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Vol. 63 March, 1956 No. 1

AUSTRALIAN CARABID BEETLES III.
NOTES ON THE AGONINI[1]

By P. J. Darlington, Jr.

Museum of Comparative Zoology, Cambridge, Mass.

One of the interesting things in the geography of carabid beetles is that certain dominant groups of them have complementary distributions. For example, among small, ground-living but non-fossorial Carabidae, the great genus *Tachys* is dominant in the tropics but diminishes northward and southward; and it is largely replaced in the north-temperate zone and to some extent in some south-temperate areas by another great, related genus, *Bembidion,* which is very poorly represented in the tropics (*cf.* Darlington, Coleopterists' Bulletin Vol. 7, No. 2, 1953, pp. 12-16).

Two other tribes of larger Carabidae which have somewhat complementary distributions are the Pterostichini and Agonini. These tribes are only partly and very complexly complementary. Both are in fact cosmopolitan, but unevenly so. In some places, they occur in nearly equal numbers; in other places, Pterostichini are overwhelmingly dominant; and in others, Agonini are so.

These tribes tend to be complementary within the Australian region. In Australia itself and Tasmania Pterostichini are dominant, with more than 350 known species against only about 20 species of Agonini in the same area. But in New Guinea Agonini are dominant, with 107 known full species and 14 additional geographical subspecies

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[1] Published with a grant from the Museum of Comparative Zoology at Harvard College.

(Darlington, Bull. Mus. Comp. Zool. Vol. 107, No. 3, 1952, pp. 89-252, pls.) against only about 20-odd species of Pterostichini (in material assembled for study but not yet formally studied).

One reason for the number of Agonini in New Guinea is that species of this tribe have multiplied on the mountains there, in forest at middle and high altitudes. Some of them occur even in the high grasslands above the forest line, at 11,000 feet or higher, where the climate is colder than it is in much of Australia. In Australia, however, Pterostichini, not Agonini, have multiplied on the mountains. Why this should be so is not immediately apparent. The Australian mountains are lower, but this does not account for the difference. On the Atherton Tableland and elsewhere in tropical Queensland in northeastern Australia, at altitudes of 2,000 or 3,000 feet, are big tracts of full-scale rainforest (called "scrub" in Australia) entirely comparable to the rainforests of New Guinea and containing some of the same species of trees. This kind of forest in New Guinea is inhabited by many Agonini and few Pterostichini; but in Australia, by few Agonini and many Pterostichini, most of the latter belonging to Australian genera which do not reach New Guinea at all. I have collected extensively in both the Australian and New Guinean rainforests, and I can testify from my own experience that the pterostichine-agonine faunas of the two places are unexpectedly and profoundly different — in spite of the fact that they share some identical species!

This difference can hardly be accounted for in simple ecological terms but is probably due to a complex combination of ecological, historical, and geographical factors. Over the world as a whole, there is a tendency for Agonini to be better represented in the tropics; Pterostichini, in the temperate zones; although this zonal complementarity is not strongly defined. Also it is probable that the Agonini are more recent in origin than the Pterostichini and that they have dispersed more recently, although the dispersal of each group has been very complex, and although even the Agonini dispersed long enough ago to have reached all parts of the world and to have differentiated to some extent in different regions. I base this guess, of the more recent rise and dispersal of Agonini, chiefly on the lesser diversity of this tribe as compared with the Pterostichini. If all this is correct, it may be guessed that Pterostichini are dominant in Australia partly because Australia is more temperate than tropical in climate, and partly because the Pterostichini reached Australia before Agonini did; and it may be guessed that Agonini are dominant in New Guinea partly because the climate there is fully tropical, and partly because the carabid fauna of New Guinea is more recent in its origins than that of Australia. Add to this that the mountain carabid faunas of Australia and New Guinea have been derived independently, each from the lowland fauna adjacent to it, and not by dispersal along a connecting mountain chain, and we have an adequate and probably correct explanation of the unexpected difference in composition of the carabid faunas in the mountain rainforests of Australia and New Guinea.

Whether or not this explanation is correct, the situation among Carabidae suggests that, although Australia and New Guinea were connected by land at times in the Pleistocene (perhaps as recently as ten thousand years ago) and although some species crossed the connection, rainforest and mountain habitats were not fully continuous and whole faunas were not exchanged.

Sloane (Proc. Linn. Soc. N. S. W., Vol. 35, 1910, pp. 453-458) revised the Australian Agonini ("Sphodrini") known to him, recognizing 4 genera and 10 species not including *Homothes,* which he transferred to this tribe ("Anchomenini") in 1920 (Proc. Linn. Soc. N. S. W., Vol. 45, p. 164). However, some of his generic assignments, although correct according to the usage of his time, are now known to be wrong and misleading. I therefore offer the following new key to the Australian genera of Agonini (Sphodrini, Anchomenini). This key is still preliminary in some ways, but it puts the Australian forms in line with the New Guinean ones and disposes of the most misleading assignments.

The following key applies only to Australian species of the genera in question. In the case of genera represented in Australia by single species, the species are characterized and named in the key. A comparable key to New Guinean Agonini is given in my paper cited above, pages 114-116.

Preliminary key to Australian genera of Agonini

1\. Tarsi sparsely pubescent above; tarsal claws serrate on inner edge in basal half; (relatively large, c. 13-15 mm., dull black; introduced) .... *Laemostenus complanatus* Dej.
— Tarsi not pubescent above; claws not serrate 2
2\. Tarsal claws each with an acute tooth on inner edge at base; (winged, brown, rather slender, prothorax suboval) .... *Dicranoncus queenslandicus* (Sl.)
— Tarsal claws not toothed 3
3\. Wings full *and* all normal setae of head and pronotum present 4
— Wings vestigial *and/or* one or more pairs of supraocular or lateral prothoracic setae absent 7
4\. Sole of hind tarsus with a single, regular row of bristles on each side, with middle of sole bare; (slightly aeneous, *Agonum*-like) ...... *Lorostemma cooki* (Sl.)
— Bristles of hind-tarsal sole not as above 5
5\. Brown, bronzed, or black; last hind-tarsal segment without accessory setae at sides below; elytra (in Australian species) not spined .... *Notagonum*
— Purple (or blue), at least on elytra 6
6\. Last hind-tarsal segment with accessory setae; elytra not spined; (prothorax narrow; elytra wide, purple) .... *Colpodes porphyriacus* (Sl.)
— Last hind-tarsal segment without accessory setae; elytra spined at apex about opposite second intervals; (prothorax rather wide; color purple or bluish-purple) .... *Violagonum* (n. gen.) *violaceum* (Chd.)
7\. Wings full; humeri normal; (depressed; dull brown or black, often margined or finely speckled with pale) .... *Homothes*
— Wings vestigial; humeri dentate; (convex; shining black) ...... *Odontagonum* (n. gen.) *nigrum* n. sp.

List of genera

Laemostenus (or *Laemosthenes*) is a Palearctic genus. *L. complanatus* Dej. is native to the sub-desert regions of North Africa. It has been introduced around the Mediterranean, on several Atlantic islands, in western North America, southern South America, and parts of Australia and Tasmania, etc.

Dicranoncus is a mainly Oriental genus. *D. queenslandicus* (Sl.) extends from India and the Philippines to North Queensland. In the Philippines (on Luzon) I found it living in clumps of tall grass in open country.

Lorostemma is an Oriental-Australian genus. *L. cooki* (Sl.) occurs from North Queensland south at least to Brisbane, where I took a series in flood debris in Oct.-Nov., 1943. It resembles *L. informalis* Darl. of New Guinea, but has a smaller prothorax with narrower margins. I have not made a more detailed comparison.

Notagonum is a genus of convenience, proposed for a number of relatively unspecialized New Guinean species which resemble the northern *Agonum* but do not really belong to it. I tentatively assign to *Notagonum* about 8 Australian species. Most of them have heretofore been listed as *Agonum, Platynus, Anchomenus,* or *Europhilus,* but these genera are all primarily northern and do not occur in the Australian Region. I shall not discuss these species in detail, except (below) to record one of them from Australia for the first time and to describe another as new.

Colpodes, as used here, is another genus of convenience not sharply separable from *Notagonum,* but containing usually more specialized, larger, often more brightly colored, often arboreal rather than terrestrial species. The only Australian species here assigned to *Colpodes* is *porphyriacus* (Sl.), which is known to me only by description. Of two other "*Colpodes*" listed by Sloane (1910), one (*lafertei* Mont.) is here tentatively assigned to *Notagonum,* and the other (*violaceus* Chd.) is placed in a new genus (below).

Violagonum is a new, monotypic genus proposed for *Colpodes violaceus* Chd. of New Guinea etc. and North Queensland.

Homothes is a primarily Australian genus, with half a dozen or more species in Australia and Tasmania. The genus is now known to have an endemic species also in Java and Luzon (Louwerens, in Treubia, Vol. 21, 1952, pp. 215-217).

[*Aeolodermus emarginatus* (Chd.), related to *Homothes* and described as from Victoria, is probably not Australian. It occurs from the Malay Peninsula to Celebes and the Philippines.]

Odontagonum is a new, monotypic genus based on a new species from North Queensland.

This list of genera shows that the native Agonini of Australia, heretofore thought to include geographically isolated representatives of several north-temperate genera, actually consist of the following:

> Two chiefly Oriental genera which extend to north-eastern Australia: *Dicranoncus* is represented in Australia by a widely distributed Indo-Australian species; *Lorostemma,* by a slightly defined endemic species.
>
> One mainly New Guinean genus and species, *Violagonum violaceum,* which extends to North Queensland without differentiation.
>
> Two tentative genera of convenience, *Notagonum* and *Colpodes,* with about 9, mostly relatively unspecialized Australian species. One of these species, *Notagonum dentellum,* is mainly New Guinean; 1, *Notagonum lafertei,* shared with New Caledonia; and 1, *Notagonum submetallicum,* shared with New Zealand.
>
> One genus, *Homothes,* which is chiefly Australian but represented in Java etc. by an endemic species.
>
> And one probably autochthonous (but not necessarily very old), flightless genus and species, *Odontagonum nigrum,* confined to North Queensland.

The general nature of this fauna is consistent with the Agonini being relatively recent in Australia, and having accumulated there by successive arrivals from (or exchanges with) the Orient and New Guinea.

New records and descriptions

Notagonum dentellum Darl.

Darlington 1952, Bull. Mus. Comp. Zool. Vol. 107, 147.

This species, which is widely distributed in New Guinea, occurs also in North Queensland. I took two specimens of it at Millaa Millaa, on the Atherton Tableland, in April, 1932.

Notagonum nigrellum n. sp.

With characters of genus as defined in my paper on New Guinean Agonini, pages 127-129. Form of rather slender *Agonum;* black, appendages dark, margins of prothorax and elytra not pale; upper surface moderately shining, not iridescent, not punctate; microsculpture isodiametric on head, slightly transverse on pronotum and elytra. *Head* .77 and .77 (in ♂ ♀ measured) width prothorax; eyes large, moderately prominent; posterior supraocular setae about between posterior edges of eyes. *Prothorax*: width/length 1.29 and 1.29 (in ♂ ♀ measured); base/apex 1.32 and 1.25; sides rather broadly arcuate, sometimes subangulate at anterior marginal setae, converging and nearly straight or slightly sinuate before posterior angles; latter obtuse, usually slightly blunted; lateral margins rather narrow; basal foveae rather shallow, not or vaguely punctuate; anterior marginal line entire or nearly so, posterior one vague at middle. *Elytra* moderately wide; humeri rounded, sides behind humeri nearly straight and slightly diverging, then increasingly arcuate to moderate subapical sinuations; apices rounded or slightly denticulate (variable) at sutural angles; striae well impressed, not or faintly punctulate; intervals moderately convex, outer ones not much modified toward apex, 3rd with 3 normally placed punctures. Lower surface virtually impunctate; abdomen not pubescent. Fourth hind-tarsal segment rather deeply emarginate but not strongly lobed. Length, about 8-9; width, 2.9-3.4 mm.

Holotype ♂ (M. C. Z. Type No. 29,461) and 22 paratypes all from Mt. Kosciusco, 5,000-7,000 ft. altitude, Dec. 1931, taken by myself probably (if my memory is correct) beside brooks.

This new species is probably related to *Notagonum* (*"Anchomenus"*) *marginellus* (Er.), but differs from it and from other related species in being entirely black and in having narrower prothoracic margins.

Violagonum n. gen.

Broad *Agonum*-like in form; color (in single known species) purple or purplish-blue. *Head* rather short (not elongate as in *Colpodes*); mentum toothed; mouth parts and antennae normal; both pairs supraocular setae present. *Prothorax* rather wide, with usual 2 pairs lateral pronotal setae. *Elytra* each with a spine at apex about opposite 2nd interval; striae normal; intervals normal except 9th narrowed apically (above subapical sinuations); 3rd normally 3-punctate. Inner wings full. Legs and tarsi normally agonine; tibiae not sulcate on outer edges; hind tarsi sulcate on each side above, with setae not forming single regular rows on each side below; 4th hind-tarsal segment lobed, outer lobe much longer than inner; 5th hind-tarsal segment without obvious accessory setae; claws simple. External sexual characters normal for tribe. Genotype: *Colpodes violaceus* Chd.

Although the species for which this new genus is proposed was, as a matter of convenience, left in *Colpodes* in my paper on New Guinean Agonini, it is not a true *Colpodes*. The short head particularly distinguishes it. The position of the elytral spines distinguishes it from the few species of *Notagonum* that have spines: in *Notagonum*, the spines (when present) are about opposite the ends of the 3rd elytral intervals. The lobes of the 4th hind-tarsal segment are longer than in most *Notagonum*. And the general form and color of *Violagonum* are distinctive, though not themselves of generic value.

