabilis*, Apr. 28-Nov., are host and inquiline, as stated by Frison (1). Their time and frequency indicate this.

Halictidæ, Sphecodini and Paralictus.—The Halictidæ, Mar. 17-Nov., are probably infested by Sphecodini, Mar. 31-Nov. *Chloralictus* is probably host of *Paralictus*, both March 15-Nov. *P. cephalicus*, May 9-Oct. 19, was taken at a bank where *C. zephyrus*, Mar. 21-Nov., was nesting.

I would arrange the Halictidæ as follows: Halictinæ, wing veins not enfeebled; Halictini: Halictus, etc.; Sphecodini: Sphecodes, etc.; Lasioglossinæ, outer veins enfeebled; Lasioglossini: Curtisapis, Evylæus; Chloralictini: Chloralictus, Dialictus, Paralictus. The last is an offshoot from *Chloralictus*. The Sphecodini were derived from Halictini, not from the forms with outer veins enfeebled.

Andrenidæ and Nomadidæ.—The Andrenidæ fly 227 days, March 17-Oct. 30, have a maximum of 68.8 per cent May 11-13, 75.5 per cent flying in May, 64.4 in April, 48.8 in June. Only one is flying July 30-Aug. 12, while 6 are simultaneous Sept. 8-20. The Nonadidæ fly 212 days, Mar. 21-Oct. 19. Twenty species fly 129 days, Mar. 27-July 27. The maximum is May 5 when there are 14 species flying simultaneously. Three species fly 54 days, Aug.27-Oct. 19, all together for 25 days, Sept. 8-Oct. 2.

Forty-five species of Andrenidæ and 20 of Nomadidæ complete their flight before August and are evidently related as host and inquiline, but there are so many that it is hard to match them. I think *Centrias erigerontis*, June 17-21, is an inquiline of *Pterandrena rudbeckiœ*, June 10-Aug. 17. *C. americanus*, Apr. 29 -July 16, ends when only 3 Andrenidæ are flying, *Pterandrena rudbeckiœ*, *Trachandrena quintilis* and *T. obscura*. It begins 42 days before any of these, in which time it evidently infests some other species. *Cephen texanus*, July 17-27, probably belongs to *Trachandrena quintilis*, July 8-29, *T. obscura*- July 16, or *Pterandrena rudbeckiœ*, which are the only Andrenidæ flying at the time. *Holonomada vincta*, Aug. 27-Oct. 2, is probably an inquiline of *Pterandrena helianthi*, Aug. 27-Oct. 10. *H. placida*, a small species, Sept. 6-Oct. 19, may belong to *Pterandrena solidaginis*, Aug. 13-Oct. 22, or *Andrena nubecula*, Aug. 13-Oct. 30. *Nomada vicina*, Sept. 8-Oct. 19, is most closely associated in time with *Pterandrena asteris*, Sept. 8-Oct. 21.

Panurgidœ and Pasititidœ.—*Holcopasites illinœnsis*, June 6-Aug. 23, is probably an inquiline of *Calliopsis andreniformis*, May 30-Oct. 14. *Heterosarus parvus* and *Pseudopanurgus albitarsis* are the only other Panurgidæ flying in the early part of June.

Anthophoridœ and Melectidœ.—Five species of Anthophoridæ fly 166 days, Apr. 8-Sept. 20, averaging 63.4 days. Excluding *Emphoropsis floridana*, the male observed for 16 days, the average is 75.2.

Bombomelecta thoracica, April 18-May 28, flies during the time of *Anthophora ursina*, April 8-June 22. *Melecta interrupta*, taken twice, June 18, July 19, is probably an inquiline of *Amegilla walshii*, July 6-Sept. 20. It no doubt flies much later than *Anthemœssa abrupta*, May 7-July 29, and *Clisoden terminalis*, May 25-July 27.

Emphoridæ, Euceridæ and Triepeolus.—The Euceridæ fly 198 days, Apr. 8-Oct. 22. Excluding *Tetralonia*, they fly 132 days, June 13-Oct. 22. *Triepeolus* flies 118 days, June 26-Oct. 21, all together for 5 days, Aug. 30-Sept. 3.

In 4, 37, I accepted Ashmead's erroneous opinion because *Triepeolus* was mixed with *Epeolus*. There were too many of them and they were too large to be inquilines of *Colletes*.

Triepeolus donatus, Aug. 11-Oct. 11 infests *Melitoma taurea*, June 24-Oct. 7 (Ashmead in **5**). *T. helianthi*, Aug. 11-Oct. 3, infests *Melissodes trinodis*, June 14-Oct. 6 (Grænicher **2**). *T. pectoralis*, Aug. 30-Oct. 21, coincides pretty well with *M. autumnalis* Aug. 21-Oct. 22. *Triepeolus* is too late to infest *Tetralonia*. *Tetralonia dilecta*, Apr. 18-July 14, may be infested by *Holonomada superba*, Apr. 20-June 24.

Of 296 local species, the short-tongued bees are 50.6 per cent. In general they are the primitive bees and occupy the original positions. The long-tongued bees, developed later, have turned to flowers whose nectar has become so deeply seated as to be rather inaccessible to the short-tongues. They have not displaced the lower bees, but have taken up new ecological positions. That the long-tongues have been compelled to find new places for themselves is shown in the development of inquilines, 77.7 per cent of which are long-tongues. Inquilines are 38.3 per cent of long-tongued bees and 10.6 per cent of short-tongued bees.

Of the short-tongues, the Halictidæ are the only ones which have developed inquilines, Sphecodini and *Paralictus*. Natural selection seems to have favored the development of inquilines, just as if they could live at the expense of previously established bees better than they could actively compete with them.

About the only adaptive characters shown by inquilines are differences in size. They run smaller than their hosts and the small species belong to small hosts.

The characters by which the species may be distinguished are unusually non-adaptive. The mutationists, with whom the origin of species seems to be the same as the origin of specific characters, might readily point to inquilines as species with whose origin natural selection had nothing to do.

The inquilines, however, generally, if not always, have different hosts with which their size and flight are correlated. Natural selection clearly favors this diversification. My view is that the inquilines separated first and got their specific differences afterwards.

An inquiline producing mutants infesting the same host could not produce more individuals and could not become the basis of new evolution any more than one which did not produce them.

As regards species in general I hold that everyone has selective characteristics, holds its own bionomic position, and is the result of natural selection.

Note on Sphecodini.—According to Schuckard (**7**, 108), St. Fargeau, Westwood and Latreille regarded these bees as inquilines, while Kirby and Smith regarded them as nest-makers. Mueller (**9**, 50) says they feed their young with the disgorged surplus of their own food.

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DESCRIPTIONS OF FOUR NEW SPECIES OF EUSTICTUS (HEMIPTERA, MIRIDÆ).[1]

By Harry H. Knight,

Ames, Iowa.

Eustictus ainsliei n. sp.

This species runs to *venatorius* Van. D., in my key to the species (Hem. Conn., 1923, p. 481), but is distinguished by the long hairs on antennal segment I, by the shorter length of segment I as compared with width of head, by the long bristle-like hairs on pronotum, and long hairs on hind femora instead of spines.

♂. Length 6.4 mm., width 2.4 mm. Head: width 1.32 mm., vertex .23 mm. Rostrum, length 3 mm., extending upon fourth ventral segment. Antennæ: segment I, length .98 mm., thickness .17 mm., set with erect bristle-like hairs, length of several hairs greater than diameter of segment, mottled with black and white; II, 2.7 mm., brownish black with a few fine pale marks evident; III, 1.4 mm., with more pale than segment II; IV, 1.35 mm., brownish black. Pronotum: length 1.23 mm., width at base 2.14 mm.

Coloration very suggestive of *venatorius*, but more broadly white on hemelytra, basal half of pronotum, and front of head; calli black, with five blackish rays extending back half way to basal margin. Dorsum clothed with erect long hairs, distinctly bristle-like on pronotum; apical half of femora and basal half of hind tibiæ set with long erect hairs, the hind femora without true spines such as are found in *venatorius*.

Holotype: ♂ April 14, Orlando, Florida (G. G. Ainslie), collected at light; author's collection. Named after the collector, Mr. G. G. Ainslie who kindly presented the specimen.

[1]Contribution from the Department of Zoology and Entomology, Iowa State College, Ames, Iowa.

Eustictus spinipes n. sp.

Allies to *mundus* Uhler, but distinguished by the longer antennal segment I and the strong spines on apical half of femora and basal half of hind tibiæ.

♂. Length 4.9 mm., width 1.8 mm. Head: width 1.01 mm., vertex .36 mm.; eyes smaller and vertex much wider than in *mundus*. Rostrum, length 2.46 mm., attaining base of fourth ventral segment. Antennæ: segment I, length .81 mm., thickness .157 mm., set with short bristle-like hairs which in length do not exceed half the width of segment; II, 2.2 mm.; III, 1.14 mm.; IV, .94 mm.; all the segments red without dark markings, last segment somewhat darker red. Pronotum: length 1.06 mm., width at base 1.67 mm.

Coloration very similar to *mundus* but with antennæ reddish. Hind femora with several long spines on apical half, occurring on dorsal surface near apex only; hind tibiæ set with regular rows of strong spines, longer on basal half, length exceeding thickness of tibia.

Holotype: ♂ August 25, 1925, Sanford, Florida (E. D. Ball); author's collection.

Eustictus pilipes n. sp.

Coloration nearly as in *spinipes*, but differs in the long, erect hairs on first antennal segment and the longer, erect hairs on tibiæ and femora.

♀. Length 5.9 mm., width 2.2 mm. Head: width 1.13 mm., vertex .46 mm. Rostrum, length 2.93 mm., extending upon fifth ventral segment. Antennæ: segment I, length .97 mm., thickness .18 mm., bearing erect bristle-like hairs, several of which exceed thickness of segment; II, 2.77 mm.; III, 1.42 mm.; IV, 1.14 mm.; red, without black marks. Pronotum: length 1.13 mm., width at base 1.89 mm.

Coloration nearly as in *spinipes*, but head, antennæ, and legs of deeper red. Spines on basal half of hind tibiæ replaced by long hairs several of which in length are equal to three times thickness of tibia. Femora also bearing long hairs on ventral margin, and apically on posterior and dorsal margins.

Holotype: ♀ August 30, 1925, Sanford, Florida (E. D. Ball); author's collection. *Paratypes*: 2♀ July 18, 1894, Tavures, Florida.

The coloration of this species would suggest that it might be the female of *spinipes*, but of twelve species known from both sexes, no variation of tibial spines and hairs, and type of hairs on antennæ occurs.

Eustictus pubescens n. sp.

Distinguished by the short but rather abundant pubescence on legs, body and antennæ; legs and antennæ uniformly yellowish without black marks.