Odontagonum n. gen.

Genus proposed for one medium-sized, flightless, convex *Agonum*-like species with two characters which, so far as I know, are unique among Agonini: antennae pubescent from the middle of the 3rd (not 4th) segments, and humeri toothed. Since the genus is based on one species, other generic and specific characters are all combined in the following specific description. Genotype: *Odontagonum nigrum* n. sp., below.

Odontagonum nigrum n. sp.

Form of a broad, very convex *Agonum;* black, moderately shining, not iridescent, legs brownish black, antennae and mouth parts brown; upper surface impunctate except for fixed setigerous punctures; microsculpture light but normal, approximately isodiametric on head, transverse on pronotum, more transverse and oblique on elytral disk. *Head* rather elongate, only .57 and .59 width prothorax (in ♂ ♀ measured); eyes much less prominent than in typical *Agonum* but not much reduced otherwise; genae rather short, oblique, slightly arcuate; anterior supraocular setae absent, posterior ones present, about between posterior edges of eyes; antennae rather short (in tribe), normal except pubescent from middle of 3rd (not 4th) segments; mandibles, maxillae, and maxillary palpi all longer and more slender than usual in tribe; labial palpi shorter and stouter; mentum with triangular tooth; neck constriction weak; frontal sulci rather deep, linear, curved; clypeal suture distinct. *Prothorax* rather large, more narrowed in front than behind; width/length 1.18 and 1.11 (in ♂ ♀ measured); base/apex 1.3+; sides arcuate (not strongly) for most of length, less so or straight toward base; basal angles rather narrowly rounded; anterior angles slightly produced, rather narrowly rounded; lateral margins wide posteriorly, narrowed anteriorly, rather strongly reflexed, each with seta about 1/3 from apex but none at base; disk convex; basal foveae moderate, not sharply defined, not punctate; middle line well impressed from extreme base nearly to apex; transverse impressions less defined; base not or vaguely margined; apical marginal line distinct at sides, vague at middle. *Elytra* 1.32 and 1.31 width prothorax (in ♂ ♀ measured), convex; basal margin strong and entire; humeri dentate; sides arcuate (only slightly so at middle), with moderate subapical sinuations; apices bluntly subacute but not produced; lateral margins rather wide, forming slightly convex 10th intervals; sutural striae absent; other striae entire, deep, impunctate; intervals convex, 7th subcostate in about anterior 1/2 of length, outer ones not much modified toward apex, 3rd with 1 setigerous puncture, near middle of length. Inner wings evidently vestigial; metepisterna scarcely longer than wide. Lower surface impunctate; abdomen not pubescent. Tibiae not sulcate on outer edges; hind tarsi slender, not distinctly grooved above; 4th hind-tarsal segment simply emarginate; 5th segment with 2 or 3 accessory setae each side below. External sexual characters normal; ♂ front tarsi more widely dilated than usual in tribe. Length about 11.0-11.5; width about 4.0-4.3 mm.

Holotype (M. C. Z. Type No. 29,462) ♂ from Millaa Millaa, Atherton Tableland, North Queensland, 2,500 ft. altitude. Two (♂ ♀) paratypes from Lake Barrine, Atherton Tableland, 2,300 ft. All specimens taken by myself in "scrub" (rainforest), in April, 1932.

SYMBRENTHIA SILANA DE NICEVILLE, A GOOD SPECIES (LEPIDOPTERA: NYMPHALIDAE)

By Nicholas W. Gillham
Biological Laboratories, Harvard University

While revising the Nymphalid tribe *Vanessini* I have had occasion to make a number of genitalic preparations from males and females of most of the species belonging to the genus *Symbrenthia*[1]. A study of these preparations has revealed that *Symbrenthia silana* de Niceville is a distinct species, and not a subspecies of *Symbrenthia niphanda* Moore as Fruhstorfer[2] maintains. The males of both species have very distinct genitalia and can also be told apart by several minute differences in the external facies. Females of *silana* were not available for study in the material at hand so the following diagnosis is applicable to the males of the two species only.

Symbrenthia niphanda Moore

Figs. 1-2

Symbrenthia niphanda Moore, 1872. Proc. Zool. Soc. London, 1872:559. Type locality: Sikkim, India, described from a ♂ and a ♀.

External facies. 1. Eyespot between M_2 and M_3 on underside of hindwing only slightly elongate as compared with those on either side of it. 2. Marginal green lunules on underside of hindwing crescentic in shape with an orange spot separating them from the blue marginal spot at the outer angle. 3. Forewing below bearing five or six black spots between Cu_2 and 2dA.

Male genitalia (Figs. 1 & 2). 1. Aedeagus short and thick. 2. Saccus very short and narrow. 3. Valve bear-

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[1] Most of the material examined is in the collection of the U.S. National Museum and is under the care of Mr. William D. Field, who was kind enough to let me make full use of it.

[2] Fruhstorfer, H. 1912. *In* Seitz, The Macrolepidoptera of the World, 9:533.

ing a single caudal prong. 4. Uncus flanked by two well developed prongs.

Distribution. This species is recorded from Sikkim and Bhutan by Fruhstorfer, *loc. cit.*, and I have seen a male from Assam (U.S. National Museum Collection).

Symbrentia silana de Niceville
Figs. 3-4

Symbrenthia silana de Niceville, 1885. J. Asiatic Soc. Bengal 54:117. Type locality: Buxa, Bhutan, and Sikkim, India, described from a male and female.

External facies. 1. Eyespot between M_2 and M_3 on underside of hindwing very elongate as compared with those on either side of it. 2. Marginal green lunules on underside of hindwing chevron shaped and continuous with the marginal spot at the outer angle. 3. Forewing below bearing three or four black spots between Cu_2 and 2dA.

Male genitalia (Figs. 3 & 4). 1. Aedeagus long and

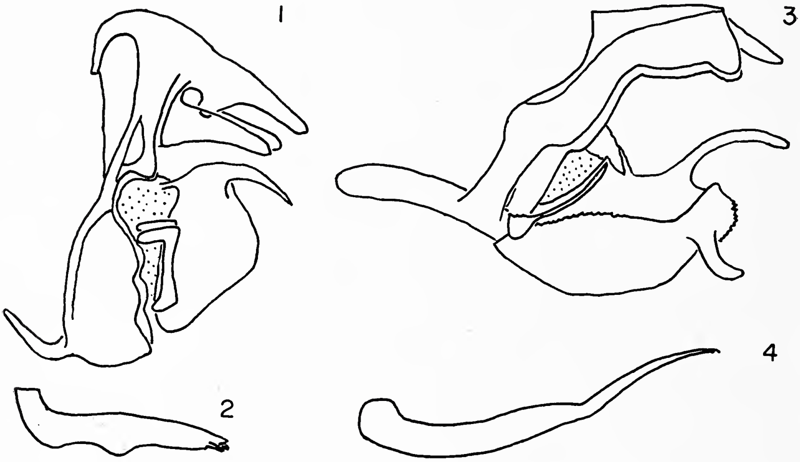


Fig. 1. Male genitalia of *Symbrenthia niphanda* Moore with the aedeagus and left valve removed. The locality from which this specimen came is unknown. Fig. 2. Aedeagus of the genitalia in Fig. 1. Fig. 3. Male genitalia of *Symbrenthia silana* de Niceville with the aedeagus and left valve removed. This specimen was collected at Sivoke, Sikkim. Fig. 4. Aedeagus of the genitalia in Fig. 3. All views are of the lateral aspect at 45x. Both specimens are in the collection of the U.S. National Museum.

tapering. 2. Saccus moderately long and thick. 3. Valve bearing a caudal and a darsal prong. 4. Uncus flanked by two poorly developed prongs.

Distribution. This species is only known from Sikkim and Bhutan.

DROSOPHILID AND CHLOROPID FLIES BRED FROM SKUNK CABBAGE. — During May and June, 1956, I collected a great many rotting spathes of skunk cabbage, *Symplocarpus foetidus* L. (Nutt.) from a shady red maple swamp in Lexington, Massachusetts. These were placed in a cloth-covered jar, and from 10-20 days later, a succession of small Diptera emerged. The first flies were small psychodids, still undetermined. Two days later, several *Drosophila quinaria* Loew adults appeared, plus a single small damaged *Drosophila,* possibly *D. transversa* or near. Following the first drosophilids by 2-3 days were numerous chloropid adults: about 100 *Elachiptera costata* (Loew) and 2 each of *E. nigriceps* (Loew) and *E. erythropleura* Sabrosky, as well as two specimens of *Tricimba lineella* (Fall.). *Drosophila* was also reared later from rotting skunk cabbage leaf petioles that were macerated and left exposed for a week in the same swamp during June; the emergents were all or nearly all *D. quinaria,* and this species was also collected resting on skunk cabbage leaves at the same locality. *D. quinaria* does not come to baits of watermelon and other rotting fruits placed in the swamp, though numerous other *Drosophila* and *Chymomyza* were attracted in this way. I owe the determinations to Dr. Curtis W. Sabrosky, Dr. A. H. Sturtevant, and Dr. Marshall R. Wheeler. — W. L. BROWN, JR., Museum of Comparative Zoology, Harvard University.

THE GENUS *MESENTOTOMA*
(COLLEMBOLA: ENTOMOBRYIDAE)

By Kenneth A. Christiansen

Grinnell College, Grinnell, Iowa

In 1942 Salmon described a new genus and species of littoral Collembola under the name of *Mesentotoma exalga.* As he pointed out, these animals had a number of peculiar characteristics, not the least of which was the littoral habitat. Two species previously described as members of the genus *Entomobrya* also display many of these peculiar characteristics, including the littoral habitat. These are *E. laguna* Bacon and *E. dollfusi* Denis, and both are clearly separated from the remainder of the members of *Entomobrya.* Of the three species mentioned above, *dollfusi* is most similar to the members of the genus *Entomobrya,* and *laguna* is least so. In text-figure one below, it can be seen that the three species give the appearance of steps in a linear series of species, becoming more differentiated from the typical *Entomobrya* body structure. The differences between *dollfusi* and the typical *Entomobrya* species is so great that it is difficult to tell to what group of the genus it is allied. The most likely candidate appears to be the *E. marginata* group, and if we accept this hypothesis, then the idea of a linear relationship among the species is considerably reinforced by the structure of the male genital plate and the empodial appendage. While the basal position of *dollfusi* is fairly clear, some specializations of *exalga* would tend to indicate that it is not directly ancestral to *laguna,* although much less differentiated from the members of the genus *Entomobrya.* In the remainder of this paper the genus is redefined, and the three species belonging to it are described and figured. Although the unusual habitat makes this animal difficult to find, eventually more species will probably be turned up, and these may serve to fill out some of the blank spots in the phylogeny of the group.

Genus *Mesentotoma* Salmon

Mesentotoma Salmon, 1942. Records of Dominion Museum, 1: 58,59.

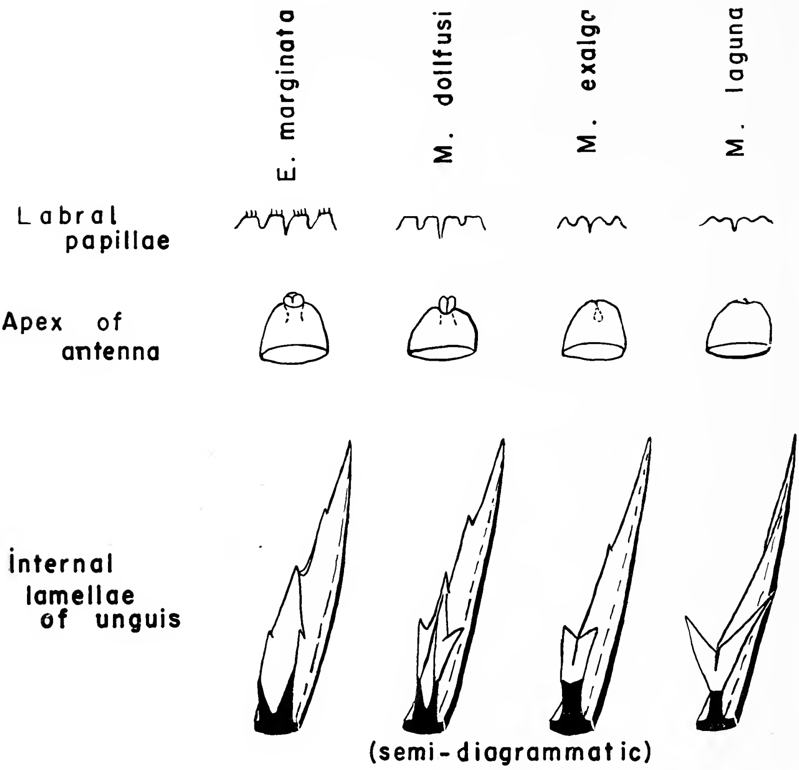
Body form oval to elliptical, circular in cross section. *Antennae.* Lengths of segments variable, commonly 1-2. 5-2.5-3. Second segment with a more or less definite indication of basal subsegmentation. Apical bulb of fourth antennal segment present or lacking. *Head* oval, only slightly longer than broad. Labral papillae lacking setae. Labial appendage with a well developed differentiated external seta. *Legs* with all setae ciliate except for normal apical internal smooth setae on third pair of legs. Tenent hair clavate or acuminate. Empodial appendage quadrilammelate, widened for basal one-half to one-third of length and sharply acuminate for apical remainder. Internal distal edge often excavate. Unguis with from two to four internal teeth. The basal pair enlarged, often basally joined. Internal teeth large, basal in position and usually heavily reinforced. External teeth small or wanting. *Mucro* lacking basal spine, with small anteapical and large apical teeth.

Mesentotoma exalga Salmon

Figs. 8-10

Mesentotoma exalga Salmon, 1942. Records of Dominion Museum, 1: 58,59.

Color and pattern. Background color yellow, pigment blue as follows: all of antennal segments two, three, and four; basal and apical rings on antennal segment one, plus ventral surface of this segment; ring around each antennal base and a connecting band. Small irregular spots over surface of head and a V-shaped mark in mid-region. Thoracic segment three through abdominal segment three largely blue except for scattered small pale spots and pale regions along the posterior edges of dorsum of abdominal segments one and two. Anterior and posterior margins of abdominal segment four with large oval dark areas. Anterior margin of fifth and all of sixth segment dark. Distal part of legs slightly darkened, remainder of body pale. *Head.* Labial appendage with external differentiated seta slender, acuminate, reaching only two-thirds of the distance from base of seta to apex of same papilla. Labral papillae rounded. Fourth segment with apical pit, but no retractile bulb. *Legs.* Smooth setae on third pair of legs slightly curved. Tenent hair with clavate tip very flat and thin. Unguis with three or four internal teeth, basal pair large, remainder small to minute. Lateral teeth very large, basal in position and reinforced by heavy ridges. Empodial appendage triangular, strongly



Text-figure 1. Representation of the condition of various organs in the species of *Mesentotoma* and in *Entomobrya marginata.*

excavate along inner distal surface. *Dens and mucro.* Dens basally with a number of short heavy ciliate setae, blunted apically. Mucro typical of genus. *Clothing* generally as in genus *Entomobrya.* Large flexed clavate setae with expanded apex unusually large and projecting. Small common setae covered with short cilia along one side.

Discussion: The "bow-like lamella" mentioned by Salmon requires further study before its taxonomic importance can be evaluated. I have found structures similar, if not identical, to it in many species of *Entomobrya,* but present in only a few specimens of large series. The short knob-like projections on the venter of the manubrium are clearly seen in the one specimen examined; however, the possibility of their being artifact, combined with the complete lack of homologous structures in the Collembola, has caused me to leave them out of the description until further series are available for examination.

Distribution: *New Zealand*: Island Bay, Lyall Bay, Wellington (from bundles of seaweed).

Mesentotoma dollfussi (Denis) (New Combination)
Figs. 1-7

Entomobrya dollfussi Denis, 1924. Ann. Soc. Ent. Fr., 93: 232.

Entomobrya nigrina Womersley, 1928. Ann. Mag. Nat. Hist., (10) 2: 63.

Entomobrya atrata Womersley, 1929. Ann. Mag. Nat. Hist., (10) 4: 304.

Color and pattern. Background color white to yellow, pigment blue to purple. Second and third antennal segments apically darkened. Remainder of body with irregular pigmented bands and spots (see figures). *Head* slightly longer than broad. Labial appendage with external differentiated seta almost attaining level of apex of same papilla. Labral papillae truncate. Antennae with apical bulb of fourth segment bilobed, in a deep apical pit. Sense organ of third segment with two angled blunt thick setae, one conical guard seta. Second segment with two similar blunt setae more widely separated than those on third segment. Second segment with definite basal subsegment, weakly demarcated. *Legs.* Tenent hair well developed, with normal clavate apex. Empodial appendage strikingly truncate, with one inner lamella excavate apically. Unguis with normal four internal teeth, basal pair partially joined by an incomplete lamella. *Mucro and genital plate.* Mucro typical of genus. Male genital plate of twelve smooth setae. Basal seta pair flattened, blade-like, remainder slender, acuminate. *Clothing.* Small underlying setae conical and unilaterally ciliate, with short ciliations.

Discussion: There is considerable variation in the pattern of this species, as is shown by the figures; however, this is less striking than in many species of the genus *Entomobrya.* The external differentiated seta of the labial appendage may reach the apex of the same papilla. The truncate nature of the labral papillae is not always clear. The species has been taken from Southern France, England, and North Africa, but may be widely distributed and uncollected elsewhere.

Distribution: *England*: Lundy Island; *France*: Greve de Vert, St. Jean Doigt; *North Africa*: Oued Ykem.

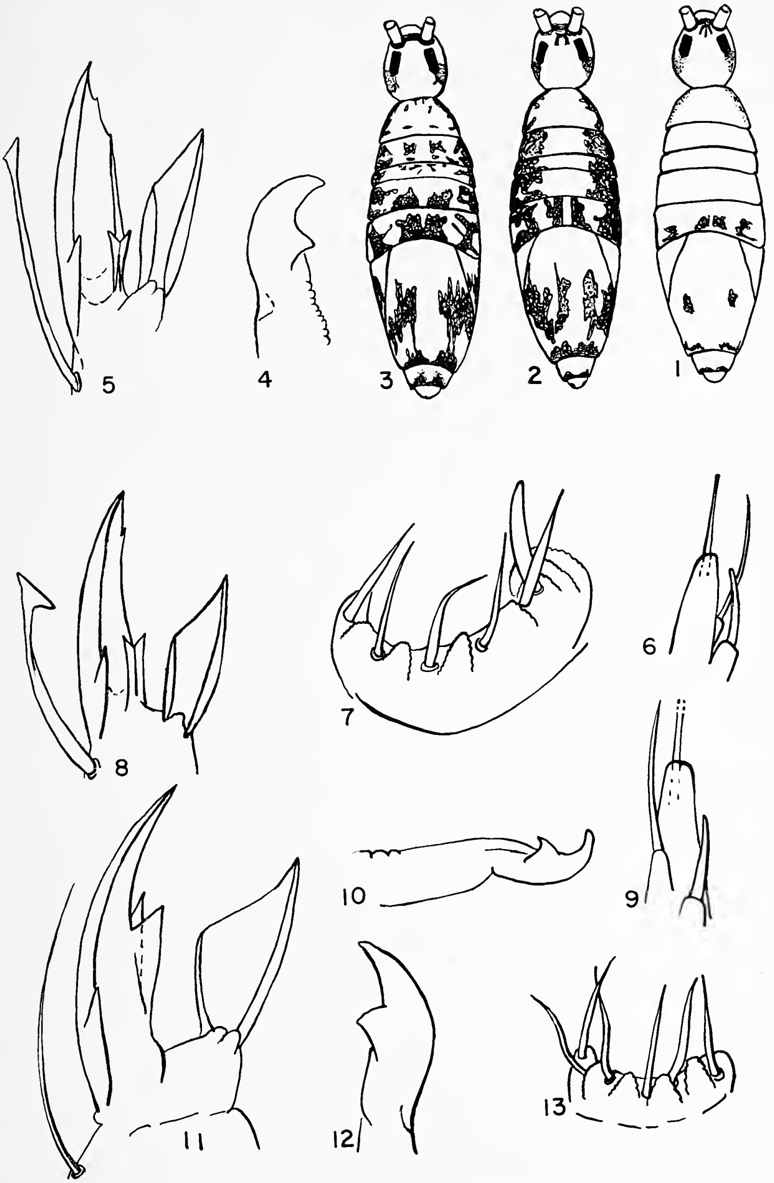
Mesentotoma laguna (Bacon)
(New Combination)
Figs. 11-13

Entomobrya laguna Bacon, 1913. Jour. Ent. Zool. Claremont, Calif., 5:202-204. Bonet, 1934. Eos, 9:157. Essig, 1942. College Entomology, 83. Gisin, 1944. Verh. Naturf. Ges. Basel, 55:71.

Color and pattern. Pigment gray-brown to gray-blue except for appendages which are always blue. Pigment generally distributed over body, except for mid-region of venter. Many small pale spots scattered over body.

Explanation of Plate 1

Characteristic structures of the genus *Mesentotoma.* Figures 1-7 of *M. dollfusi*: 1-3, various patterns from France; 4, left mucro; 5, hind unguis and empodial appendage; 6, external setae of labial appendage; 7, half of male genital plate (basal seta to right). Figures 8-10 of *M. exalga*: 8, hind unguis and empodial appendage; 9, external setae of labial appendage; 10, right mucro. Figures 11-13 of *M. laguna*: 11, hind unguis and empodial appendage; 12, right mucro; 13, half of male genital plate (basal seta to right). All figures greatly enlarged.



CHRISTIANSEN — MESENTOTOMA

Head with a double V-shaped pale mark running from the posterior corner of each eye to the mid-posterior head region. Irregular pale areas occur on the dorsum of the fourth segment, and all intersegmental membranes are pale. *Antennae.* Apex of fourth segment with four or five flat knobs. Largest setae of antennae clubbed and ciliate, similar to but shorter than clubbed setae of body. Second antennal segment with distinct subsegment or partial suture. *Head.* Labial appendage with external differentiated seta contracted only at apex. Apex not reaching apex of same papilla, and slightly wider than normal setae. *Clothing.* Large flexed clavate setae unusually long (longest longer than antennae), with expanded tip produced into a slender filament.

Discussion: Only a few specimens were seen. The most striking variation concerns the color which varies from gray-blue to pale brown. The subsegment of the second antennal segment may be incomplete but at least part of the dividing suture is clearly visible in each case. The knobs at the apex of the fourth antennal segment may be very small or indistinct. Bacon illustrates an external tooth on the empodial appendage but this was not visible on any specimen in the series here examined.

Distribution: California: Palos Verdes (under submerged rocks) Laguna Beach (lower tidal zone, under rocks).

Acknowledgements

I wish to express my gratitude for the loan of material from the Dominion Museum of Wellington, New Zealand, and the private collections of Dr. Denis and Dr. Delamare Deboutteville of France. It was only the availability of this material which made this study possible.

FEEDING BEHAVIOR IN THE ANT *RHOPALOTHRIX BIROI* SZABÓ

By Edward O. Wilson
Biological Laboratories, Harvard University

Through recent work on the biology of the tribe Dacetini[1], it is now known that the members of this large, cosmopolitan group are generally predators which feed primarily on collembolans and secondarily on other soft-bodied arthropods. Most are slow-moving and rely on stealth and the trap-like action of their mandibles in securing their prey. It has been an open question whether other groups of ants morphologically convergent to the dacetines, such as the tribe Basicerotini and genera *Myrmoteras* and *Stegomyrmex,* show similar feeding behavior. Exclusively tropical distributions, scarceness, and small colony size have made the study of living material in these groups prohibitively difficult in the past. I was fortunate, therefore, during a recent visit to New Guinea to be able to find and study in life the basicerotine species *Rhopalothrix biroi.*

This species was encountered in lowland rainforest in the vicinity of the lower Busu River, near Lae. Here it is relatively common, turning up regularly in soil-litter berlesates and as strays under rotting logs on the ground. As in other *Rhopalothrix* species I have collected, colonies were exceedingly difficult to locate. I found only one (my accession no. 987), occupying indistinct chambers about a quarter-inch below the surface in loose soil under a rotting log. The colony was uncovered and partly scattered by random scraping of the soil surface in search for other ants. Thirty-four workers, two males, and a quantity of pupae and all stages of larvae were retrieved. Colony cohesion was good, and there was no trouble in

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[1] See Brown, W. L., 1953, Ann. Ent. Soc. Amer., *46*: 465-471; and Wilson, E. O., *op. cit*: 479-495.

getting the ants to move into the brood chambers of a small plaster-of-paris Janet nest. The workers had soon massed the brood and were back out foraging in the food chamber.

During the next several days the following small animals were introduced alive into the food chamber: nematodes (possibly confused with small enchytraeid annelids), mites, spiders, isopods, millipedes, symphylans, entomobryid and onychiurid collembolans, campodeids, homopteran and heteropteran nymphs, fly larvae, beetle larvae and adults, and an adult minor worker of the ant genus *Pheidole.* The *Rhopalothrix* showed definitely neutral or aversive behavior toward the isopods, millipedes, onychiurid collembolans, beetle adults, and *Pheidole.* The nematodes, mites, and homopteran nymphs were completely overlooked or at least no definite reaction was recorded. One worker seized a cyclorrhaphan fly larva but was not able to subdue it. The remaining prey offered — spiders, symphylans, entomobryid collembolans, campodeids, and heteropteran nymphs — were captured and then eaten by the workers or larvae or both. Of this last group, entomobryids were the most quickly captured, and this could be explained on the basis of their relatively small size and feeble strength. My observations are too limited to establish prey specificity within the accepted group, but I believe that entomobryids may have formed the principal dietary staple of the colony in nature, since these insects were far and away the most abundant and accessible arthropods in the vicinity of the nest. Otherwise, if any generalization is to be made about food preference, it is probably safest to say that this species of *Rhopalothrix* accepts a wide variety of soft-bodied arthropods and rejects other animals that are either hard-bodied or possess repugnant odors.

Hunting behavior of the observation colony was very similar to that we have seen in the short-mandibulate dacetines. The workers foraged with the same slow, deliberate gait, but in addition punctuated by little total halts in the movement, one to three a second, making them appear to jerk along. On contacting potential prey the ants "froze" in their movement, drew their antennae part way back (but not all the way against the head), and opened their mandibles maximally, that is, to the extent where the tips were about as far apart as the width of the clypeus. This was followed by a slow, cautious movement toward the prey. On one occasion a worker was seen to lunge and snap at an entomobryid immediately upon making contact, but careful stalking is probably the rule, as it is in the short-mandibulate dacetines.