♀. Length 5.7 mm., width 2.74 mm. Head: width 1.2 mm., vertex .40 mm. Rostrum, length 2.29 mm., scarcely attaining posterior margins of intermediate coxæ. Antennæ: segment I, length .68 mm., thickness .18 mm., clothed with very short stiff pale hairs; II, 1.7 mm., somewhat more slender at base; III, .97 mm.; IV, 1.11 mm.; uniformly yellowish. Pronotum: length 1.21 mm., width at base 2.3 mm.; rather sparsely and coarsely punctate; scutellum smooth.

Coloration rather uniformly yellowish, pronotal disk and scutellum fuscous, calli paler. Embolium broad and flat, clear, yellowish to red on apex, embolar margins thickly set with short pubescence. Membrane, inner and apical angles of cuneus, fuscous. Legs thickly clothed with erect, short pale pubescent hairs, tibial spines very short and confused with the hairs.

Holotype: ♀. June 11, 1913, Monticello, Florida (H. B. Scammell); Cornell University collection.

METHODS OF ORIENTATION IN DRAGON-FLY LARVÆ

By C. E. Abbott

Elgin, Illinois.

Most terrestial insects orient themselves through vision, and most of them take advantage of the direction of light rays. Although other factors may influence the direction in which a given individual will travel, the visual, and possibly the olfactory, senses seem to be those chiefly utilized in maintaining a direct path. The only studies of a complete nature relating to this phenomenon in aquatic insects were made by Holmes (1905).

In the following experiments, the larvæ of *Anax junius* and some species of Aeschna were employed. Two larvæ were taken from the water, and the left eye of one insect and the right eye of the other covered with asphaltum. As soon as the asphaltum hardened they were put back into the water for about an hour. They were then removed and placed on a sheet of white paper. Their courses were traced with a pencil as they crawled. Ten such tracings were taken at one time; the animal was then placed in the water and allowed to rest. Thirty tracings in all, were taken for each of the two insects. The animal always turned toward the side with the covered eye. Often, after a few trials, the paths were almost straight; showing that habit tended to overcome the turning. These experiments were conducted in diffuse daylight.

Other experiments were tried with a beam from a 500 watt bulb. A larva with the left eye covered was placed at right angles to the beam and to the left of its source. In twenty-one trials it turned five times to the left, eight to the right, four times it followed a straight course, and finally turned four times to the right. On the following evening it turned seven times to the left, eighteen times to the right, once it took an irregular course, and once turned to the right. Two evenings later it first followed a straight course once, turned six times to the left, once followed a straight course, and finally turned seven times to the right. On the same evening, this insect was tried facing the light. Once it followed a straight course, once turned to the left, again moved in a straight course once, turned twice to the right, to the left once, moved straight ahead once, turned to the right once, and resume' the straight course five times. An insect with the right eye covered entered the light at right angles and at the left of its source. This larva turned to the right twice, took one irregular path, turned to the right once, to the left twice, to the right once, and to the left twenty-one times. When facing away from the source of light, it first followed a straight course, and then turned to the left twenty times. Facing the light, it turned always to the left.

Observations based on a study of these larvæ in their natural habitat or in aquaria gives some clue to the above irregularities. The insects are strongly thigmatropic. When a number of them are put into a vessel containing nothing but water, they will cling to one another until a great mass of intertwined insects is formed. This mass is not easily broken by the addition of chemicals, but very warm water will scatter the larvæ. Normally, these larvæ will seek out small sticks or the stems of plants and cling to such objects. Usually the entire ventral surface of the insect is in contact with this substratum, and the legs surround it in a close embrace. This brings the long axis of the insect's body parallel to the object upon which it rests.

The revolving disc that Dolley (1916) used so successfully in his experiments on *Vanessa antiopa* had no influence on the young dragon-flies, either in or out of the water. The nature and direction of light was a little more effective. Among aquatic insects the tactile sense seems to be only a shade less important than vision, and in may cases even more important. Anax and Aeschna larvæ orient primarily through contact stimuli. The influence of vision in orientation is secondary.

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New name for Odynerus clypeatus Robertson.—On account of *Odynerus clypeatus* Saussure 1852, this is changed to *Odynerus bradleyi* Robertson.—Charles Robertson, Carlinville, Illinois.

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SEQUENTIAL DISTRIBUTION OF *FORMICA EXSECTOIDES* FOREL.

By E. A. Andrews.

Johns Hopkins University.

Observations here recorded, indicate that the mounds made by this ant arise and pass away in rhythms harmonious with phases of forestation.

The continued life of this species may indeed be dependent upon the migrations to new growths of trees. Trees that when young furnish food for the ant, when mature may cut off sunlight needed to make the mound a successful incubator for the young.

Thus in fifteen years there has been found a migration of mounds comparable to the moving on of some primitive peoples dependent upon newly cleared forests.

According to *the* book upon ants, and to other writings of that foremost student of these animals, Professor William Morton Wheeler; the most common mound building ant of North America belongs in the species of *Formica exsectoides* Forel, and its mounds have been observed in Nova Scotia, Ontario, Maine, New Hampshire, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Maryland, North Carolina, Georgia, Wisconsin, Illinois and Colorado, though there may be doubt as to all the extreme western forms being of the same species as the others.

In general these ants are spread along the Appalachian region and are to be looked for in hilly or mountainous regions where the land is wooded more or less. It is thus exceptional to find these mounds near sea level as Wheeler observed them in Staten Island and as I have seen a few in Massachusetts ten feet above low tide and but few hundred feet from open salt water and again near Baltimore in the region of Cowenton on the neck between Bird River and the Gunpowder at an elevation of much less than one hundred feet.

One important factor in restricting these mounds to hilly country may well be not so much the elevation as the probable association of good cultivation with level and lower lying land while in the hills there are greater opportunities for partly wooded regions, especially abandoned fields and clearings growing up with new woods and left comparatively free from live stock and human interferences, so that the colonies of ants may find both food and freedom from disturbance for long periods of years.

The classical account of the mound building ants of America is that of the enthusiastic student of ants, the late Rev. Henry C. McCook, who camped out for a week in August 1876 amongst the ant communities one mile north-east of Hollidaysburg near Altoona, Pennsylvania, where there were some fifty acres of ant mounds on the southwest base of Bush mountain belonging to the Cambria Coal and Iron Co. This region of sandy, stoney soil grown up with open woods of oak and few pines was known to the people of the region as the "Ant City": and at the present date the trolley station there is labelled "Ant Hills." In this community or city were no less than 1700 dwellings; 25 to 33 to the acre. In other neighboring regions: Warriors Mark and Pine Hill: there were in the former 30 to the acre (but some were abandoned and moss grown) and in the latter 1800 dwellings at the rate of 30 to 59 per acre.

Not only were the mounds so numerous but some were of great size, 10-12 feet around the base and 2½-3 feet high. A photograph published by McCook shows a mound that was 25 feet around, 6 ft. 9 in. up the West front, 3 ft. 6 in. up the East, 4 ft. 4 in. on the South and 4 ft. 3 in. down the North face. Another photograph represents a mound 24 inches in vertical height and a third one 32 in height.

At Warriors Mark and Pine Hill he records even larger mounds. A fine cone was 12 feet across over the top and 30 feet around the base. While the largest of all three thousand or more seen was 42 inches in vertical height and 58 feet around the base while a line across its top measured 24 feet. This was one of a pair and the other measured 15 feet across the top and 47 feet about the base. Both these great structures were built up upon an old level charcoal hearth; and hence their age was limited.

No such large accumulation of these vast works of mound-building ants seems to have been recorded elsewhere; but Wheeler figures a mound in New Jersey 1 m. x 3.25 meters and a mound of another species in Belgium as 2.15 x 9.8 meters.

In Maryland the mounds made by this ant are not uncommon in the wooded mountains of central and western countries where the summer visitor often evicts them with little regard for any claims that might be set up by these red and black original inhabitants so that in time not only the demands of agriculture but the thoughtless aspects of enjoyment of nature may combine to exterminate the present mound builders.

In eastern Maryland one may find the mounds here and there in Baltimore County, near Baltimore, as along the hills West of the limestone valley in which lies Cockyesville, up the Beaver Dam Run, and north of Green Spring valley where a fine grass-grown mound was measured and photographed in 1906 by Professor Philip H. Friese, along the North Run, a mile north of Stevenson. As described in a letter of that date this mound was about thirty inches in height and a perfect cone except for rounded top and evidently owed its steepness to being covered with grasses, some of which were not represented among the grasses of that neighborhood. And as above noted there are quite a number of small medium mounds near the shore below the Piedmont Plateau, in the region near Cowenton. While most of these mounds stand alone or a few in a group, an unusually populous settlement of ant's mounds was found near Lutherville and Timonium, some nine miles north of Baltimore, by the late Professor Basil Sollers who called attention of the Baltimore Naturalists Field Club to this favorable place for study of these mound builders.

However these ants were earlier known to the late Professor Philip Uhler, sometime Associate in Natural History in the Johns Hopkins University and Provost of the Peabody Institute, who told me that in his boyhood, when he lived at Lutherville, these ant mounds were less numerous but individually larger. That period was probably about 1850. This is in harmony with the existence in 1905 of a few very large circular regions indicating old mounds long since washed away.

The region in which these ant mounds of Timonium occur is a large tract of deserted land of some 600 acres, roughly a mile on each side, bounded on the West by the York turnpike, on the East by a road leading out of the old Dulaney Valley and Sweet Air Turnpike, on the North by the "cinder" road and on the South by the open farming country of Long Quarter. This region is largely given up to young woods and used as wood lots, not pastured nor fenced for the most part, having been formerly used as source of bog-iron ore for the Ashland Iron Ore Co. of Ashland, Md. which left various large and small excavations abandoned at different dates down to 1888 when the last work was done. It is represented by diagram one, which shows the positions of the ant mounds, but with the size exaggerated.

The land slopes gently from elevation of 400 feet in the northwest to elevations of 300 toward the southeast and two springs give rise to a little run which flows toward the Gunpowder.

The soil is poor with gravel and at the south a small outcrop of crystalline limestone with two large excavations. The geological formation is said to be Potomac or lower Cretaceous.

A reconnaissance of this area made in December 1905 showed that the ant mounds were located in two regions, a larger "town" near the York road [above in the diagram] and a smaller "village" to the south [to the right and below in the diagram] separated from the larger settlement by a third of a mile of woods in which however a few faint indications of the former existence of large mounds suggested that at one time the two settlements might have been connected. Ants carried in the following summer from the mounds of the larger to the mounds of the smaller settlement did not seem to excite hostile responses but were immediately allowed to run into the mounds without being fought by the inhabitants. Ants taken April 14, 1906 from the "village" and put in a mound in "town" did not start up a fight, but the queens were seized and dragged along into holes in the strange mound. This may be taken as some indication that the ants in the two settlements were not of remotely different origin, but probably all of one general society.