Prey were carried into the brood chamber directly after capture; only once was a worker seen to feed on an entomobryid at the spot of capture. Captured animals were either left on the brood chamber apart from the larvae, or else placed immediately among the larvae, which fed on it directly, ponerine fashion. The adults fed separately or simultaneously with the larvae on the same animal, as I have observed many times in the dacetine genus *Smithistruma*.

While they behaved in an alert, aggressive manner toward potential prey, the *Rhopalothrix* reacted toward potential enemies, such as larger staphylinid beetles, by lowering the head, retracting the antennae entirely, and keeping the mandibles closed. One worker, knocked over by a beetle walking past, was seen to draw in all of its appendages and feign death.

The workers were very solicitous of the brood, washing it and moving it about constantly. They were in fact more attentive in this way than any dacetine genera I have studied. Adult oral trophallaxis was observed twice; the workers faced one another and twisted their heads slightly sidewise to approximate mouthparts. The adults also licked one another's bodies constantly. Once I saw a worker standing rigidly still, while a second worker curled around its upraised head and gave the mouthparts, gula, and prosternum a thorough washing. Adult transport was observed once. The transporter gripped the transportee's pedicel from below, while the transportee folded in its appendages pupal fashion. Later the transporter shifted its grip so that one mandible rested on the gaster.

A NEW SOUTHWESTERN SPECIES OF *MALLOTA* MEIGEN (DIPTERA: SYRPHIDAE)[1]

By Frank Montgomery Hull

University of Mississippi

I wish to thank Dr. Darlington and Dr. Bequaert for the opportunity to study the Syrphid material of the Museum of Comparative Zoology. This new species is in the Museum collections.

Mallota bequaerti, n. sp.

A large species characterized by dense yellow pile on mesonotum and scutellum. The abdomen is entirely short, densely black setate, with the exception of the fourth segment which is short, golden red, appressed setate. This species is very distinct from other forms, including *facialis* Hunter, var. *flavoterminata* Jones, because of the presence of the large, distinct, subquadrate, dark brown spots on the middle of the wing and the presence of the rather widely separated eyes of the male. Length, about 16 mm.

Male. *Head*: eyes bare, the vertex is convex and shining black with black pile; the ocelli lie in an equilateral triangle. The lateral margins of the vertical triangle, anterior and lateral to the ocelli, are striate. The eyes are separated by a distance at least equal to the space between the posterior ocelli. The front is shining black broadly down the middle and in front of the antennae, with the sides rather thickly dusted with pale yellowish pollen, which becomes more brownish medially; this leaves approximately the middle two-thirds of the front shining and bare, with the ground color black. The face is black, with a broad, shining, bare, medial stripe, its sides widely, silvery white micropubescent; pile of the face and front

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[1] Published with a grant from the Museum of Comparative Zoology at Harvard College.

white. In profile the face is distinctly concave above the low tubercle; the cheeks are shining black. The first two segments of the antennae are black; the third segment distinctly wider than long and evenly rounded apically, a uniformly dark reddish brown color; the arista thickened, bare and entirely light brownish-yellow. Occiput black, densely covered with silvery pollen along the middle and below; this pollen begins near the upper third of the eye; the pile of the occiput is yellowish throughout, including long, dense, yellow pile immediately behind the vertex.

Thorax: the mesonotum is black, but is densely covered with light ochreous yellow pollen and thick, long, dense opaque, yellow pile, including the humeri and throughout the entire dorsum. The scutellum is subtranslucent ochreous yellow and covered with the same sulfur yellow pile; pleura black with thick, opaque yellow pile on upper portion of the mesopleura, which becomes sparse and scattered and less conspicuous on the ventral portion of the mesopleura and on the anterior and upper portion of the sternopleura. The pile on the posterior corner of the sternopleura and all of the pile of the pteropleura is black. Squamae subtranslucent brownish white; fringe brownish yellow; halteres yellow with dark brown knob.

Legs: all of the femora black or nearly so; in some lights the hind femora, towards the base, appear to be dark reddish sepia; the anterior and middle tibiae are nearly black, becoming more faintly dark brown near the base and apex; hind tibiae similarly colored, markedly flattened apically and distinctly arcuate. The pile of the femora and of the tibiae black, except along the anterior surface of the anterior tibiae, where the pile is yellow and there are a few yellow hairs along its posterior surface. All of the tarsi brown with black pile dorsally.

Wings: hyaline, with a strong, rather distinctly delimited, large, subquadrate, sepia brown cloud situated in the middle of the wing; this spot encloses and covers the anterior margin, the whole basal half of the first posterior cell; the apical half of the first basal cell; the upper basal corner of the third posterior cell; the apex of the second basal cell and narrowly the posterior margin of the second basal cell. The costal cell is entirely pale brown, becoming darker towards the apex.

Abdomen: of the usual shape, except that it is perhaps somewhat more tapered posteriorly; it is quite broad basally and distinctly wider than the thorax and begins to rapidly narrow from the base of the second segment so that the shape is that of a short wedge-shaped triangle. The first, second and third segments are black or nearly so; in some lights close scrutiny suggests that the second segment and the third segment have a slight appearance of dark reddish sepia, which is almost black in color. The fourth segment is blackish basally, but becomes very dark mahogany reddish posteriorly; this is especially apparent when this segment is viewed from the rear; actually the fourth segment is also very dark and might be called black. The pile of the abdomen is dense, short, subappressed and black, but longer on the sides of the first and second segments; on the fourth segment it is appressed, short, abundant and golden reddish in color. The lateral pile along the extreme margin of the third segment is also golden. Hypopygium dark reddish brown with golden pile.

Holotype: male, Chisos Mts., Big Bend National Park, Texas; collected by J. Bequaert. I take pleasure in naming this handsome species in honor of its collector.

NYMPHALIS VAU-ALBUM (SCHIFFERMULLER & DENIS), A HOLARCTIC SPECIES (LEPIDOPTERA: NYMPHALIDAE)[1]

By Nicholas W. Gillham
Biological Laboratories, Harvard University

The purpose of this paper is to show that *Nymphalis j-album* (Boisduval), long considered a distinct species by North American workers, really represents the Nearctic populations of a Holarctic species correctly designated as *Nymphalis vau-album* (Schiffermuller and Denis).

Nymphalis vau-album (Schiffermuller & Denis)

Papilio vau-album Schiffermuller & Denis, 1775. Ankündung syst. werkes schmetterlinge Wiener gegend, p. 176; sex not specified. Type locality: "Wiener gegend".

Papilio N.[*ymphalis*] *Ph.*[*aleratus*] *L album* Esper, 1781. Die schmetterlinge in abbildungen nach der natur beschreibungen, 1 (Bd. 2): 69, pl. 62, contin. 12, figs. 3a & 3b; sex not specified. Type locality: Hungary and Austria.

V[*anessa*] *j-album* Boisduval & Leconte, 1833. Histoire général et iconographie Lépidoptères Amérique septentrionale, 1:185, pl. 50, figs. 1 & 2; sex not specified. Type locality: environs of New York, Philadelphia, and New Harmony, Indiana. New Synonymy.

Vanessa pocahontas Scudder, 1889. The butterflies of the eastern United States and Canada with special reference to New England, 1:379; proposed in synonymy without description, sex not specified.

Vanessa L. album samurai Fruhstorfer, 1907. Societas Entomologica, 22:60; 2♀♀, & 4♂♂. Type locality: Hondo, Japan. New Synonymy.

Aglais j-album watsoni Hall, 1924. Jour. N. Y. Ent. Soc.,

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[1] Published with a grant from the Museum of Comparative Zoology at Harvard College.

32:109; holotype ♂+5♂♂ & 3♀♀. Type locality: Sicamous, B. C., Canada. NEW SYNONYMY.

The name *vau-album* was proposed, together with several other names, in one very limited description by Schiffermuller and Denis in 1775. In addition, there are no figures of the species given and this name could easily be considered a *nomen nudum* as Stichel (1909) has done. However, most of the other names in this volume were proposed in a similar vague fashion and many are presently in general use. Therefore, I have followed the example of Grey, Klots, and dos Passos (1952), as regards this publication, and am considering *vau-album* as validly proposed. Because of this, *L-album* Esper, 1781, falls as a direct synonym of *vau-album* on the basis of priority.

The names *j-album* Boisduval, *watsoni* Hall, and *samurai* Fruhstorfer are synonymized. *J-album* and *watsoni* are the names applied to North American populations of *vau-album*. They differ from the Palearctic populations in that they average slightly smaller[2] and are more lightly marked along the outer margin of the upperside of the hindwing. These differences are very weak, however, and would probably break down completely when material covering the whole range of the species becomes available. In addition, a comparision of the male genitalia of specimens from the two areas failed to reveal any differences that were not attributable to individual variation.

The name *samurai* applies to populations from the easternmost portions of the Palearctic. This subspecies is supposed to be distinguished from nominotypical *vau-album* by the following characters: ♂♂ with richer black designs above and a distinct white band on the underside of the hing wing, ♀♀ more darkly marked below and along the basal edge of the hindwing above. These

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[2] The measurement used as an index of relative size was the length of the costa from base to apex as measured with a vernier caliper. Measurements are given to the nearest millimeter and are as follows: Palearctic populations, ♂♂ N = 12, Mean = 31 mm., Range = 27-33 mm.; ♀♀ N = 4, Mean = 32 mm., Range = 30-33 mm.; Nearctic population, ♂♂ N = 19, Mean = 32 mm., Range = 31-55 mm.; ♀♀ N = 16, Mean = 33 mm., Range = 30-37 mm.

distinctions are very minor and do not hold up when series are examined.

In the Old World this species ranges from southeastern Europe eastwards across Asia to Kamtchatka, Korea, and Japan. From there it ranges south to Assam and Kashmir. It is found over most of North America from Alaska and Labrador south to West Virginia and Utah (Gertsch, *pers. commun.*).

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TWO NEW SPECIES OF *EMELINUS* FROM ARIZONA (COLEOPTERA: ADERIDAE)[1]

By Floyd G. Werner
University of Arizona, Tucson, Arizona

The two species of *Emelinus* described here bring the known species in our fauna to four. Others assignable to the genus have been described from Central and South America but, so far, none from the Old World. Since the last general work on Nearctic species of Aderidae, by Casey in 1895,[2] there has been only one significant publication affecting our fauna, a reclassification on a World basis by Baguena Corella in 1948.[3] Whereas neither Pic nor Champion felt that the genera set up by Casey could have more than subgeneric or species-group significance, Baguena Corella has made an effort to split up the huge and diversified assemblage of species already assigned to *Xylophilus* or *Hylophilus,* raising *Emelinus* not only back to generic rank but setting it off in a separate tribe, Emelinini. Baguena Corella also shows good reason for using the family name Aderidae, thus ending a triple tie for the names Euglenidae, Xylophilidae and Hylophilidae.

Baguena Corella's definition of *Emelinus* restricts it to species with the head totally visible from above and with the male antennae flabellate from the fourth segment. The two new species fit this diagnosis but differ in some details possibly of generic significance from *E. melsheimeri* (Lec.) and *E. ashmeadi* Csy. In these the antennae angle beyond the third segment in the male and the rami of segments six through ten originate near the apex of the segments. The two species from Arizona do

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[1] Published with a grant from the Museum of Comparative Zoology at Harvard College.

[2] Ann. N. Y. Acad. Sci. *8*:772-809.

[3] "Estudio sobre los Aderidae," Instituto de Estudios Africanos, Madrid.

not have the antennal angling and the rami all originate before or near the middle of the segments. Casey noted the angling in *E. ashmeadi* but it was not mentioned by Champion in the Central American species, nor does it appear in his figures. It seems most likely that the two Arizona species are more closely related to those described from Central America than they are to *melsheimeri* and *ashmeadi,* the two species from which a genotype must be selected.

Both the species described below were collected by the author, in company with Dr. George D. Butler, Jr., in Ramsey Canyon, Huachuca Mts., *huachucanus* mostly below the "box" and *butleri* entirely about one-half mile above the "box." The presence of both species was detected by random sweeping of vegetation alongside the path. In each case additional specimens were obtained by more intensive sweeping and examination where the first specimens were taken. All the *butleri* specimens came from an area less than twenty feet across and mostly from maple leaves. Almost all the *huachucanus* came from a similar area, from leaves of a broad-leaved oak. Since both trees are widely distributed in the canyon, it seems likely that the small areas of abundance were in some way tied in with emergence of the adults from a very restricted habitat. Undisturbed individuals of both species appeared simply to be resting on the upper surfaces of the leaves; there was no sign of feeding of any kind.

Key to the Nearctic Species: Males

1. Antennae angled backward at apex of segment III; rami of antennal segments VI-X arising near apex of segments, of such lengths that the rami and segment XI form an almost evenly rounded series across their ends. Elytra with a variegated pattern of darker markings . . . . 2.

   Antennae not angled at apex of segment III; all rami arising before middle of segments, almost uniform in length, not making a rounded series across their ends . . . . 3.

2. Eyes almost contiguous in front .... *E. ashmeadi* Csy.
Eyes separated in front by 2/5 their maximum width .... *E. melsheimeri* (Lec.)
3. Rami all less than 1/5 the total length of the antenna. Elytra brown, with a variegated paler pattern .... *E. huachucanus* sp.n.
Some of the rami almost 2/5 total length of antenna. Elytra very dark brown, marked with reddish at the humeri .... *E. butleri* sp.n.

I have before me a single male of *melsheimeri* I collected in LaSalle Co., Illinois, June 29, 1938, and compared several years ago with the type in the LeConte collection. A male of *ashmeadi* collected at Gainesville, Florida, March 4, 1947, by H. V. Weems, Jr., has been loaned by Mr. C. A. Frost. What I take to be the female of this species is before me from Fairfax Co., Virginia, collected in June, 1923, by Mr. Quirsfeld, on loan from the Cornell collection.

It seems inadvisable to attempt a key to the females at this time, there being little to compare them with in other genera. The peculiar structure and pubescence at the base of the pronotum, as described under *butleri*, may be diagnostic of the genus. The female of *ashmeadi* has antennal segment II very sharply, obliquely truncate at base. In females of *butleri* and *huachucanus* segment II is simple. What appears to be still another undescribed species is represented by a single female from Sta. Rita Mts., Arizona, July 30, 1938, collected by D. J. & J. N. Knull. This is in most respects like the female of *huachucanus* but has the elytra pale and has the eyes more deeply emarginate than the female of that species. The emargination is almost ogival rather than rounded, as it is in *huachucanus* and *butleri*. This specimen is being returned to the collection of the Ohio State University.

Emelinus butleri sp.n

Very dark brown, the humeri of the elytra broadly rufous. Bases of legs pale. Sparsely and quite evenly clothed with short cinereous pubescence. Rami of male antennae short, all less than 2/5 as long as antenna and quite even in length, only just perceptibly thickened apically.

Holotype male: Length (based on length of head to front margin of eyes, plus length of pronotum and length of elytra) 3.65 mm.; maximum width of elytra ca. 1.1 mm. Antennae 2.10 mm., 0.57 as long as the body. Head suborbicular, deeply and evenly punctured, with moderately sparse, decumbent, cinerous pubescence. Length, to bottom margin of eyes, 0.56 mm.; width across eyes, 0.73 mm. Fronto-clypeal suture deep; clypeus and labrum more finely and sparsely punctured and pubescent than the rest of the head. Eyes deeply excavated for the antennae, 0.42 × 0.33 mm., separated from each other by 0.09 mm. A smooth border surrounds the eyes, somewhat widened behind. Last segment of maxillary palpi securiform, 0.24 × 0.14 mm. Last segment of the labial palpi, as in all the species treated here, oval and with a conspicuous membranous sensory area beneath.

Antennae very dark brown, with sparse, suberect pubescence. Segment I is barrel-shaped; II short and stout, the dorsal the shortest side; III subcylindrical, slightly expanded at the apex; IV-X with dorsal rami, curved slightly toward the apex of the antenna, and slight ridges anteriorly near the apices. The ramus of IV originates near the base, of X just beyond the middle of the segment and there is a gradual transition in between. Segment XI has a knob 0.63 of the distance from the base, this knob most prominent posteriorly. Measurements (in relation to a total length of 1,000 units, from segment I to XI, length/thickness): 99/46, 37/41, 109/37, 92/25, 86/25, 86/25, 86/25, 86/25, 86/22, 86/22, 236/55. Segment XI is slender at base, 23 units, gradually expanding to knob, 55, then abruptly contracting, with a short apical section 25 units wide. Rami (at same ratio) IV to X: 238, 308, 337, 326, 320, 295, 246. The individual rami are ca. 0.03 mm. wide at base, expanded feebly at apex to ca. 0.05 mm.

Pronotum subcampanulate, the effect accentuated by a tuft of several setae at the posterior angles. Length 0.65 mm., width 0.64 mm. Base slightly indented at middle, the indention flanked by a pair of feeble elevations on the disc. The pubescence is peaked posterior to these elevations, leaving the slight median indentation free of setae. Surface shiny, densely and deeply punctured and sparsely, evenly pubescent, as on head. Scutellum truncate, densely punctured. Elytra almost parallel-sided, evenly, conjointly rounded behind, 2.44 mm. long, 0.87 mm. wide at humeri, ca. 1.1 mm. at widest. Basal 25%, except along suture, rufous. This zone is not sharply defined. Omoplate area slightly, conjointly elevated. Surface shiny, deeply punctured but not as densely as on pronotum, the middle of the punctures ca. 0.05 mm. apart. (On the disc of the pronotum they are ca. 0.03 mm. apart). All of the dorsal punctures have rounded bottoms. Pubescence correspondingly sparser, longer, about 0.09 mm. long, decumbent, all cinereous, not at all influenced by the ground color.

Underside dark brown, the coxae and trochanters, as well as the inner edge of the front and middle femora, paler. Suture between the first and second apparent abdominal sternites distinct all the way across. Posterior femora thickened beyond middle, ca. 2 times as thick as at base. First segment of the posterior tarsi 0.44 mm. long, the rest together 0.28; ratio of the first to the rest 1.54: 1.

Allotype female: differs from the male most notably in the absence of rami on the antennae, also in the size of the eyes. Segments IV-X are truncate basally and apically, as in the male, but there is no sign of any projections in the places where the rami occur in that sex. These segments are articulated anterior to the middle. The antennae are 1.66 mm. long, on a specimen 3.9 mm. in total length, or 0.43 the length of the body. The individual measurements (to a total length of 1,000 units) are: 129/61, 61/46, 109/42, 92/46, 84/46, 77/46, 77/48, 77/48, 77/48, 77/60, 138/77. It will be noted from these figures that segment XI is of more normal proportions than in the male, where XI appears, at first glance, to be just one more ramus on the flabellate antennae. The eyes are 0.44 mm. × 0.22 mm. and are separated by 0.22 mm. The posterior tarsi are slightly shorter than in the male. Segment I is 0.38 mm. long, the rest together 0.20 mm., the ratio of I to the rest 1.94: 1.

Holotype male and allotype female: Ramsey Canyon, Huachuca Mts., Cochise Co., Arizona, July 12, 1955, F. G. Werner & G. D. Butler, deposited in the MCZ. 6 male and 1 female paratypes from the same locality, July 12 and 13, 1955, in the collections of the University of Arizona, the U.S. National Museum, California Academy of Sciences and the author. 1 male paratype Madera Canyon, Sta. Rita Mts., Arizona, July 31-Aug. 1, 1948, W. Nutting & F. Werner, in the collection of the author, and 1 female Mud Springs, Sta. Catalina Mts., Arizona, July 17-20, 1916, — 6,500′; being returned to Ohio State.

There is very little variation in the series, the length ranging from 3.3 mm. to 3.65 mm. in the males and 3.9 mm. to 4.3 mm. in the females. This species is named after Dr. George D. Butler, Jr., my collecting companion and colleague in the Department of Entomology.

Emelinus huachucanus sp.n.

Brown, the elytra paler in an obscure pattern as follows: an oblique zone on 2nd quarter of each elytron, approaching suture behind; a smaller zone at apical 3/4, transverse and extending approximately 1/3 across each elytron, narrowly and obscurely connected behind along suture to a small zone at apical 5th. Rami of male antennae short, almost uniform in length, all less than 1/5 as long as the antenna. Only *E. breviramus* (Champ.) approaches this condition and, if the illustration in the Biologia is correct, the longest ramus is 1/4 as long as the antenna in that species.

Holotype male: length 3.51 mm.; maximum width of elytra ca. 1.06 mm. Antennae 2.12 mm. long, 0.60 as long as the body. Head elliptical, 0.53 mm. long to front edge of eyes, 0.77 mm. wide across eyes. What little surface is not covered by the eyes is smooth, shiny, deeply and densely punctured, with moderately sparse, subdecumbent pubescence. Eyes very large, 0.50 × 0.42 mm., separated by only ca. 0.03 mm., deeply excised for the insertion of the antennae. Fronto-clypeal suture strong; clypeus and labrum with finer and sparser punctures and pubescence than rest of head. Last segment of maxillary palpi 0.26 × 0.14 mm. Details of antennal segments almost exactly as in *butleri*, except that the rami are of different proportions. Measurements (to a total length of 1,000 units): 73/49, 36/36, 115/35, 85/27, 85/24, 91/23, 85/23, 79/22, 85/27, 85/27, 182/42. Rami, from IV to X: 121, 176, 182, 188, 182, 176, 158. Individual rami noticeably thickened apically, from ca. 0.02 mm. at base to ca. 0.04 mm. at apex. These figures are similar to those of *butleri* but the shorter rami here accentuate the thickening. Segment XI is 24 units wide at base, gradually expanding to the knob, 42, at 0.6 of the way from the base, then constricts and tapers gradually to the apex. Pronotum very similar in detail to that of *butleri*, except that there is a pair of feeble impressions on the disc just anterior to the slight postero-median elevations, within the basal third. Details of scutellum and elytra likewise almost identical with *butleri*, except for the color pattern of the elytra. The punctures do not appear as distinct, because of the paler ground color. Pronotum 0.64 × 0.64 mm.; elytra 2.34 mm. long, 0.94 mm. wide at humeri, ca. 1.06 mm. at widest. Details of underside also much as in *butleri*, but thorax pale and legs, except coxae and tarsi, mainly dark. First segment of posterior tarsi 0.44 mm. long, rest together 0.30 mm.; ratio of I to rest 1.48: 1.

Allotype female: The remarks about the comparison of male and female under *butleri* apply equally well here. On a specimen 3.3 mm. long the antennae are 1.37 mm. long, or 0.40 as long as body. The individual measurements of the segments (to a total of 1,000 units) are: 130/56, 75/47, 112/43, 94/51, 79/54, 69/54, 75/54, 75/58, 75/65, 75/66, 140/82. The eyes are 0.37 × 0.31 mm. and are separated by 0.18 mm. The first segment of the posterior tarsi is 0.41 mm. long, the rest together 0.24 mm., giving a ratio of the first to the rest of 1.68: 1.

Holotype male and allotype female: Ramsey Canyon, Huachuca Mts., Cochise Co., Arizona, July 12, 1955, F. G.

Werner and G. D. Butler, deposited in the MCZ. 102 male and 19 female paratypes from the same locality, July 12 and 13, 1955, in the collections of the MCZ, University of Arizona, U.S. National Museum, California Academy of Sciences and the author. One female paratype collected in Huachuca Mts., Arizona, July 20, 1937, D. J. & J. N. Knull returned to Ohio State.

There is some variation in the extent of the pale markings on the elytra, these being reduced to not much more than dots in some and broadened so that they are very conspicuous in others. Total length ranges from 2.8 to 3.7 mm. in the males and from 3.1 mm. to 3.8 mm. in the females.

SOME SYNONYMIES IN THE ANT GENUS *CAMPONOTUS*

By William L. Brown, Jr.
Museum of Comparative Zoology, Harvard University

Ant specialists have long since "lost control" of the ants genus *Camponotus* Mayr. Somewhere between one and two thousand names of species, subspecies and varieties currently stand in the books, and the fifty or so subgeneric names in use are probably not all familiar to any single pair of myrmecological ears. Small samplings of different parts of the world fauna, and the few larger works like Creighton's book on the ants of North America, reveal that the taxonomy of the genus is in a very confused state. It appears that a great many, perhaps a majority, of the subspecies and varieties are straight synonyms, as are also a goodly percentage of the full species. Other varieties and subspecies are certainly good species in the biological sense, even though morphological differences separating them may be relatively weak in conventional terms. The job of revising *Camponotus* is probably too great for one man to attempt, even if any specialist were game enough to try, during a normal life span; there are just too many names to deal with. A piecemeal attack therefore seems to afford the best chance of reducing the genus to a reasonable number of species, a number small enough to attract revisers of the future. One class of synonymies especially should be published as soon as detected; I refer to the cases where types of two forms can be compared directly. At the Museum of Comparative Zoology, which now houses the largest and most complete collection of ants in existence, the constant accession of types by exchange, and examination of still others by loan, permits the certain detection of many obvious synonyms that would otherwise be very uncertainly identified from their descriptions. It seems wise to have such synonymies enter the published record as they are made, even if the record consists of short notes. If properly set up, such notes will be caught and listed, with their new synonymy, in the Zoological Record, and will thus become even more widely disseminated. Every certain synonymy properly listed and justified is a further step toward the eventual fulfillment of a badly needed revision.

Camponotus acvapimensis Mayr

Camponotus acvapimensis Mayr, 1862, Verh. zool.-bot. Ges. Wien, **12**: 664, worker minor. Type loc.: Akwapim Mts., Gold Coast.

Camponotus akwapimensis (!) var. *Poultoni* Forel, 1913, Rev. Zool. Afr., **2**: 353, "female," *recte* worker. Type loc.: Lagos, Nigeria. NEW SYNONYMY.

Camponotus (*Myrmoturba*) *acvapimensis*, Wheeler, 1922, Bull. Amer. Mus. Nat. Hist., **45**: 948, with var. *poultoni*, p. 949; synonymy and bibliography.

Camponotus (*Myrmopyromis*) *flavosetosus* Donisthorpe, 1945, Ann. Mag. Nat. Hist., (11)**12**: 271, soldier, worker. Type loc.: near Flabo Falls, 1200 feet, British Togoland. NEW SYNONYMY.

This is one of the common ants in many parts of Equatorial Africa. Variation at single localities, and even within colonies, extends to include Forel's var. *poultoni* as he described it. I have examined a worker paratype of *flavosetosus* and found it an average *acvapimensis* example.

Camponotus testaceipes (F. Smith)

Formica testaceipes F. Smith, 1858, Cat. Hym. Brit. Mus., **6**: 39, worker. Type loc.: King George Sound, Western Australia.