In the larger town 157 mounds were enumerated of which 95 were occupied and 62 deserted while in the village only 27 mounds were found; of these 22 were occupied, and 5 deserted. The larger mounds were in the larger settlement, while the village had the appearance of being a more recent growth from immigration.

In size the mounds varied from 1 to 8 feet in diameter and 4 to 24 inches in vertical height.

Three general types of architectural effect were noted. Some mounds were free from vegetation and showed fine conical forms the resultant of the untiring efforts of the ants to carry up onto the mound mouthfulls of earth and bits of stick and dead leaf as well as large bits of stone and other objects to be found on the surface of the ground near the mound, counteracted more or less by the down rolling and washing of the materials in the usual process of denudation of hills of all sizes. When the sub-soil is red the mounds are red, when white, white, and again the collections of small sticks may give grey effects.

A second type of mound common in grassy glades presents more abrupt sides and artificial, tower-like contours from the combination of the above factors complicated by the upgrowth of certain grasses and other plants, as peppergrass, which tend to holding the down-rolling materials in steep slopes. A third and rare aspect is that of the mound partly coated over with moss which makes the natural surface more resistant to denudation and tends to emphasize differences in slope between the faces of the mounds that do and do not support moss.

While the typical mound is nearly circular many are much elongated as if made up of the fusion of two formerly separate cones: while others elongate down steep slopes of the ground.

Changes in Distribution of Ant Mounds in the Timonium Ant Community in 15 Years.

The census of the mounds of the entire region made in 1905 showed 184 mounds of which 117 were occupied and 67 deserted.

A second census made by several students in 1920 recorded

193, of which 182 were occupied and 10 or more deserted. The impression, however, was that many mounds were smaller, that there were not as many great mounds as fifteen years before; and this is in harmony with the opinion of Professor Uhler that the mounds of 1850 or so had been larger and fewer than fifty years after that.

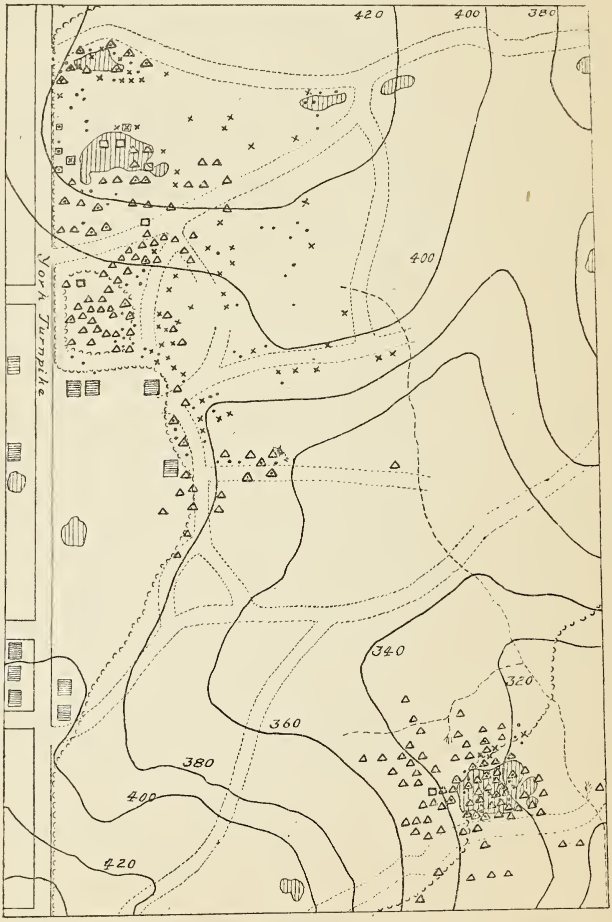


Diagram 1

Actual survey showed that the many mounds were distributed differently from the mounds of 1905. The following table shows the changes in distribution:

	North		Middle		South	
	Active	Deserted	Active	Deserted	Active	Deserted
1905	40	24	55	38	22	5
1920	33	9	65	1	84	1

Thus the deserted mounds of the north section had largely disappeared, and so had those of the middle region and of the southern region; however, the census of deserted mounds was not as accurate in 1920 as in 1905.

The increase in active mounds was most pronounced in the southern settlement or village where the number jumped up from 22 to 84, nearly a 400% increase.

There was also an increase from 55 to 65 in the middle region and a diminution in the north from 40 to 33. The increase was greatest in the south, great in the middle, and negative in the north.

The shift of population from the north and the occupation of new mounds in the middle and south is shown at a glance in the first diagram, which shows by dots the mounds that were active in 1905 and by x marks the mounds deserted in 1905, and by triangles the active mounds of 1920 and by squares the inactive mounds of 1920.

Many of the active and very many of the deserted mounds of 1905 were not extant at all in 1920. We see here that the more easterly mounds of the community had been abandoned, all the mounds of 1920 being to the west or to the south, with few exceptions. None of the deserted mounds became reinhabited as far as ascertained. After 15 years but two of the deserted mounds were still discernible as traces as indicated by a square enclosing an x. In 1920 three of the active mounds of 1905 had been deserted as indicated by squares enclosing dots. After 15 years, some 25 mounds still remained active as indicated by triangles around dots. But very many of the active mounds, shown by the plain triangles, were new developments not directly connected with the mounds of 1905.

The nearly pure constellations of these new mounds are, near the York Road in the middle region, called the flats, and the larger one in the south, village, region.

The area embraced by the population in 1920 is no more extensive than in 1905 and the number of active mounds about the same, but there was a shift of relative location of many domiciles: the north losing, the middle and especially the south village gaining many new mounds.

There had been increase in density of housing: in the north and middle concentration had resulted from occupancy of about one fourth the former area. Concentration is accompanied by abandonment of some areas and migration into others but the entire area is not abandoned nor fundamentally altered in its interior, but rather one edge fades away as the opposite advances. After fifteen years the northwest part is reorganized; there is recession all along the east and great protrusion in the middle west portion; while the south village expanded in all directions.

In the town the centre of population moved to the west; destruction of some suburbs being compensated for by new growths elsewhere.

Yet the entire occupied area has shrunken while holding about the same number of domiciles.

Before considering possible causes of these shifts in population, some details of change in the northwest region may be considered. Of 61 nests mapped in 1905 only 18 were found, of these 8 were still active and 10 dead; but three of these had been dead in 1905, thus of the 18 found, 8 had continued 15 years and 7 had failed in that time. Of the 61, 21 were apparently deserted in 1905. Thus, of 40 active nests, fifteen years left 7 remaining as vestiges and 8 as still active. Also there were still remaining vestiges of three that were dead in 1905.

Table of amount of growth in 6 of the 8 that survived 15 years.

Mound No.	Gain in Height	In Diameter.
3	2 in.	34 in.
54	2	5
54 twin	8	18
58	12	50
59	3	12——36 N. S.
60	9	18——20 N. S.
	Average 6	Average 23-27

The mounds that continued active through 15 years had grown variably, from 2 to 12 inches in height and from 5 to 50 inches in width. Each of the above eight mounds was a foot or more in height in 1905 and doubtless of some years' standing.

Special attention should be called to the pair of mounds No. 54 on the edge of a gravel pit which were always conspicuous for dark color and coarse sandy surface due to the special environment; there being hereabouts little but subsoil and a growth of false indigo which in the fall yielded dark blackish leaves that were collected on the nests to such an extent as to make these appear very dark. The hills in 1905 were small but not apparently young; one 9 by 24, the other 4 by 18 inches. In the whole 15 years the former grew to be 11 by 29 and the latter 12 by 36. They had grown almost to touch at the base and one had advanced a little over the edge of the cliff. From that period up to the present, these two mounds remain but little changed, being of very slow growth, apparently resulting from poor conditions of soil and of vegetation.

In contrast, the mound No. 59 which was very large in 1905, being 2 feet by 5 feet, had in fifteen years grown to 32 inches by 96 inches, measuring 115 inches over its surface and with a circumference of 22 feet. This mound in the midst of Japanese honeysuckle has always been nearly clear of all but a little grass and the vine has stopped rather abruptly at the moat or clear area about the base, being restricted in growth by the ants of this very successful nest. This mound still continues, and though in the past few years it showed signs of weakness in lack of growth and poor upkeep it is greatly recovered in 1926.

Many other cases were recorded showing marked individuality in the mounds, not only in architecture and location but in longevity, rate and character of growth and decay.

The individuality of each mound is a result of interaction of the environment and the special internal states of each community, as failure or success depends upon both external and internal factors.

The mound is not only the abode of the adults but preeminently the incubator for the young and thus the means of securing the perpetuation of the race. The mound is not a temporary seasonal affair like the nest of a wasp but may be of very considerable permanence, one of the most enduring architectural results of insect communism. In considering possible reasons for differential success and failure as between mounds near together, it must be born in mind that these ants are long-lived amongst insects. Ants were kept in captivity by Lubbock for five or six years as workers and up to fifteen years of age in the case of a female ant.

In nature ants of this species lie dormant about four months of the year and it may be that thus they live longer than in captivity; nevertheless it is probable that the mound may outlast the lives of the original builders and be possessed throughout the generations.

Some of the mounds mapped in 1905 were already large and remained active in 1920 and even in 1926. To attain that large size probably requires several or many years judging from the measurements elsewhere recorded (Andrews, Growth of Ant Mounds, Psyche, 32, 1925); so that a mound already large in 1905 may at this present writing be over thirty years old which is in harmony with the estimates of McCook as to the time that one mound may endure and in agreement with the fact that Forel had a prosperous mound of a related European ant under observation for forty years. The final end of the existence of a mound may be like that of a human city, variable, complex and to be known only by detailed history—which has not as yet been written up to the last day of any ant mound.

That the mound may persist longer than the original founders of the mound is probable also from a described habit of this ant to seize upon young female ants after swarming and to get them into the old mound in some cases so that many mothers of different ages are actually found in a well advanced mound. Hence the deficit of population from old age may be compensated for and the tribe or family be able to live on in the same old mound, if all goes well.

As to empty mounds: beside desertion by migration any one mound may lose its inhabitants either from internal or external causes, (sufficient disease or epidemics are not yet known) but old age of the inhabitants would lead to an empty mound if the above process of substitution of younger for older did not succeed in any one mound. Of external inimical factors there are many, such as man's culture of the field, his domesticated animals tramping on ants and the mounds, his direct hostile acts and the attacks from animals that feed on ants, as the skunk and the woodpecker, also adverse influences of mosses and other vegetation. In this Timonium region, the direct causes of the extinction of life in mounds are not at all known.

On the other hand the differential dying off of many mounds in one part of the area and the coincident appearance of new mounds in another section of the area is a phenomenon that may be correlated with environmental factors. As far as known important enemies of the ants are largely absent from the whole area and as impotent in one as in another section of the region and the success or the failure of groups of mounds would seem more likely due to some factors that have changed slowly through the many years.