Camponotus (*Myrmophyma*) *darlingtoni* Wheeler, October, 1934, Jour. R. Soc. W. Australia, **20**: 160, workers max., med., min.; female. Type loc.: Margaret River, Western Australia; *nec C.* (*Myrmocladoecus*) *sanctaefidei darlingtoni* Wheeler, November (!), 1934. NEW SYNONYMY.

Camponotus (*Myrmophyma*) *rottnesti* Donisthorpe, 1941, Ent. Mon. Mag., **77**: 239, *nom. pro C.* (*Myrmophyma*) *darlingtoni* Wheeler, 1934. NEW SYNONYMY.

Dr. E. O. Wilson has kindly compared types of *C. testaceipes* in the British Museum with syntypes of *C. darlingtoni* (Margaret River series) sent to him from the Museum of Comparative Zoology; he judges them to be of the same species. This situation was previously thought to hold, even though Wheeler reported upon specimens he identified as the true *C. testaceipes* in the same paper in which he described *darlingtoni*. This species is quite variable in color in Western Australia, where it is a common inhabitant of the sand plains paralleling the coast from Geraldton around to the country east of Esperance.

Camponotus hartogi Forel

Camponotus Hartogi Forel, 1902, Rev. Suisse Zool., **10**: 500, worker. Type loc.: Yarra Districts, Victoria, Australia.

Camponotus (*Myrmosaga*) *ferruginipes* Crawley, 1922, Ent. Mon. Mag., (3) 8: 125, worker major. Type loc.: Healesville, Victoria. NEW SYNONYMY.

The types of Crawley's and Forel's species come from the same general area to the east of Melbourne, and there seems little doubt that both descriptions apply to the same common species of black *Camponotus* with red legs found in this area by many collectors, including myself. The species occurs in and around the cool, rainy highlands of Victoria, New South Wales and southeastern Queensland. It is abundant near the summit of Mt. Donna Buang (Brown) and on the Bogong High Plains (5600-6000 ft., F. E. Wilson leg.) in snow-gum and snow-grass woodland.

Camponotus whitei Wheeler

Camponotus (*Myrmosphincta?*) *whitei* Wheeler, 1915, Trans. R. Soc. S. Australia, **39**: 818, pl. 66, fig. 8, worker minor. Type loc.: Flat Rock Hole, Musgrave Ranges, S. Australia.

Camponotus (*Myrmosaulus*) *scutellus* Clark, 1930, Proc. R. Soc. Victoria, Melbourne, (n.s.) **42**: 123, fig. 1, nos. 9, 10, workers maj., min. Type loc.: Tammin, W. Australia (by present selection). NEW SYNONYMY.

Types of *scutellus* (MCZ) compare well with a series of *whitei* determined by Wheeler, collected by A. M. Lea at Port Lincoln, South Australia. This curious little species ranges very widely in the arid and semiarid parts of the southern half of Australia. It is known from the Victorian mallee country (Sea Lake, leg. J. C. Goudie), from many parts of South and Western Australia, and from as far north as Alice Springs (Brown) in central Australia and Mullewa in Western Australia (W. M. Wheeler leg.).

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PSYCHE

Vol. 63 June, 1956 No. 2

A NEW SPECIES OF *MYRMOTERAS* FROM CEYLON (HYMENOPTERA: FORMICIDAE)[1]

By Robert E. Gregg

Department of Biology, University of Colorado

Several specimens of a new ant belonging to the genus *Myrmoteras* were collected recently on the Island of Ceylon by Dr. Edward O. Wilson, and were sent to me for study and description.

Myrmoteras ceylonica sp. nov.

Fig. 1

Worker: Length, 3.09 mm.; head length (excluding mandibles), 0.90 mm.; head index, 0.94; thorax length, 1.17 mm.

The head of this species is heavily granulate, except for the shining occiput, occipital flange, and gula, and recalls the condition of *M. williamsi*, but unlike the latter species in which the cephalic furrow is marked, *ceylonica* shows no more than an elusive trace of this furrow. In certain lights, a narrow, median line of reduced and more widely spaced granules permits the area to shine and thus give a faint resemblance to the groove of other species such as *binghami, donisthorpei, williamsi,* or *karnyi. M. ceylonica,* therefore, belongs in that subdivision of the genus in which the head does not possess a median longitudinal furrow, or in which such a furrow is short and indistinct or nearly obsolete. Previously, only three species were found in this group, namely, *mjoebergi, kemneri,* and *barbouri.*

The new species may be distinguished at once from *mjoebergi* (3-5.6 mm.) by its smaller size (3.09 mm.) and

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[1] Published with a grant from the Museum of Comparative Zoology at Harvard College.

by the heavy granulate sculpture of the head, for in the latter species the head, according to previous authors, is very smooth and shining. From *barbouri* (6.9 mm.), it may be separated by its much smaller size, by the possession of two distinct denticles between the last and the penultimate mandibular teeth, and by the presence of more or less longitudinal rather than transverse rugae on the mesonotum.

In the published keys to the species of *Myrmoteras* (Creighton, 1930; Wheeler, 1933; Gregg, 1954), the Ceylon specimens run easily to *M. kemneri.* Despite their apparent close relationship to this species, consideration of the structural details and size of *kemneri* (6 mm.), and the wide distributional gap between the two, make it quite evident they represent different species. Although the author has not seen a specimen of *kemneri,* a study of the description and the figures given by Wheeler enable me to provide the following comparisons. The antennal scape in *ceylonica* surpasses the occipital corner by a distance equal to a little less than one-half its total length, while in *kemneri* the scape surpasses the corner by an amount equal to a little more than one-half its total length. Mandibular teeth in *ceylonica* number 11, not counting the minute ante-apical denticles, whereas there are 10 in

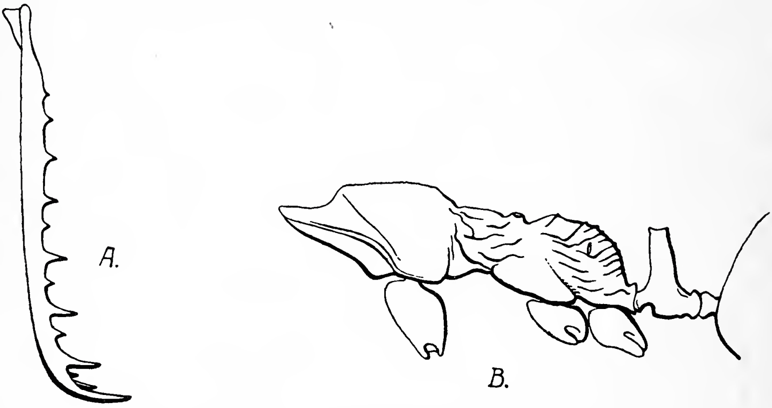

Fig. 1. *Myrmoteras ceylonica* sp. nov. A. Right mandible. B. Profile of thorax and petiole.

kemneri. Further, the 5th, 7th, and 9th teeth in *ceylonica* are distinctly smaller than the ones with which they alternate, while in *kemneri* only the 8th appears to be smaller (Fig. 1). In profile, the dorsal surface of the pronotum is flat in the center and passes through distinct angles to slope both anteriorly and posteriorly, whereas in *kemneri* the pronotum shows an even and relatively low convexity from front to back. The mesothorax of *ceylonica* is short in side view, being almost quadrate, and with a flat dorsal contour that depresses slightly to the meso-epinotal suture. The same structure in *kemneri* is decidedly elongate and shallowly saddle-shaped with prominent mesonotal spiracles. The epinotum of *ceylonica* is about as high as it is long with an even curvature dorsally, while that of *kemneri* is very much longer than high and its dorsal contour arches upward to the rear. Probably the most distinctive feature separating these two ants is the petiole. In *ceylonica* the anterior and posterior peduncles are quite short, the scale is narrow antero-posteriorly, and high, with flat, nearly vertical front and rear surfaces; the crest is truncated and margined anteriorly and posteriorly with minute but definite ridges, which give the summit of the node an appearance of being depressed or concave. By contrast, in *kemneri,* the posterior peduncle is longer than the anterior, the anterior and posterior surfaces of the node are rounded and sloping, and the crest is evenly rounded in all directions.

Sculptural features of the head in the two species seem to be remarkably similar, as they are heavily granulate and give the surface a coriaceous and opaque appearance. The same condition is true of the pronota also, though this structure is a little more shining at least in *ceylonica* owing probably to the large size of the granules. The mesonotum and epinotum of *ceylonica,* unlike the smooth, opaque, almost sculpturless corresponding structures of *kemneri,* are furnished with pronounced rugae that are more or less longitudinal on the mesonotum, but very heavy and distinctly transverse on the dorsum of the epinotum. Rugae of the mesopleurae and epinotal pleurae are longitudinal but finer in texture. The interrugal granules of all these areas are sparse, causing a general shininess of the regions despite their heavy sculpture. The surfaces of the petiole and the gaster are very shining and thus different from the dull aspect of these parts in *kemneri.*

In color, *ceylonica* does not appear to differ significantly from *kemneri.* The head and thorax are rich reddish brown, the petiole and gaster a bit lighter brown, and the mandibles, antennae, and legs yellowish to yellowish brown. Hairs pale yellow.

Holotype: worker (in the collection of the Museum of Comparative Zoology).

Paratypes: two workers (one in the M.C.Z. and one in the author's collection).

Type locality: Udawaddatekele Sanctuary, Kandy, Ceylon; elevation 2000 feet; collected by E. O. Wilson, July 13, 1955, No. 1245.

Dr. Wilson has been able to supply a few natural history notes concerning *Myrmoteras ceylonica.* The workers were observed in second growth tropical evergreen forest, and were found to be foraging during daylight hours on the ground and over low herbaceous vegetation. They were said to be in the company of individuals of *Tetramorium* and *Trigonogaster*, and moved with about the pace of a *Tetramorium caespitum.* When they were disturbed, their mandibles were thrown open and seemingly "locked" at approximately 200°.

In a previous paper (1954), I discussed the known limits of distribution of the genus *Myrmoteras,* and included a tentative map showing the supposed range of these ants. The present specimens and the new species which they represent, extend the distribution beyond the boundaries of the Indo-Malayan region to the Island of Ceylon. Such a pattern suggests that the genus may be represented in India, but until actual records showing this have been obtained, it is impossible to make such a claim. The northern-most localities for these ants at present are Tenasserim, Burma, and the Island of Hainan off the southeast coast of China.

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A SYNONYM IN THE GENUS CHRYSOPA (NEUROPTERA: CHRYSOPIDAE)—Banks described *Chrysopa sperryi* (Psyche *50*:74-75) as differing from all other species of the *plorabunda* section in lacking genal markings. An examination of the type (from Riverside, Calif., Sept. 7, 1940, ♀, Sperry: here designated lectotype), paratypes, and additional material from Riverside disclosed every gradation from no genal marks to well-defined red ones. The type and all but one of the paratypes are faded or pale individuals of *Chrysopa comanche* Banks 1938 (Can. Ent. *70*:119-120) ; *sperryi* is therefore a synonym of this species. One of the paratypes, collected at the same time as the others, is a faded male *C. plorabunda californica* Coq., which lacks the red on the cheeks, but has the black mark plainly visible. A long series of *comanche* from Sabino Canyon, Baboquivari Mts., Arizona, Sept., 1951 (L. M. Martin, Los Angeles County Museum) also shows every gradation between well-defined cheek markings and none at all; the holotype of *comanche*, from Laredo, Texas, has only the faintest trace of the red marks. These identifications were made with the aid of male genitalic characters. — PHILLIP A. ADAMS, Harvard University.

TWO NEW SPECIES OF CERATOPOGONIDAE (DIPTERA)[1]

By Franklin B. Lewis

Forest Insect and Disease Lab.
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During an investigation of the bionomics and immature stages of the Ceratopogonidae, two new species were encountered. The purpose of this paper is to describe these insects.

Helea (Isohelea) serrata n. sp.

Fig. 1

Description: Antennae dark brown, pedicel black; vertex black; eyes barely touching. Tergum of thorax shiny black with faint bluish brown pruinescence; pleurae shining black; scutellum black. Femora brownish, all tibia with yellow-white apices; tarsi whitish, claws unequal with small basal barbs. Wings milky-white; M2 broadly interrupted; costal vein light brown; radial cells with slight brownish infuscation; cell R1 longer than cell R2, cell R2 teardrop-shaped. Halteres with bases brownish, knobs white. Abdomen black-brown above with faint bluish pruinescence. Female resembles male in most respects, but has lighter legs. Tibial comb with six equally long spines, each about as long as tibial width at distal tip; five small spines between each two adjacent long spines; these small spines one half the length of the long spines. Male genitalia (Fig. 1) large, basistyles about as broad as long, dististyles very short and slender. Parameres separated at base, fused distally and finally separated at very tip, these tips recurved. Aedeagus

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[1] A portion of a thesis submitted in partial fulfillment of the requirements for the Doctor of Philosophy degree at the University of Connecticut in 1955.

broad, spatulate with sclerotized teeth on lateral margins of tip (Fig. 1, B). Dorsal inner processes small but longer than ventral inner processes. Ninth sternite small with a shallow excavation in middle. Apicolateral processes small and blunt.

Length: 1.4 mm.; wing 1.0 mm. x 0.5 mm.; female slightly larger.

Type Data: Holotype; male, Storrs, Conn., May 18, 1953 (F. B. Lewis); USNM type No. 62699, deposited in U.S. National Museum. Paratypes; male, Storrs, Conn., June 15, 1953 (F. B. Lewis); two females, Storrs, Conn., June 14, 1954 (F. B. Lewis); deposited in USNM, University of Connecticut, and author's collections.