As in general *Formica exsectoides* is found where there are trees but not dense old forests, it may be regarded as a dependent upon certain stages of forestation.

In the north region of the diagram during the slow disappearance of so many mounds there was greater growth of the trees and increase in their age. In the middle region the inrush of new mounds in fifteen years has been accompanied by the upspringing of a new growth of young trees.

This correlation of many new mounds with new trees and many empty mounds with old trees may well be significant. It is supported by such facts as: the vestiges of old mounds in the region between the ant "town and village" where the woods are dense and old; the failure of a mound transplanted to the large woods of "Homewood" and its better success when the ants migrated spontaneously to the open edge of the wood in Wyman Park; the great success of colonies in the Holidaysburg region where mining operations kept the forest cut down in part; the present flourishing of a large colony in the cut-over forests of the neighboring Warriors Mark. (Andrews, Ent. News, 1925), and the observation that this ant in early spring is more active in regions of sunny exposure than in older woods.

If the trees and ants are interconnected possibly one or the other of the two basal factors of animal success may be involved; the gaining of food for energy of the individual ant or else the proper conditions for reproduction and the continuance of the species. One mound may not obtain food enough to keep up the depletion in population, while another mound may obtain a surplus of food and be able not only to maintain itself but actively to colonize the surrounding neighborhood with new and rapidly growing mounds.

Unfortunately little is known about the food of this particular mound building ant. In this region it is observed that the ants climb the trees near their mounds and go out on the branches and leaves; it is observed that they get honey dew from some kinds of aphids or plant lice and from the black leaf hopper *Vanduzea arcuata* Say. They are seen to drag various dead insects into their mounds.

It may be assumed that these ants depend greatly upon trees for their food supply which is partly at least carbohydrate in nature. In artificial formicaries many kinds of ants can be kept very long periods when fed chiefly sugar and water or honey.

If it be granted that ants derive their energies from food supplied by trees, there may be an inverse ratio between the food got and the work done in getting it, according to the height and food-supplying character of the trees. If small young trees give as much food per unit of leaf or photosynthetic element as do the old trees, then the labor of going up the old tree to get the food will be greater than going the short distance up the young tree; and on an exceedingly tall tree, the ants might use up all the energy acquired before they ever got down to the ground again. Also, it may well be that the tender young shoots of young trees feed more aphids and yield more sap than is available from like area of the twigs of an old tree, so that it would advantage the ant to visit the young rather than the old tree.

From the data given in "Bau und Leben unserer Waldbäume," M. Buesgen, Jena, 1917, we infer that the total photosynthetic area of a young tree five or six years old may be some 4 square meters; but of an older tree 13 to 14 meters in height, from 8 to 24 square meters according as to whether it grows under shade or jutting up into the sunshine. In a crowded stand of such trees each may have 12 square meters area of leaf. Each of these crowded trees may then expand three times as much leaf area as when young but it will be perhaps six times as high as when young: thus the ant to get all over its green leaves will have to run up twice as much trunk as when the tree was young. We conclude that as long as the trees are young and have not crowded one another and have plenty of sunshine their combined leaf surface within the ant's walking distance to its mound will be greater than when these trees have grown crowded and tall, since the stems of the trees increase more rapidly in height than the entire leaf area expands.

In endeavoring to apply the above considerations to the observed changes in distribution of the ant mounds we observe that in the fifteen years the trees of the old wood in the northwest area had grown older and the ground more densely shaded, and the ants had not increased.

In the middle region where in 1905 the earth was quite bare and very poor dump, spread out in a plain of several acres, there had grown up more and more young trees, especially black locust, gradually encroaching from the edges over more and more of the bare area along with coarse grass and brambles and Japanese honeysuckle. In this region the new ant mounds became very abundant.

Again in the region of the "village", where in 1905 trees were few and far from the two old mine holes that were grass-grown, there sprang up more and more young trees and here again the number of ant hills greatly increased.

On the other hand, in the region where the large "stone house" group of mounds had been in 1905 there was no increase and no new trees, and besides the fields were cultivated and there was some passing of vehicles along the wood edge. Also the diminution along the older roads to the east may have been due to the fact that trees had grown larger so that there may not have been as good feeding conditions here, in 1920, as formerly.

There seems to be some correlation between the success of new mounds and the presence of young vigorous trees, and some correlation between the dying away of colonies of old mounds, and the maturity of trees which brings shading and presumably difficulties of food getting. The subject of shading as a cause of decay is very important and may be the decisive factor in the effect of old trees upon ant mounds.

Although in the Alps the natives may find their way by the elongation of the E. W. axis of mounds of *Formica exsecta* (as confirmed by Huber, 100 yrs. ago);—in Timonium, many nests seem elongated N. S. with longer south slope, but that this is not universal is indicated by the following measurements made for me in April 1920 by Mr. Spielman.

Twenty vigorous nests in the region. on the flats, were measured as to diameters N. S. and E. W. and as to angles at the top of the nest along those directions of compass as follows:

	E. W. angle	N. S. angle	Diameter E. W.	Diameter N. S.
	Degrees		Inches	
	130	145	63	63
	130	125	57	44
	120	155	60	60
	120	120	46	57
	125	140	67	86
	125	135	28	26
	115	140	36	40
	130	135	66	74
	130	125	63	62
	130	145	82	89
	125	100	50	48
	120	130	56	65
	125	100	50	48
	120	115	42	40
	130	125	44	60
	125	130	55	52
	110	115	45	40
	120	120	52	56
	125	150	80	73
	120	120	40	42
Sum	2475	2570	1082	1125
Average	123.75	128.5	54.1	56.25

While these measurements show that some nests do not have any extension toward the South, which would lower the angle and increase the diameter N. S. as compared with the E. W., yet on the average there is a slightly greater angle and greater diameter in the N. S. direction.

Moreover the angles, running from 100 to 155 degrees, are much more uniform in the E. W. than in the N. S. directions; thus there are no very flat nor steep angles E. W. while the extremes are all found in the N. S. direction.

When the above angles are plotted on curves of frequency it is seen that the E. W. angles cluster close to the 120-130 degree norm, in a steep curve, while the N. S. angles spread widely right and left from an irregular flat curve having the same norm.

Apparently there is some factor in the N. S. direction acting to disturb the conical symmetry the materials of the nest would exhibit if deposited without preference, like the sand in an hour glass.

A second set of measurements of vigorous growing mounds taken at random in the same general region rather newly occupied, was made in October 1920 by students, Spielman and Lord, with the results given in the following table:

Height in inches.	Angle at top.		Angle of slope to horizon.				Distance over top. in inches	
	E. W.	N. S.	W.	E.	N.	S.	E.W.	N. S.
22	104	110	34	42	27	43	80	92.5
11	121	102	28	31	55	23	42	39.5
21	121	123	30	29	31	26	91	90
7	131	130	26	23	22	28	31	28
12.5	126	124	30	24	37	19	46	53
11	112	115	34	34	33	32	40	43
11.75	108	126	30	42	24	30	43.5	50
15	114	126	30	42	24	30	43.5	50
24	120	125	30	30	30	25	84	87
32	100	110	50	30	50	20	77	80
16	110	125	30	40	25	30	54	55
24	120	125	30	30	30	30	90	89
20	130	125	30	20	25	30	89	85
16	110	105	30	40	45	40	54	54
14	120	125	30	30	25	30	58	55
Sum 258	1747	1796	482	487	483	436	923	951
Aver. 17	116.5	119.7	32	32.5	32	29	61.5	63.5

From this table may be gathered that the average angle at the top was slightly larger in the N. S. than in the E. W. direction and that the distances over the top were somewhat greater, in average, in the N. S. than in the E. W. directions; moreover the four different angles made by the slopes N. S. E. and W. were least in the S. and greater and almost equal in the other three, on the average. This indicates a tendency for the south slope to be spread out, increasing the angle at the top and the distance over the top and diminishing the angle of slope on the south face.

These fifteen hills were steep cones, the angles at the top being small, from 100 to 131 degrees and graphs indicate a norm about 120-125. The angles on the W. and E. were similar in variation from 26-34 and from 23-42 respectively while the angles N. and S. show a wider range, 22-55 and 19-43 respectively. Thus the most gentle slope was found on the south face and the most abrupt slope, 55 degrees, on a north face.

The measurements over the top show the mounds to range from 31 to 91 inches E. W. and 28 to 92.5 N. S. And curves of these measurements show the norm of the N. S. distances to be greater than that of the E. W., indicating again that the mounds are prevailingly drawn out in the N. S. direction.

This slight average overgrowth of the southerly exposure of many mounds in this Timonium region is due to more work being put on that part of the mound and this is very patent in some mounds whose northerly sides show but few ants over them and even become abandoned to such an extent as to be no longer thatched over with a compact layer of earth and organic fragments, as are the perfect mounds, but are eaten out by the rain so that some internal cavities are bared, as in an abandoned roofless part of a human dwelling.

Irrespective of North and South, extra work upon only one aspect of a mound is often very patent when the mound is reared upon a slope, as often happens in this region of many old open mine holes. Here the running of the soil down hill is ever counteracted by the ants placing more particles upon the steep slope till the form of the mound departs very greatly from a cone of circular base and becomes drawn out like a glacier. Investigation would be needed to determine why the ants put more material on the side from which it tends most to roll away but this may be connected with the observed ability of the ants to repair breaches in the mound, filling up cavities, and finally reconstructing perfect cones, when as much as half the mound has been taken away completely.

Presumably the greater work on the south side is connected with temperature or some other result of insolation. In general the ants are very sluggish in cool weather and very increasingly swift and active with high temperatures and we know from horticultural experience that any mound of earth in these latitudes tends to be noticeably warmer on the southerly expanse and this difference in temperature might be the reason for greater work put on that more sunny side just as Forel has assumed that the early morning sun on some European mounds enables ants to get to work earlier and so succeed in rearing more young on the easterly slope of a mountain than on the westerly slope.

On the other hand the connection between sunshine and mound building may be much more complex as is suggested by the remarkable facts brought out by the investigations of this ant, *Formica exsectoides*, by foresters in New England. It was observed from 1912 onward that plantations of forest trees were found to show dead regions about ant-mounds and after some false clues it became evident that the ants took active part in killing the trees.

H. B. Pierson (Jour. of Forestry, XX, 1922) described the actual actions of the ants in biting and stinging the small trees not far above the ground, resulting in death of the whole tree. In other trees the ants killed the leaves. Mapping the dead trees indicated that the ants killed the trees with reference to the sun, the trees being damaged most greatly on the east, west and south of the mounds. "As soon as the shadow of a tree was cast on the nest for any length of time, that tree was attacked."

Some attacks of these ants upon vegetation near the mounds were seen in the Timonium colonies as follows. About each mound there is a well cleared area or moat on which most all vegetation is checked and surface material carried off till the underlying pebble or gravel is often exposed very markedly. When the strongly encroaching Japanese honeysuckle is rampant all over the adjacent area, its leaves and shoot tips are nibbled by the ants as soon as they encroach onto the mound or even grow within a foot of it. External to this circumferential band of denudation there are also attacks upon vegetation. In one case catbriars growing to overhang the mound on the north were attacked and the ants seen to nibble the bases of the leaves that overhung the mound. In other cases small shoots of poplar about a foot in height were attacked, the twig nibbled near the base and farther up irregularly and the bases of the leaves bitten till the leaves shrivelled. Also rank upgrowing shoots of blackberry arising after a wood fire that killed most all vegetation down to the ground were seen to be attacked by these ants which opened their jaws as wide as possible to bite the bark of the upper parts of the bramble and at the bases of the leaves, which wilted and drooped down. Some other smaller plants were also attacked. The attack involves not only biting, but curving of body and apparently ejection of acid and resulting brown dead areas on the plant. Now these attacks were two to four feet from the mounds and on all sides without any discerned reference to the shading effects that might be assumed, in fact some of the objects attacked could scarcely intercept any appreciable light and one might compare the attack to that of an ant upon a new object as upon the legs of a person standing near a nest, when the ant runs up till something soft enough to be bitten is encountered and then bites persistently in one spot. Also in founding a new mound the ants did kill all the small plants in and close to the mound when its foundation is first begun.

It may well be that the responses of the ants to sun and shade are very complex and deeply ingrained and that the mere warming of their bodies may not be the decisive factor in making them work more on the sides of the mound exposed more to the sunlight.

As the mound is largely useful as an incubator for the young, the slight differences in temperature between various internal parts of the mound may be potent, as in sprouting seeds or growing bulbs, and be the basis for the ants actions. In one mound thermometers showed differences varying from 25.5° to 32°C. when the natural soil near by was 24°C., June 1926.

Whether investigation shall prove that the internal temperature of the mound is a factor or not, the facts seem to be that these ants do work more on the sun side and that the mounds are most permanent and successful in places exposed to the sun and less successful in deep shade. Thus the upgrowth of trees would eventually introduce an adverse element in the permanence of the mound as being hostile to the optimum temperature needed.

Attempts to establish transplanted mounds both in city back-yard and in the old forest at Homewood, in 1906, 1916 and again in 1926 proved futile; some communities of this ant, *Formica exsectoides* planted at Homewood at various seasons of the year were decimated by birds, especially robins and flickers.

Thus one influence of forestation upon this ant will be through the bird fauna of the forest; for where the robin is favored by the vegetation there can not be good stands of these ant dwellings and when the trees have grown so large as to furnish not only food but nesting sites for flickers, this ant cannot be expected to flourish; hence again the older forest will be inimical to *Formica exsectoides.*

Some of the facts as to association of trees and ant mounds are represented more in detail in the second diagram-map which embraces only the middle western part of the whole area indicated in the first diagram-map.

The area mapped in the second diagram is about four acres of sterile sandy iron soil from former iron ore pits, spread out in a flat with steep bank running down to the York Road on the west and roughly outlined to the east by abandoned wood roads.

In 1905 this was largely a bare barren expanse with little vegetation, few trees and about fifteen ant mounds; but by 1920 trees had come in over its eastern half and ant mounds had scattered all over it as roughly suggested in the first diagram. Both trees and mounds extended into the area from the east.

The first map shows that in 1905 these four acres had many deserted mounds in the easterly part and some occupied mounds in the middle part, but that in 1920 the population was chiefly in the western part and made up of active mounds while many mounds in the middle region had disappeared.

Along with this advance to the west and dying off to the east there was a fifteen year growth of trees which is indicated in the second diagram, the trees to the east becoming older and new trees gradually growing up in the empty west.

That this same procession of forest and mounds is going on still is indicated in the second diagram which is bssed upon a detailed survey made in April 1920 by students, Hoffmeister, Swartz and Kellum combined with a re-survey in June 1926. The mounds present in 1920 are indicated by dots, except two which were then deserted and are indicated by crosses. The mounds grown up in the past four years are indicated by triangles except those now deserted which are represented by squares.

The last survey being made after a severe woods fire in the winter had destroyed underbrush and many trees; mounds were more conspicuous than formerly.

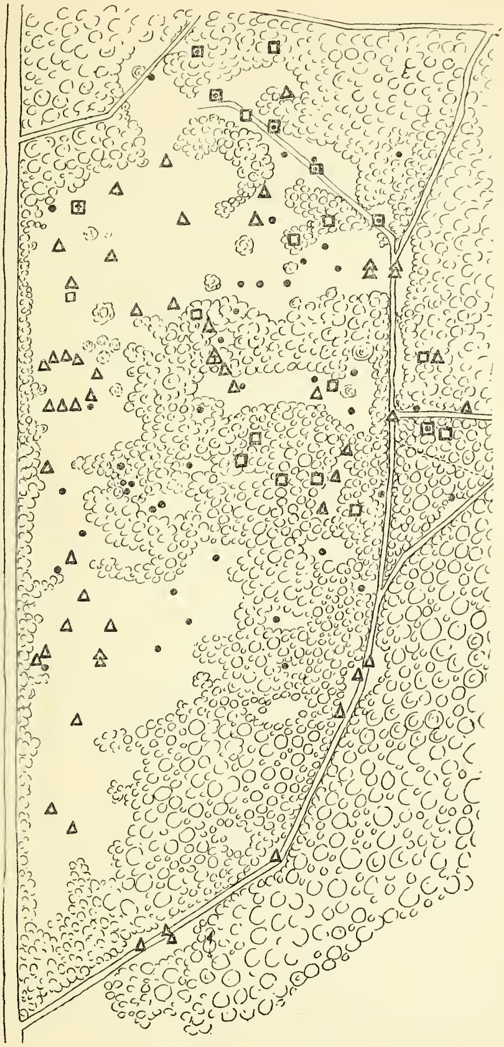
In the diagram the regions of little shade are left clear while the extensions of the wooded area are outlined. It is noteworthy that the woods to the east have spread largely over the area leaving but a strip of clear ground separated from the York Road by narrow band of trees.

The trees are chiefly young seedling oaks, black gum, maple, tulip, dog-wood etc. of small size; with much black locust running rapidly from roots in the loose surface soil. The dense undergrowth of Japanese honeysuckle, catbriar, blackberry and "weeds" extends out into the sunny areas.

Of the 118 mounds found in June 1926, 42 are in the main open sunny region to the west, 11 in its chief extension toward the east, about 28 in various small clear areas amidst the woods, 21 along the grass grown roads to the east; leaving only 15 mounds in the denser shade of the woods as contrasted with the above 103 in the sun.

The old mounds of 1922 are largely in middle and eastern not in the western part; about 37 central and east to 14 west.

On the other hand the new mounds of the past four years are some 30 in the west, 22 in the mid region, and fifteen to the east and of these 11 are along the grassy roads. Thus in four years the advance of mounds has been into the sunny west, and along the grass roads which were not previously occupied



Diagran 2.

The considerable number of mounds in open spaces in the woods is noteworthy: though not all open spaces contain mounds most of them do and in the woods very few mounds are found that are not surrounded by clear spaces of some extent.

In the reg'on immediately to the north of this second map, dense thickets of new growth are interrupted by a few rounded clear spaces each with a large ant mound within it, surrounded by catbriars but not overshadowed by the trees that seem to have grown densely up to a line about ten fee from the mound, and stopped as if the presence of the ant community had prevented other trees from growing up near to the mound.

The distribution of the 118 mounds shown in the second map with reference to more or less shading, may be shown in the following tabulation:

Entire number				Occupied	Deserted
	Those in shade	15	12%	4	11
118	Those in sun	103	88%	94	9
Part found in 1922	Those in shade	3	5%	1	2
51 in number	Those in sun	48	95%	43	5
Those added in 4 years	Those in shade	12	18%	3	9
67 in number	Those in sun	55	80%	51	4

Thus whether we consider the entire number of mounds shown on the map or the part there in 1922 or those added in the past four years, the small percentage is in the shade, much the largest in the sun.

Moreover almost all the mounds in the sun are occupied while the mounds in the shade are for the greater part deserted.

While a deserted mound may be found in the sun this is not common and it is also rare that an active community is found in the shade.

The larger number of deserted mounds recorded in 1926 is due to the wood fire having revealed old mounds long deserted and concealed under thick growth of honeysuckle so as to be invisible. Many of these were doubtless deserted at the date of the first survey.

Strangely enough the mounds that have become abandoned in the past four years are chiefly along the old wood road to the north, but no special reason for this is discovered and shading does not seem to account for these exceptional cases. House rubbish has been dumped in adjacent regions.

The interrelation of tree and ant is thus a sequential one, the young tree supplying food, the older tree deterrent to breeding by shading the mound. On the other hand, the result for the trees of the ant's activities is partly the furnishing of some protection by the removal of injurious insects but also conversely, defense of some enemies of the tree and in part, the destruction of some trees that may too soon shade the mound. Yet in the long run this association allows the trees to become mature, thus driving the ants to new regions of less shade; mounds dying off and new ones being made near by till some of them eventually become established in regions adjacent to trees but not overshaded by trees.

In the natural succession of forests it may be that the position occupied by *Formica exsectoides* is that of a dependent upon conditions in which the forest is temporarily interrupted or destroyed as by fire or wind or small areas of defective soil and that with eventual maturity of forest the ants must move gradually in the course of very many years from place to place.

Human intervention while tending eventually to eliminate *Formica exsectoides* may in some cases supply favorable conditions, as in mining and deforestation operations and in abandonment of old fields to new growths as well as in actual plantation of trees.

There is a general parallelism between the periods of time required for many trees to reach maturity, and the presumed length of existence of mounds of *Formica exsectoides*, thirty years and more. The ultimate extinction of the community living in any one mound may be brought about naturally by the failure of that community to perpetuate individuals, to replace those dying from accident and from old age; and this may be due partly to lack of ability of the ants to obtain food sufficiently from the crowns of old trees and partly from the lack of adequate temperature for successful rearing of many young when the optimum temperature is reduced by the shading of the mound by old trees.

Summary.

The ant *Formica exsectoides* constructs mounds in wooded regions. Observations made near Baltimore Md. show that the distribution of mounds occupied by a large community of colonies varied through the years 1905-1926, older mounds being replaced by newer ones in adjacent territory.

Individual mounds may persist many years or may be abandoned from unknown causes; but in general there seems a correlation between mounds and forest growth; new mounds arise in new forested regions and old mounds become vacant in older forests.

The history of a colony is coordinate with tree life, and in general will be briefer. It is inferred that the organic relation between tree and ant colony is sequential; the new ant family or colony obtaining food from younger trees (the growth of some of which they may prevent); the older colony having to contend against the greater shade and lesser food supply from the older trees, may be unable to continue existence except by migration into younger stages of forestation.