Comparative Notes: A small blackish species having a shiny black thorax and a dull black abdomen with brownish blue pruinescence. The wings are whitish. This species keys out to *pruinosa* in Wirth's (1952)[2] key to the California species. *Serrata* resembles *pruinosa* Wirth closely but differs in the bluish cast, larger size, and unequal claws. The most outstanding difference is between the aedeagi of the two species. The toothed edges of *serrata's* aedeagus is the best distinguishing character as it separated the species from all others in the genus known to the author. The bluish cast will separate either sex from all known New England species.

Johannsenomyia smithi n. sp.

Fig. 2

Description:

Head black, eyes separated; vertex shining black; antennae brownish, pedicel shining black; flagellar hairs brownish-black. Dorsum of thorax shiny black with a thin covering of short light brown hairs, pleurae shining black. Fore and mid femora light brown with black apices, hind femora light brown on basal fourth, distal three-quarters dark brown. Hind tibia all dark; hind tarsi light with dark apices. Claws equal and unbarbed. Wings hyaline,

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[2] Wirth, W. 1952. The Heleidae of California. Univ. Cal. Pub. Ent., 9(2):95-266.

M2 sessile; two distinct radial cells. Abdomen dark brown. Tibial comb with five long equal spines shorter than tibial width at distal tip. Small spines one quarter the length of the long spines. Male genitalia (Fig. 2) with ninth sternite deeply excavated; basistyles long and slender with sharp medially pointing inner processes very large; dististyles small, slender, and sharp-pointed. Ninth tergite blunt and truncated with large lobe-like apicolateral processes each with a small lateral lobe at the base. Parameres fused to distal third, tips separate and knobbed. Aedeagus broad, sclerotized along lateral margins, tip with laterally produced lobes forming a cresent-shaped tip.

Length: 1.7 mm.; wing 1.5 mm. x 1.0 mm. Female unknown.

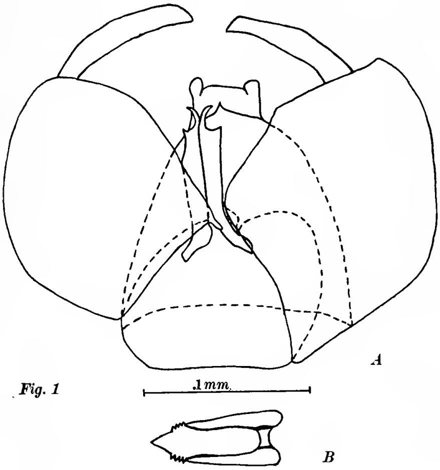

Fig. 1

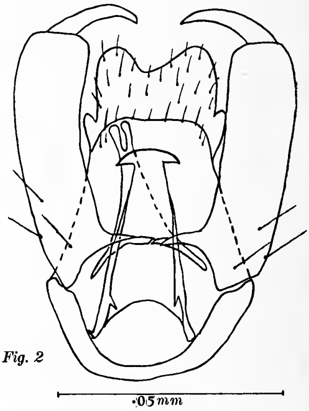

Fig. 2

Fig. 1. A. Ventral view of male genitalia of *Helea* (*Isohelea*) *serrata* n. sp. B. Aedeagus. Fig. 2. Ventral view of male genitalia of *Johannsenomyia smithi* n. sp.

Type Data: Holotype; male, reared from pupa, Oxford, Conn., June 4, 1954 (F. B. Lewis), USNM type No. 62698, deposited in U.S. National Museum, Paratypes; two males, same data as holotype, in University of Connecticut and author's collections.

Comparative Notes: A blackish species with shiny black thorax and legs brownish with black knees. The specimens were taken from a small brook-fed bay on a large lake. The water was still and algae-choked. This species resembles *Johannsenomyia syblae* Wirth from California, but differs in the details of the male genitalia. The genitalia easily separate this species from any known New England species. This species is named for Dr. Howard W. Smith in appreciation of his continued advice and help during the author's study.

THE IDENTITY OF LORDOMYRMA RUGOSA CLARK. — Through the courtesy of Curator Elisabetha Bajári of the Hungarian National Museum, I have been able to examine the type of *Dacryon christae* Forel (1907, Ann. Mus. Nat Hungar., 5: 16, worker: type loc., Botany Bay, Sydney, New South Wales) and to compare it with nidotypes and topotypes of *Lordomyra rugosa* Clark (1934, Mem. Nat Mus. Victoria, Melbourne 8: 38, pl. III, figs. 3, 4, worker, female: type loc., Ferntree Gully, Victoria) and with a worker and female from Como, New South Wales (J. Freeland). All of these samples appear to represent a single species. The type is a rather small example, with a relatively slightly narrower head (head L, including clypeus, 0.92 mm., head width without eyes 0.82 mm.), but in other ways agrees perfectly with the *rugosa* types. *Lordomyrma rugosa* must therefore be considered as a NEW SYNONYM of *Dacryon christae*. This species varies appreciably in depth of color, length of propodeal and petiolar teeth, and coarseness of sculpture. At Ferntree Gully, Victoria, where I collected the species, it nested in small colonies (40-50 workers, one queen) under stones in grassy-floored sclerophyll forest of the intermediate moisture type. The adults feign death when disturbed. — W. L. BROWN, JR., Museum of Comparative Zoology, Harvard University.

THE FIRST SPECIES OF PAMPHANTINAE FROM PUERTO RICO (HEMIPTERA: LYGAEIDAE)

By James A. Slater

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The subfamily Pamphantinae was erected by Barber & Bruner (1933) with *Pamphantus* Stal as type genus. Prior to that time only three species were known, all from Cuba. Barber & Bruner described a new genus, *Neopamphantus*, also from Cuba, and recorded a new species, *Pamphantus atrohumeralis*, from Haiti. Barber has recently (1954a) described a remarkable new Cuban genus, *Abpamphantus* and in the same year (1954b) a second new genus, *Parapamphantus*, from Brazil, this latter representing the first occurrence of the subfamily outside of the West Indies.

The new species described in the present paper is the first species known from Puerto Rico and adds an additional island to the distribution of this essentially Caribbean group.

Pamphantus pellucidus, new species

Macropterous male: Surface shining; coloration pale testaceous throughout, lacking dark dorsal markings; terminal one-half of fourth antennal segment dull brown; eyes and ocelli bright red; body very sparsely clothed with scattered upright hairs.

Head non-declivent, vertex with a narrow, sharp median longitudinal carina, first antennal segment extending beyond apex of clypeus for one-half its length, head strongly contracted behind eyes, length head .60 mm., width across eyes .70 mm., interocular space .40 mm.; pronotum elongate, nearly as long as wide and only slightly narrowing anteriorly, lateral margins sinuate and narrowly carinate anteriorly, surface punctate except in area of calli, lacking a well defined transverse constriction, length pronotum .75 mm., basal width .80 mm.; scutellum punctate, lacking a median carina, length .30 mm.; hemelytra strongly expanded on posterior two-thirds along corial margin, claval commissure well developed, length .45 mm.; apical margin of corium straight, distance apex clavus-apex corium .85 mm., distance apex corium-apex abdomen .75 mm., membrane not quite attaining apex of abdomen; labium attaining mesocoxae, basal segment extending posteriorly halfway to base of head, second segment exceeding base of head by one-half its length, length labial segments I, .28 mm., II, .38 mm., III, .30 mm., IV, .32 mm.; femora not incrassate, devoid of spines or teeth; antennae elongate, first segment rather stout, fourth fusiform, length antennal segments I, .25 mm., II, .72 mm., III, .62 mm., IV, .85 mm. Total length 3.75 mm.

Brachypterous male: Smaller (total length 3.15 mm.), head somewhat more declivent, posterior pronotal lobe markedly reduced; hemelytra reduced to a pair of heavily punctured truncate pads with a very narrow terminal rim of membrane, clavus and corium indistinguishably fused, hemelytra extending caudad onto third abdominal tergite, posterior margin of tergites four and five curving caudad mesally (as in *Geocoris*), anterior abdominal sterna incompletely fused, connexivum prominent and upcurved; labium reaching metacoxae.

Holotype: Macropterous male. PUERTO RICO: El Yunque, 3,000 ft., May 1938, Darlington. In Museum of Comparative Zoology (Harvard). Paratype: Brachypterous male. PUERTO RICO: Ensenada, June 14-19, 1915. In American Museum of Natural History.

This species is related to *Pamphantus pallidus* Barber & Bruner from Cuba. It differs primarily in not possessing spined and incrassate fore femora, in the complete lack of fuscous color markings on the dorsum and in the greater relative length of the fourth antennal segment. In *pel-*

lucidus the length of the fourth antennal segment is slightly greater than the width of the pronotum (85:80) whereas in *pallidus* the antennal length is considerably less (60:80).

This is the only known occurrence of marked brachyptery in the genus *Pamphantus,* although both *Abpamphantus* and *Parapamphantus* were described from brachypterous specimens. In fact the non-spinous fore femora (unique in the genus) and the presence of a median vertex carina are suggestive of *Parapamphantus.* However, in most respects the species is related to *Pamphantus.* There seems to be little value in establishing an additional genus for the species at the present time when a moderate expansion of the present generic concept of *Pamphantus* will probably more accurately reflect the systematic picture.

The posteriorly curving fourth and fifth abdominal tergites support the geocorine relationship of the pamphantines as noted by Barber & Bruner.

The brachypterous paratype has the right antenna missing and the left is oligomerous with three segments present.

Check List of the Pamphantinae

ABPAMPHANTUS Barber 1954.

1. *gibbosus* Barber 1954 (*Abpamphantus*) Cuba

NEOPAMPHANTUS Barber & Bruner 1933.

1. *calvinoi* Barber & Bruner 1933 (*Neopamphantus*) Cuba
2. *maculatus* Barber & Bruner 1933 (*Neopamphantus*) Cuba

PAMPHANTUS Stal 1874.

1. *atrohumeralis* Barber & Bruner 1933 (*Pamphantus*) Hispaniola
2. *elegantulus* Stal 1874 (*Pamphantus*) Cuba
3. *mimeticus* Barber 1926 (*Pamphantus*) Cuba
4. *pallidus* Barber & Bruner 1933 (*Pamphantus*) Cuba
5. *pellucidus* new species Puerto Rico

?6. *stenoides* Guerin 1857 (*Lygaeus; Pterotmetus*) Cuba

7. *vittatus* Bruner 1932 (*Pamphantus*) Cuba

PARAPAMPHANTUS Barber 1954.

1. *braziliensis* Barber 1954 (*Parapamphantus*)
Brazil

Acknowledgements

My sincere thanks are extended to Drs. Mont Cazier and Herbert Ruckes of the American Museum of Natural History and Drs. P. J. Darlington and W. L. Brown of the Museum of Comparative Zoology for allowing me the privilege of examining material from their respective institutions.

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STUDIES ON THE NORTH AMERICAN REPRESENTATIVES OF *EPHEBOMYRMEX* (HYMENOPTERA: FORMICIDAE)

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Pogonomyrmex (*Ephebomyrmex*) *imberbiculus* was described by W. M. Wheeler in 1902 and seven years later he added the descriptions of *pima* and *townsendi.* Since that time there has been surprisingly little additional information published on these interesting ants. What has appeared has consisted largely of locality records, but few of these have added much to our knowledge of the ranges of these insects. It is gratifying to be able to present a more complete picture of the distribution of our representatives of *Ephebomyrmex,* particularly since this clears up certain questions related to the taxonomic status of *townsendi.* It has also been possible to expand Wheeler's account of the habits of *imberbiculus,* for it appears that these same habits are true of *pima* also. In past years the writer has been able to study 53 colonies of *Ephebomyrmex* at 40 stations. This study has shown that the ranges of both *imberbiculus* and *pima* are much more extensive than was formerly supposed. It has also shown that *townsendi* is a synonym of *imberbiculus.*

Wheeler described *townsendi* in 1909 (1) on the basis of a single specimen from Chihuahua. It is hard to avoid the suspicion that one of Wheeler's reasons for giving *townsendi* specific status is the fact that the type specimen came from Mexico. Certainly the structural features which distinguish *townsendi* from *imberbiculus* are not particularly impressive. They consist mainly of the sculpture of the postpetiole and the first gastric segment. Wheeler believed that in *imberbiculus* the postpetiole is so feebly rugose as to be almost smooth and is marked only by scattered patches of punctures. In this same species the dorsum of the first gastric segment was said to be smooth and shining and without basal punctures. In *townsendi,* on the other hand, both the postpetiole and the dorsum of the first gastric segment were described as completely covered with fine, dense punctures and opaque. Wheeler also claimed that in general *townsendi* is more opaque than *imberbiculus.* Olsen accepted *townsendi* as a separate species in 1934 (2) but the writer in 1950 (3) treated it as a subspecies of *imberbiculus.* At that time there was little material of *townsendi* available but, since it was still the only member of the subgenus known from Mexico, it could be regarded as a southern race of *imberbiculus.* It is now clear that such a treatment is erroneous. As material began to accumulate it became apparent that *imberbiculus* occurs much further south in Mexico than does *townsendi* and that the latter form occurs at random, principally in the northwestern portion of the range of *imberbiculus.* The writer has taken colonies which agree well with the type of *townsendi* in northern Sonora and at three stations in southern Arizona. In these specimens both the postpetiole and the basal two-thirds of the dorsum of the first gastric segment are densely and evenly covered with small, close-set punctures which render the surface opaque or nearly so. These specimens can, without any diffculty, be assigned to *townsendi,* but this is not true of others which are intermediate in character. One nest from northwestern Chihuahua has the gastric punctuation limited to the anterior third of the segment. Another large colony from southeastern Arizona shows some individuals without gastric sculpture and others with only a small area of sculpture immediately adjacent to the postpetiole. In both these colonies the sculpture of the postpetiole is like that of *townsendi.* After it was appreciated that the supposedly definitive features of *townsendi* vary, a reexamination was made of all specimens previously assigned to *imberbiculus.* This established the surprising fact that in most of the longer nest series there were a few workers which had a dull, densely punctate postpetiole like that of *townsendi.* In short, there is no constancy in the sculptural characteristics which were used as the basis for the recognition of *townsendi.* The case offers a close parallel to that of Olsen's *salinus,* a species which was also based on a single specimen which had a densely sculptured gaster. M. R. Smith has recently shown (4) that *salinus* is a synonym of *occidentalis,* being nothing more that an inconsequential variant which occurs in certain nests at the western end of the range of that wide-spread species. It appears that we must take the same stand with *townsendi.* Since *townsendi* is nothing more than a minor variation which occurs at random over a part of the range of *imberbiculus,* it is best treated as a synonym of *imberbiculus.*

Presented below is a list of the stations at which *imberbiculus* and *pima* have been taken. The previous records for *townsendi* are included with those for *imberbiculus.* Where possible elevational data for the older records have been supplied from topographic sheets. The writer is aware of the difficulties inherent in this method, but the stations so treated were in areas which left little doubt as to the elevation involved. The records for which no collector's name is given are those of the writer. Elevational data for these stations were secured from altimeter readings at the station, which were checked then or later against topographic sheets.