The "tree-ant-association" is complicated by such birds as frequent certain stages of forest growth and do destroy such ants.

COLOR AND SEX IN THE INDIAN WALKING STICK, *DIXIPPUS MOROSUS*

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In cultures of the Indian walking-stick, *Dixippus morosus*, reared in the insectary at the Bussey Institution, it was observed that in each generation there was a wide range of coloration varying from a uniform green in some individuals to a brownish black in others. Since this insect usually reproduces parthenogenetically the question as to the behavior in inheritance of the several color types appeared to be one of considerable interest.

Dobkiewicz (1912) had already shown that the color of these insects is influenced by their surroundings. He reared them in cages lined with colored paper, and found that those in green and yellow cages remained light green throughout their lives, while those in red and black cages had become quite black by the time they had reached sexual maturity. However, the occurrence in our cultures under what appeared to be a uniform environment of green and dark brown individuals, in addition to a number which were intermediate between the two extremes, suggested that there might be inherent individual differences in reactivity to a background of a given color.

To obtain further information on this question two females, one a light green and the other a dark brown, were isolated and their eggs saved. The eggs are dropped at the rate of two or three a day, and egg-laying may extend over a period of three to five months. Over one hundred eggs were obtained from each female. They were placed in wide-mouthed bottles stoppered with a cotton plug, and were stored in a damp situation in the insectary. In about five months after the first eggs were laid, hatching began.

Four cages were constructed,—two were lined with light yellowish-green cheesecloth and two with the same material of a very dark red color. After a number of eggs from both the green and the brown parent had hatched, twenty-four young from each female were selected and divided into two lots of twelve each. One lot was then placed in a green cage, the other in a red cage.

The insects at this stage were uniformly of a dull green color. They were fed each night with shoots of *Tradescantia fluminensis*, the remains of which were removed each morning to avoid obscuring the background.

No change could be observed after either the first or the second moult. After the third moult, however, those in the green cages had taken on a clearer, lighter shade of green, while those in the red cages had become perceptibly darker. After the fourth moult the difference was striking,—those in the green cages remained a clear green, while those in the red cages were dark brown. There was but little difference in the rate of change between the progenies of the two females. Those from the green parent showed, if anything, a more rapid change to brown than did those from the brown parent.

To determine whether the change to dark brown could be effected in the later stages of the life history, two individuals were transferred from each of the green cages and placed with their sisters in a red cage After passing through several moults, they became almost dark as those which had occupied the red cages from the beginning of the experiment

At the same time two brown individuals were removed from each of the red cages and were placed with their sisters in the green cages to determine whether the color change to brown is reversible. In each case the middle pairs of legs of the transferred individuals were removed to distinguish them from the others. After several moults they had taken on a somewhat lighter shade, and when mature they were of an indefinite greyish color; but the dark pigment was never completely resorbed. The middle legs, however, which were regenerated under the influence of the green background were of a peculiar bluish-green shade, their color presenting a striking contrast to that of the rest of the body.

In each of these cases no differences could be observed in the reactivity of the two progenies.

After the insects had attained sexual maturity, two other green individuals were transferred to red cages and two dark brown individuals to green cages. No color change was observed. Apparently the color present after the last moult is permanent.

The question as to the reasons for the original variations in color of individuals occupying the same environment as found in our cultures remains unanswered. The only explanation which suggests itself is the following: The insects feed during the early part of the night attaching themselves before dawn to a branch or any other suitable support, and remaining motionless in the same spot throughout the day. They show a marked tendency, in captivity at any rate, to return to the same support day after day. If the slight differences which exist in the illumination and background are sufficient to bring about the differences in color, this habit may be responsible for the observed variation.

Fryer (1913), working with a bisexual walking-stick, *Clitumnus cuniculus*, from Ceylon, in which both yellow and green forms are found, interpreted the color differences as being inherited. The color, according to his hypothesis, is due to action of a single factor pair, yellow being dominant over green His data, however, do not furnish the necessary proof for his hypothesis. The males are uniformly of the same color, and he was thus able to assign to the male used in a given mating the particular genetic constitution necessary to explain the proportions obtained in the progeny; but apparently the tests necessary to determine the correctness of his assumptions were not made. The fact, as shown by Pantel and de Sinety (1918), that coloration in several other species of walking-sticks in addition to Dixippus, is dependent upon the environment, suggests the desirability of reexamining the behavior in *Clitumnus* from this viewpoint.

Among a total of several thousand individuals reared in our cultures, two males and one gymandromorph appeared. The sporadic occurence of males and gymandromorphs has also been reported by others. Nachtsheim (1922) has suggested that non-disjunction is responsible for their appearance. In the Orthoptera generally, the female is characterized by the presence of two X-chromosomes, the male by one. The loss of one X-chromosome by non-disjunction or in any other manner would presumably recult in maleness. If the loss occurred before the first somatic division, the entire individual would be male,—if it occurred later a gynandromorph would presumably result. In the gynandromorph mentioned, the left side throughout the entire length was typically typically female, the right side was male, suggesting that the loss of an X-chromosome had occurred at the first somatic division.

One of the males was placed in a cage with several females which had just attained sexual maturity. Only females appeared in their progenies. Copulation was not observed, but the insects were seldom examined at night. Nachsheim mated one of the males which appeared in his cultures with females and observed repeated copulation but with no effect upon the sex of the progeny,—as in the progenies resulting from unmated individuals, all were females. Since, according to Pehani (1924) normal spermatozoa were produced by one of the sporadic males studied by him, it appears that the eggs have lost their capacity for fertilization.

In forms whose eggs have the ability to develop parthenogenetically and where parthenogenetic reproduction results exclusively in females, a trend in the sex ratio is automatically set up, which must end in the ultimate elimination of males unless this effect is offset by some factor or factors such as greater viability of males or of male-producing spermatozoa, which tend to distort the sex ratio in the opposite direction. In the Orthoptera, forms having the capacity for parthenogenetic reproduction are known in which males are never found, others in which males are rare, and still others in which the sex ratio is near equality. It must be concluded that forms in the last category have developed the capacity for parthenogenesis only recently or, as already suggested, that the trend toward an excess of females, which would otherwise be an inevitable concommitant of thelyotokous parthenogenesis, is being offset by other factors tending toward an excess of males.

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NOTES ON THE BEHAVIOR OF *DINEUTES AMERICANUS*

By Howard B. Smith,

Los Angeles, California.

A study of *Dineutes americanus* carried on in the vicinity of Boston, Mass. during the past two years has led to some interesting results which are briefly presented in the present note. Recent papers ('23, Wilson, C. B.; '25, Hatch, M. H.) have dealt with the life history and ecology of this beetle and the following observations serve to clear up certain points not included in the accounts of these authors. Among the several families of water-beetles, the Gyrinidæ show more peculiar adaptations in structure and, consequently, in behavior and mode of life.

Movement:—These beetles swim by means of the meso- and metathoracic legs, which are so modified as to be almost useless for land locomotion. While on the water *D. americanus* exhibits perfect mobility and ease in swimming, on land it turns to an awkward crawl, pulling itself along by the long forelegs, tilting from side to side as the heavy unsupported body is dragged across the uneven ground. Usually, however, when off the water surface, the body is supported only by the front legs.

When about to swim the beetle extends the middle and hind legs laterally, like a pair of oars They are then brought smartly down to the caudal axis, which is their usual position at rest. The forelegs are fitted into the grooves in the sternal plate adapted to receive them or they may be extended on the surface film. Sometimes they are used for cleaning the body or to assist in the process of feeding. Because of the grooves in the sterna the legs can be withdrawn and the body then presents a perfect "stream-line" form. When alarmed the insect dives rapidly, carrying a small silvery bubble at the abdominal tip.

Several experiments were undertaken to test the ability of *Dineutes* to swim in media other than water. A beetle was placed on the surface of 50% alcohol. It could not remain on the surface, but swam about on the bottom of the dish showing great energy and no loss of faculties during the minute it was in the liquid. On being removed to the surface of water it at once overturned and swam about belly-upward. When righted it swam deeply, keeping the head under water. It was then placed on a raft from which it dragged off with some difficulty and remained quietly on the water. The legs were not apparently capable of successful movement and at the end of five minutes the body was relaxed and the beetle died without any indication of activity. The experiment was repeated with weaker solutions as shown in the table. With the denser liquids, the ability to keep afloat was perceptibly greater but in no case was it entirely satisfactory due to the decrease in surface tension.

% Alcohol	Length of Life	% of time submerged during one minute
50	5 minutes	total
25	2 "	total
10	30 "	97
5	60 "	92
4	undetermined	89

The lighter specific gravity of the medium in combination with the fact that the alcohol serves to wet parts of the body that are normally dry causes the difficulty in keeping afloat. As these insects are easily drowned, death was probably from that cause rather than from alcoholic poisoning.

A salt solution of the density of seawater (1.026) was also used. There was no apparent t ouble in swimming but the diving speed was very much slowed down. The beetle did not object to the solution but finally crawled up the dish and escaped to the table.

During the fall of 1924 and the spring of 1925 a close watch was kept on several ponds in the vicinity for indications of the winter habits of this insect. One pond was especially scrutinized because of its greater population during the summer months.

The peak of the population had been reached during the third week in August when the pond was literally covered with *D. americanus*, together with a few specimens of another species, *D. hornii*. They remained on the deeper parts of the pond in schools well away from the bank, where they were moderately active and not easily alarmed. As the season advanced they split into more or less compact groups which spent more and more of their time near the shore. On October 4, there were two groups remaining. One, including a few individuals, drifted about the outlet; the other, a larger group, gathered on a shallow spot about a stump on the western edge. At this time there were a few specimens of *Gyrinus* scattered about also but on October eighteenth no beetles were visible. A week later two individuals were found widely separated. On November first, no insect life was visible about the pond except a few black flies. After the ice had formed beetles were found in the mud but none were resuscitated.

The first appearance of *D. americanus* in the spring of 1925 was during the latter part of April, several weeks after the first signs of insect activity. As may be seen from the accompanying table, it is evident that *Dineutes* leaves hibernation somewhat later than the Hemipterous back-swimmer of the genus *Notonecta*.

Date	Air	Water	Mud	Prec.	Weather	Time
March 28	11°C	12½°C	11°C	0.18	Showers	2 p. m.
April 3	14¾°C	10°C	9°C	0	thin clouds	1 p.m.
One water strider and six back-swimmers observed.						
April 11	11 C	12 C	10 C	0	Bright	2:30 p.m.
Back swimmers abundant						
April 23	19°C	16°C	12°C	0	Bright	12 m
D. americanus first observed.						

It will be readily seen from these data that the temperature of both mud and water determine the date of appearance. A few days later, April 25, *Dineutes* was active on several other ponds nearby in considerable numbers.

At the time of their appearance the beetles were extremely active and copulation took place quite frequently. Previous to mating the beetles swim along apparently without interest. The male then makes a dash for the female and, if successful, rides on her back holding on with his fore tarsi which are placed at the juncture of the elytra and thorax. They swim thus for several minutes, or more exactly the period varied as observed from one to twelve minutes.

The population reached a peak in the first week in June up to which time the beetles had spent their time near shore. During

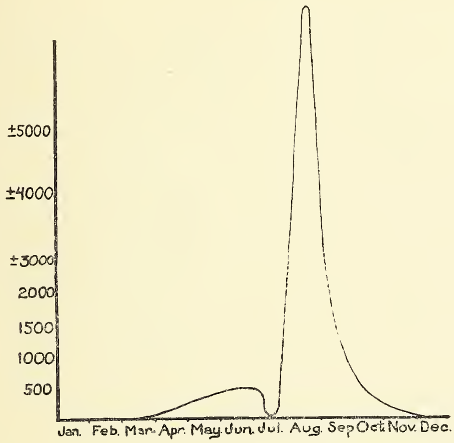

Fig. 1. Seasonal abundance of *Dineutes americanus* at Boston, Mass.

the month the population decreased rapidly until at times it was rather hard to find specimens. The curve resumed an upward trend about the first of August and within ten days, thousands were present. No copulation among these was noticed and the insects preferred to lie quietly in the sunshine, or swim slowly about on the deeper water. They are not easily alarmed and not so readily disturbed by noise or movement as in the spring. The following figure, based on careful estimates represents the fluctuations of populations as observed for five years.

From this curve and data I conclude that there is but one brood a year. The adult beetles emerge during the first few days in August, remain quiet and inactive until forced by closing waters to go into the mud for the winter. The survivors, few in number, emerge in April and, after breeding, soon begin to die out and disappear.

From observations made in a large concrete tank it is evident that there is a high mortality during the winter. The above statement is further shown to be probable by the death just after copulating on May 9, 1925, of the two surviving members of a colony which had been kept in a tank in a greenhouse during the winter.

When first brought from the pond the beetles are greatly disturbed and try to get out of the dish by swimming and later attempt to climb the sides of the dish. At times they rustle their wing covers thus producing a buzz. They become accustomed to captivity after a while and finally are not alarmed even by quick movements of the hands in their close vicinity. At this stage they can be induced to feed from the fingers. I found few things they would not attempt to eat as anything that floated was eagerly seized and examined. Live mealy bugs, cracker crumbs, bits of salmon and sardines, bread crumbs, apple parings, meat and chocolate were all sampled besides many other materials. The only requirement seemed that of ability to float. The prepared fish food known as "Ant Eggs" composed mainly of ant pupæ made a good food and a ground meat scrap containing no bone, put up by the Quaker Oats Company for poultry feed, was also successful. As long as this food remained on the surface the insects would rush about grabbing piece after piece. Sometimes two would snatch the same piece or one would attempt to take a portion from another. At such times they would dive and tear about under water until one lost its hold.

The front legs are always used to hold and turn the food about. Sometimes the beetles would attach themseleves to my hand as I dipped it into the water. On such occasions the first was sure to be followed by others all pushing and striving to get at the particular place its neighbor occupied. They never were able to pierce the skin, although their attemps produced a temporary irritating sensation. Some individuals eat more than others.

A darkened battery jar was used in studying the reaction of these insects to light. If some practicable scheme can be devised for covering the beetles eyes, better results will be obtained. I found that adhesives interfere with the insect for it usually spent its time trying to rub off the coverings, often with success.

In the darkened tank the beetles remained quiet but when light was admitted at the surface through a small hole in the varnish activity ensued. The beetles swam about and tried to get out but showed neither positive nor negative phototropism so far as could be observed. Light was then admitted in a beam six inches below the surface. The beetles left the surface and dived to the point at which the light was admitted. This latter behavior was also noticed when the light was admitted only through the lower opening. From this it is reasonable to believe that a stimulation of the lower eyes results in a positive phototropic response, while the upper pair do not show either form of phototropic response with sufficient regularity to be determined.

A statement concerning the water line of the beetle seems desirable. Hatch ('25) speaks in detail of the "stream-lines" of the body and of its position on the water. He failed to notice that the shadow cast on the floor of the tank by the beetle is not a continuous ellipse in conformity with the shape of the body but that, owing to the breaking of the surface film by the swimming legs, the shadow really consists of two circles which indicates that the body of the beetle is wet only at the point where the swimming legs enter the water.

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ON THE *MEGACHILE* OF SOUTH DAKOTA[1]

By Theodore B. Mitchell.

The following records are based on a collection of bees of the genus *Megachile* from South Dakota which were received from Professor H. C. Severin.

Megachile latimanus Say.

14♂♂, 19♀♀: Elmira, Big Stone, Brookings (July-Oct.), Milbank, Elk Point, Wentworth, Mobridge, Buffalo, L. Oakwoodand and Ft. Pierre.

Megachile dentitarsis Sladen.

6♀♀: Hot Springs, Rapid City, Newell and Interior (Aug.)

Megachile perihirta Ckll.

1♂, 1♀: Custer (no date) and Brookings (Aug. 27).

Megachile inermis Prov.

1♂, 1♀: Brookings (no date) and Harney Peak (July 22).

Megachile fidelis Cress.

1♂: Rapid Canyon (Aug. 4).

Megachile mendica Cress.

3♂♂, 1♀: Brookings (June) and Custer (July).

Megachile generosa Cress.

1♂: Gettysburg (Aug. 12).

Megachile brevis Say.

11♂♂, 10♀♀: Springfield, Hot Springs, Buffalo, Spearfish, Newell, Phillip, Ft. Pierre, Gettysburg, Capa, Elk Point, Brookings, Interior and Custer (June-Sept.).

Megachile pugnata Say.

6♀♀: Custer (no date) and Rapid Canyon (Aug. 4). The single specimen from Rapid Canyon has a small amount of pale appressed pubescence on segment 6, approaching the condition

[1]Contribution from the Department of Zoology and Entomology, North Carolina State College, in cooperation with the Entomological Laboratory of the Bussey Institution, Harvard University, (Bussey Institution No. 272). Published with the approval of the Director of the North Carolina Experiment Station as paper number 13 of the Journal Series.

in *M. pugnata pomonæ* Ckll., but the pubescence is white, not ochraceous.

Megachile mucida Cress.

2 ♀♀: Spearfish (no date) and Harney Peak (July 22).

Megachile montivaga Cress.

1 ♀: Custer (no date).

Megachile integra Cress.

1 ♂: Elk Point (Aug. 10, 1924, H. C. Severin).

Megachile vidua Sm.

8 ♂♂, 2 ♀♀: Hot Springs, Custer, Whitewood, Lead and Harney Peak (July).

Megachile pruina Sm.

3 ♂♂, 4 ♀♀: Interior, Ft. Pierre, Martin, and Nowlin Co. (Aug. and Sept.)

Megachile melanophœa Sm.

7 ♂♂: Harney Peak, Lead and Custer (July).

Megachile relativa Cress.

2 ♂♂, 4 ♀♀: Harney Peak (July), Custer and Hot Springs.

Megachile infragilis Cress.

5 ♀♀: Brookings (June and Aug.) and Newell (June). This is very close to the preceeding species, the two being separable as follows:

Segment 6 of ♀ with appressed golden pubescence and erect light hair, sometimes with a few dark basal hairs, margin of clypeus indistinctly emarginate medially; clypeal margin in ♂ with a distinct and quite strong median tubercle. . . . . *relativa*

Segment 6 of ♀ with pubescence all dark and with numerous erect black hairs, clypeal margin not at all emarginate but slightly and broadly produced medially; clypeal margin in ♂ somewhat angulate medially, but not tuberculate. . . . . *infragilis*

Chelostomoides ruflmanus Rob.

1 ♂: Spearfish (July 28, 1924).

Megachile dakotensis n. sp.

♂. Face up to level of anterior ocellus densely clothed with whitish pubescence, directed downward on the clypeus, upward on the supraclypeal plate, and outward on the inner orbits, thinner but entirely pale on the vertex and upper cheeks, longer and pure white on the cheeks below; clypeus closely and distinctly punctate apex entire; mandibles reddish apically, 3-dentate, middle tooth the smallest, the inferior tooth submedian, slightly nearer the base, punctures sparse apically, fine and close basally; cheeks shining, rather closely punctate, inferior angle simple (not grooved or toothed); vertex rather closely and deeply punctate, but shining between the punctures; lateral ocelli nearer to adjacent eyes than to edge of the vertex; antennæ black, obscurely reddish below.

Thorax with pubescence entirely pale, pure white below, rather loose and thin above; mesonotum closely punctate, tessellated between the punctures which are crowded anteriorly and laterally; scutellum more shining, with punctures somewhat finer; pleura with punctures contiguous; propodeum shining, very finely punctate, the punctures indistinct posteriorly, basal triangle impunctate, very finely tessellated; tegulæ ferruginous, shining, with minute punctures; wings subhyaline, dusky apically, nervures piceous, second submarginal cell receiving the recurrent nervures at about equal distances from base and apex, transverse median slightly before basal nervure.

Front coxæ bare in front, black, shining, sparsely punctate, with short, flattened, triangularly pointed spines which are strongly divergent with respect to each other, no patch of red bristles, spines and coxæ with long white pubescence posteriorly; front femora and tibiæ black, inclined to reddish, white pubescent, the femora keeled beneath, red on the face anterior to this keel, finely punctate on the opposite face, smooth and shining above; outer face of tibiæ rather coarsely punctate, black except apex, the two inner faces shining and reddish, apex of tibiæ yellowish; spur similarly colored; tarsi simple, not to any degree hollowed out, but yellowish and with a prominent hair fringe behind, first joint slightly shorter than joints 2-4; four posterior legs black, but all the tibiæ ferruginous apically, and the tarsi piceous, middle tarsi with a conspicuous white hair-fringe; hair on inner side of tarsi pale yellow; spurs pale yellow; claws ferruginous basally, piceous apically, deeply cleft.

Abdomen, except for a few short inconspicuous dark hairs on segments 3 and 4, white pubescent, shining, the punctures quite close but distinct; upper face of first segment very closely punctate, the concavity smooth and shining; apical margin of segments 2-5 very strongly depressed, especially on segments 4 and 5 where the apical portion of the disc overhangs somewhat the depressed margin, the segments rather strongly depressed basally also, giving the discs a rolled appearance; the depressed apical margins are white faciate on segments 2-5, white tufts of hair being present on the sides of segment 1; segment 5 is white pubescent on basal half of disc; segment 6 also with white pubescence basally, rugoso-punctate above the carina, the punctures larger and more nearly separate below; carina entire, rounded, with irregular crenulations, morphological apex of segment conspicuously carinate on either side and with a small spine at each extreme side; seventh segment quite evident, with a triangular pointed spine; ventral segments 2 and 3 depressed apically similarly as the dorsal segments, all the ventral segments shining, distinctly punctate, and with apical fringes of rather long white hairs. Length 10 mm.

♀. Head broad, eyes not appreciably converging below; supraclypeal plate closely punctate, punctures crowded laterally; clypeus closely punctate, surface finely tessellated between the punctures, apical margin smooth and shining, entire, slightly produced laterally; mandibles broad, 4-dentate, a bevelled cutting edge between the two inner teeth, shining, the punctures sparse above, especially apically, faintly reddish near the apex, fringed with yellowish hairs below; cheeks shining, but rather closely punctured, quite broad; vertex with punctures close medially except for an indistinct impunctate median line, the punctures more widely separated laterally, deep; ocelli nearer to nearest eye than to edge of vertex; antennæ black, piceous below; pubescence thin, white except for a few short inconspicuous dark hairs on the vertex laterally.

Thorax with pubescence white except for dark hairs on disc of mesonotum, with conspicuous white tufts of pubescence around tubercles and behind wings; mesonotum with scattered punctures medially, closely punctured anteriorly and laterally, tessellate between the punctures; scutellum more finely and closely punctate; pleura closely punctate, shining, with long thin white hair; propodeum tessellate, with scattered fine punctures, closer laterally, basal triangle tessellate but impunctate; tegulæ dark ferruginous, minutely punctate, with a small tuft of white hair anteriorly; wings hyaline basally, dusky apically, the second recurrent nervure entering the second submarginal cell somewhat nearer the apex than the first does to the base; basal nervure beyond transverse median; nervures piceous to ferruginous; legs black, white pubescent, femora shining, sparsely punctate, outer faces of tibiæ strongly punctate, all the tibiæ ferruginous at apex; tarsi black, the middle and hind tarsi as broad as their tibiæ, the middle ones densely pubescent, all the tarsi yellowish pubescent beneath; spurs yellowish-ferruginous; claws ferruginous basally, darker apically, without a distinct basal tooth.

Abdomen rather broad, ovoid, segments 3-5 strongly depressed on the apical margin, but not so strongly as in the male, with very deep transverse basal grooves, the anterior borders of which are sharply carinate, these carinate margins overlapping the grooves; discs of segments shining, punctures strong but well separated, finer and closer on basal segments, the portions of the discs basad of the grooves finely tessellated and very finely punctured; segment 6 obtusely triangular viewed from above, straight in profile, with a median longitudinal ridge, rather coarsely rugoso-punctate with appressed white pubescence, tinged with brown apically, and a few black hairs at the sides basally; the other dorsal segments are apparently white fasciate (specimen somewhat rubbed), the fasciæ entire on apical segments, very fine on basal segment, but tufted at sides; all the segments except the first with rather course black hairs on the discs laterally, which disappear dorsally; scopa white, black on segment 6, and with a few black hairs apically on sides of segment 5. Length 13 mm.

Type: Male; Hot Springs, S. D., July 10, 1924. Allotype; Ft. Pierre, S. D., Aug. 11, 1924 (Coll. S. D. State College).

Paratypes: 1 male, topotypical; 1 female, McHenry, Ill. (C. T. Brues, Coll.); 1 female, Dallas Tex. (Coll. Mus. Comp. Zool.).

This belongs to the group of *M. deflexa, indianorum* and *mucorosa,* those having the simple anterior tarsi and the entire carina, from all of which it may be readily separated by the abdominal characters.

A SPECIES OF UROCERUS FROM BALTIC AMBER.

By Charles T. Brues.

Bussey Institution, Harvard University.

In a large collection of parasitic Hymenoptera of oligocene age imbedded in Baltic Amber recently received from the Geological Institute of the University of Königsberg there is a single fine specimen of wood-wasp referable to the genus Urocerus. As very few fossil Siricidæ have been described and as the family is of particular interest on account of its early known occurrence in the upper Jurassic, this species is described below.

Urocerus klebsi sp. nov. (Fig. 1.)

♂. Length 16 mm. A rather well preserved specimen showing the entire fore wing, antennæ, legs and underside of body. Antenæ consisting of 21 segments, reaching to the tip of the second sternite; flagellar joints of quite even length,

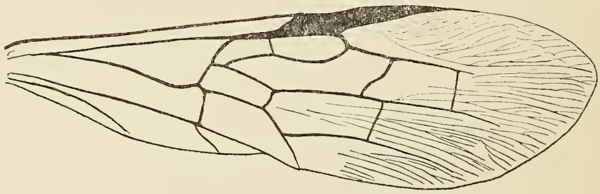


Fig. 1. Urocerus klebsi sp. nov., anterior wing.

gradually more slender to the apex of the antenna; second flagellar joint equal to the first, nearly four times as long as thick. Posterior tibiæ apparently not so distinctly flattened as in the male of *Urocerus cressoni* Norton, although they cannot be viewed exactly in the lateral aspect; with two short subequal apical spurs and with two series of small bristles below, one along each edge. Anterior wing (Fig. 1) typical for the genus; first transverse cubitus with its lower end bent sharply downward and entering the first discoidal cell at the basal fourth; second section of radius fully two-thirds as long as the third and twice as long as the first; submedian cell very little longer than the median; externomedian vein bent downward near apex, but entirely without any stump of a vein; second recurrent nervure entering the third cubital cell before its basal third; transverse lanceolate vein obscured at its base, but apparently arising just before the lower end of the transverse median vein. The apex of the abdomen has been removed in polishing the amber and cannot be described.

Type in the collection of the Geologisches Institut of the University of Königsberg

This species differs from the European *U. gigas* and the North American *U. albicornis, californicus* and *cressoni* by the insertion of the first transverse cubitus on the upper side of the discoidal cell instead of on the basal vein. The one other North American species, *U. taxodii* Ashm. is not in my collection, but Bradley has published a good figure (Pomona Journ. Entom., vol. 5, p. 31) which shows the amber species to resemble *taxodii* in this respect. The second section of the radius is proportionately much longer than in any of the above-mentioned living species except *U. cressoni* where it is as long as the third.

I have named this species in honor of Professor Klebs who first reported the occurrence of Siricidæ in amber. Klebs (Tagbl. Naturforschervers., vol. 62, p. 269) in 1889 referred Baltic amber specimens to Sirex, a closely similar genus. Quite probably the present species may be the same form.

Sirex has been reported from the miocene beds of Radoboj. This was described by Heer as "Urocerites", but later referred to Paururus by Konow (Wiener Entom. Zeit., vol. 17, p. 87, 1898). The name Paururus is now replaced by Sirex. To judge from Heer's figure the posterior tibiæ and their metatarsi are flattened much as in the peculiar Cuban genus Teredon and I cannot be satisfied that Konow's reference is correct although of course the males of other genera show a tendency in this direction and Heer's specimen is probably a male; unfortunately the antennæ of "Urocerites" were not preserved, so that there is no indication whether they were of the peculiar type of those of Teredon. Heer has restored them in one figure, but entirely on the basis of those of Sirex and Urocerus.

MELEMÆA MAGDALENA HULST.

Hulst described this beautiful geometer in 1896, regarding it as the type of a new genus, and remarking on the quite unique pattern of the wings. The type was a female collected by Bruce, with no locality stated nearer than "Colorado." This specimen has been figured by Barnes and McDunnough, Contr. N. A. Lep., vol. 1. (1912) pl. XVI. *M. morsicaria* Hulst, referred by Hulst to the same genus, is now removed to *Sicya*, but a second *Melemœa* (*M. virgata* Taylor) was described from Arizona (Huachuca Mts.) in 1906.

On Sept. 11, 1926, I took a specimen of *M. magdalena* at light at Grand Lake, Colorado, alt. 8,153 ft. The species must certainly be rare, as I had never seen it during the many years I have resided in Colorado. In the shape and pattern of the anterior wings there is a certain suggestion of theEuropean*Chesias legatella* Schiff., but I presume there is no close affinity.

T. D. A. Cockerell.

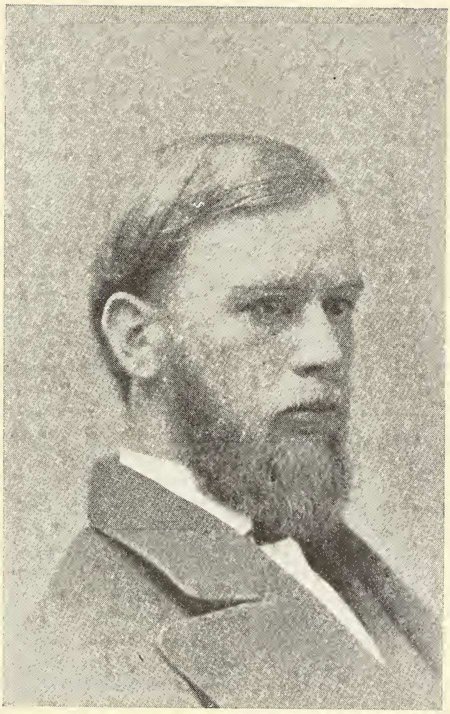
PROFESSOR CARLO EMERY

The eminent zoölogist Professor Carlo Emery, best known to entomologists for his extensive and valuable contributions on ants has died at the age of seventy-eight years. During his early career he pursued a course in general medicine, but in 1872 decided to specialize in ophthalmology. However, in 1878 he was appointed Professor of Zoölogy in the University of Cagliari where he remained for several years until 1881 when he went to the University of Bologna as Professor of Zoölogy a position which he filled for thirty-five years until his death.

Among his earlier works, prior to 1869, are a text-book of general zoölogy and papers on fishes and molluscs, but the long period of fifty-six years (1869-1925) was devoted almost entirely to a study of ants, upon which he published very extensively. These many contributions have won him lasting fame in the annals of entomology.

BENJAMIN PICKMAN MANN

Benjamin Pickman Mann, one of the founders of the Cambridge Entomological Club and its first secretary and editor of its journal "Psyche", died March 22, 1926. He was born April 30, 1848, the son of Horace Mann, well known as a teacher and advocate of public schools. He graduated from Harvard College in 1870 and for several years lived in Cambridge, where meetings of the Entomological Club were held at his residence in 1874. In 1881 he entered the Entomological Bureau of the U. S. Department of Agriculture at Washington and in 1887 became an examiner in the U. S. Patent Office. He was specially interested in entomological literature and bibliography, and while editor of Psyche, a record of entomological publications occupied a large part of the journal. While in Washington he took part in many organizations for social and public work. He was one of the Childrens' Guardians of the City, trustee of a church, member of the Single Tax Association and of the Esperanto Associo.



BENJAMIN PICKMAN MANN
1848–1926

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All new genera, new species and new names are printed in Small Capital Letters