Pogonomyrmex (*Ephebomyrmex*) *imberbiculus* Wheeler:

CALIFORNIA: Yaqui Well, Anza Desert State Park (1400′).

ARIZONA: Kofa Mountains, Palm Canyon (1600′); Ajo Mountains, Alamo Canyon (2300′); Santa Rita Mountains, mouth of Madera Canyon (4800′); Tucson (2400′) W. M. Wheeler; Pinaleno Mountains, Fort Grant (4800′) Cornell Univ. Exped.; Whetstone Mountains, Dry Canyon (5000′); Huachuca Mountains, Garden Canyon (5800′); Safford (3000′).

SONORA: Divisadora de Leon, 23 miles north of Hermosillo (1200′).

NEW MEXICO: Aden (4300′) W. M. Wheeler; Animas Mountains, San Luis Pass (5400′); Lordsburg (4200′); Alamogordo (4300′) G. von Krockow. The ten records which follow are those of A. C. Cole: Dillia (5200′); 25 miles east of Bernardo (5950′); 18 miles southeast of Bayard (6000′) Malpais Lava Beds, near Carrizozo (5400′); 8 miles west of Alamogordo (5800′); 6 miles northwest of Deming (4550′); 20 miles north of Bernardo (6550′); 7 miles west of Socorro (7000′); 12 miles west of Hope (5200′); 23 miles north of Las Cruces (4500′).

CHIHUAHUA: Sierra de en Medio, Nogales Ranch (5000′); 6 miles south of Gallego (5100′); 7 miles north of Chihuahua City (4700′); 15 miles west of General Trias (5600′); Ojo del Cerro Chilicote, C. H. Townsend.

DURANGO: 17 miles south of Rodeo (5500′); 5 miles west of Durango (6300′).

COAHUILA: Sierra de la Muralla, 46 miles south of Monclova (4000′); 24 miles east of Ramos Arizpe (4600′).

TEXAS: 10 miles west of Sierra Blanca (4500′); Chinati Mountains, Arsarca Canyon (4800′); Chisos Mountains, Burnhams Ranch (4000′); Davis Mountains State Park (5000′); Ft. Davis (4700′) W. M. Wheeler; Alpine (4500′); San Angelo (1850′) W. M. Wheeler; Pyote 2600′); Langtry (1300′) W. M. Wheeler; Del Rio (950′) W. M. Wheeler; Juno, Cornell Univ. Exped.; Austin, Mt. Barker (640′) TYPE LOCALITY W. M. Wheeler.

OKLAHOMA: Wichita National Forest, W. Fisher; Harmon County, W. Fisher.

Pogonomyrmex (*Ephebomyrmex*) *pima* Wheeler:

ARIZONA: 5 miles south of Wickenberg (1800′); Tempe (1100′) W. M. Wheeler; Phoenix (1100′) W. M. Wheeler; Florence (1500′) W. M. Wheeler; Casa Grande (1500′)

W. M. Wheeler; 8 miles north of Casa Grande (1500′); 5 miles east of Aguila (2200′); 20 miles east of Gila Bend (2700′); Organpipe Cactus National Monument, Headquarters (1600′), Dripping Spring (1700′), Abra Wash (1300′), Quitobaquito (900′); Tucson (2400′) TYPE LOCALITY W. M. Wheeler; Bowie (3750′) W. M. Wheeler; Continental (2900′) no collector.

SONORA: 10 miles south of Sonoyta (1400′); 5 miles south of Santa Ana (2500′); Puerto Gonzalitos (2500′); 10 miles south of Hermosillo (700′); 33 miles north of Guaymas (500′); 15 miles north of Guaymas (100′); 5 miles south of Peon (sea level).

I have omitted from this list the extraordinary record for *pima* carried by Olsen (2) in his 1934 study of *Pogonomyrmex*. Among the Arizona stations Olsen gave "Mt. Lemmon, South Catalina Mts., 8000-9150 feet." Mt. Lemmon is the main peak in the Santa Catalina Mountains just north of Tucson and has a height of 9185 feet. The writer has collected there on several occasions and can state that there is scant likelihood that *pima* could occur above the 3000 foot level. That it could live above the 8000 foot level is out of the question. Above 8000 feet Mt. Lemmon supports a fairly heavy stand of conifers. At its higher levels Mt. Lemmon is certainly not the place where one would expect to find a strict xerophile such as *pima*. It is possible that the specimens on which Olsen's record was based were winged forms, carried by updrafts to the crest of Mt. Lemmon. But if they were workers it is evident that the specimens were incorrectly labelled as far as elevation is concerned. It also seems probable that the record from Bowie, attributed by Olsen to *pima*, is actually *imberbiculus*. As may be seen from the foregoing list, all other records for *pima* come from stations below 3000 feet and well to the west of the latitude of Bowie.

By comparing the locality lists for *imberbiculus* and *pima* it is easy to appreciate that the former species is decidedly more adaptable. The lateral range of *imber-*

biculus exceeds that of *pima* both east to west and north to south. The vertical range of *imberbiculus* is almost twice as great as that of *pima,* for although *imberbiculus* does not descend to sea level, as *pima* does, it is capable of reaching levels above 6000 feet, while *pima* rarely reaches the 3000 foot level. The more restricted range of *pima* makes it easy to place that species in the Sonoran Desert biotic association as defined by Shreve (5) but no such single association is possible in the case of *imberbiculus.* Most of the middle of the range of *imberbiculus* lies in what Shreve calls the Chihuahuan Desert, a biotic association found on the Mexican plateau and adjacent portions of west Texas, New Mexico and Arizona. But it is scarcely possible to consider the stations in central Texas and Oklahoma in this category and those in western Arizona, Sonora and California are clearly in the Sonoran Desert association. It thus appears that the distribution of *imberbiculus* spans at least three different biotic areas.

It is interesting to contrast the distribution of *imberbiculus* and *pima* with that of *Novomessor cockerelli* and *albisetosus,* since the latter two xerophiles occur in many of the stations where *Ephebomyrmex* is present. The writer has attempted to show (6) that the distribution of our two species of *Novomessor* is largely determined by their response to elevation. There can be no doubt that elevation is also a highly important factor in the case of *imberbiculus* and *pima.* The response of *imberbiculus* to elevation is very similar to that of *N. cockerelli* hence it is not surprising to find that the two species occur together over a very large area from western Texas to western Arizona and south along the Mexican plateau as far as Durango. With certain restrictions this range is true of *N. albisetosus* also. But *pima* behaves in an entirely different fashion. Its distribution is limited to Arizona and Sonora and in those states it occurs only in stations of low to moderate elevation. It is hard to escape the conclusion that this behavior is a result of the different elevational range possessed by *pima.* Since the upper limit of this range appears to be in the neighborhood of 3000 feet it follows that *pima* would, on this basis alone, be unable to utilize stations on the Mexican plateau or similar areas to the north of it. I do not for one moment maintain that elevational range is the only factor that restricts *pima* to the Sonoran Desert region but it would surely seem to be one of the more important factors which go to determine this range.

I wish now to consider the habits of *imberbiculus* and *pima*. It is much to be regretted that Wheeler did not content himself with the excellent account of the habits of *imberbiculus* which he published in 1902 (7). All the nests on which Wheeler's original account was based were found under stones and each nest contained very few workers. Beneath the stones Wheeler discovered small chambers containing unhulled seeds and others full of brood. When transferred to artificial nests the *imberbiculus* workers made no effort to utilize the seeds as long as they were supplied with insect food. But when the supply of insect food was cut off the workers hulled the seeds and not only ate them but also fed pieces of them to the larvae. Wheeler was soon aware (8) that his original nests of *imberbiculus* had been exceptional in that they were built under stones, for he discovered other colonies at San Angelo, Texas, where the nests were free in the soil and surmounted by small craters. But it may be said that at the start Wheeler presented a very accurate picture of the nesting habits of *imberbiculus*. It is, therefore, difficult to explain why he obscured this picture in 1910 (9) by grouping *imberbiculus* and *pima* with other species of *Pogonomyrmex* with which they have little or nothing in common. In his celebrated volume *Ants* (page 283) Wheeler makes the following observation:

"1. *P. subdentatus, apache, sancti-hyacinthi* and *desertorum* and *Ephebomyrmex imberbiculus, townsendi* and *pima*. These are small species confined to the deserts of Texas, New Mexico, Arizona, Californa and northern Mexico. Their colonies are always insignificant and widely scattered, comprising only a few individuals. The nests are small, obscure craters, 10-20 cm. in diameter and a few centimeters high. The workers make no attempt to cut down the surrounding vegetation which often grows on the crater immediately around the entrance."

It is hard to see what Wheeler had in mind here. Neither *subdentatus* nor *apache* (or its synonym *sancti-hyacinthi*) are small species. Indeed the major worker of *apache* is one of our largest species, being surpassed in this respect only by the major of *badius*. While the number of individuals in a nest of *apache* is small, there is ordinarily no crater nor disc around the nest entrance and this paucity of excavated material is, as Cole has recently shown (10), one of the characteristics of this species. The colonies of *subdentatus* ordinarily contain at least 500 individuals and this species usually constructs a ragged disc of gravel, not a crater, around the nest entrance. The nests of *desertorum,* while less populous than those of *subdentatus,* are far larger than those of *imberbiculus* and *pima,* and the coarse, flattened gravel mounds which *desertorum* customarily makes are wholly unlike the delicate craters constructed by our representatives of *Ephebomyrmex.* I mention these inconsistencies because it is certain that they have obscured Wheeler's original clear-cut presentation of the habits of *imberbiculus.*

As far as the writer has been able to determine the habits of *imberbiculus* and *pima* are so similar that a single account will cover both species. On rare occasions these ants will nest beneath stones but in most cases they build their nests without any covering object. The soil selected is always hard-packed and usually of a rather fine, sandy texture. There is a single, small nest entrance not more than 3 or 4 mm. in diameter, and the passages which lead from it are equally delicate. The storage chambers are small. Both the storage chambers and the passages collapse very easily if the nest is excavated and this makes it unusually difficult to trace them. The only practical method for doing so that the writer has found is to excavate the nest very gradually and allow time between excavations for the workers to reopen the caved-in passages. If three or four days can be devoted to the process it is possible to follow the passages to their ends. There are usually not more than three or four of them and the length of any passage seldom exceeds five inches. The soil brought to the surface by the ants is usually very fine and the crater formed from it is easily dispersed by rain or wind, hence many nests are without a crater much of the time. Most of the craters measured by the writer were 2½ inches or less in diameter. There are seldom more than 75 workers in a nest. The average number seems to be about 50. The workers store both seeds and the remains of other insects, especially other ants. In view of the lack of pugnacity of our species of *Ephebomyrmex* it seems safe to assume that such stores of insect remains are secured by scavenging rather than by attacks on living victims. Seeds are stored unhulled and several sorts are accepted. One colony kept in an artificial nest preferred white clover seed to grass seed. The slow hulling of the seeds prevents the formation of a chaff pile for the hulls, which are discarded outside the nest entrance, are dispersed before they can accumulate into a chaff pile.

As Wheeler noted, it is unusually difficult to secure sexual forms. Since he observed a marriage flight of *imberbiculus* near Deming, New Mexico, on July 12th (13), and since the writer secured a colony of *imberbiculus* containing callow males and females in the Davis Mountains of Texas on May 25th, it might be expected that alates would ordinarily be present in the nests of this species during the month of June. Actually this is seldom the case and as *imberbiculus,* like many xerophilous ants in the southwest, apparently holds its marriage flight shortly after the onset of the summer rains in early July, the absence of alates in many nests during the month of June may mean that *imberbiculus* produces sexual brood only in especially favorable years. The pupal males and females show a surprising capacity for moving their appendages prior to transformation. The workers fail to remove all of the pupal exuviae from the alates when the latter transform, and the patches of pupal casing which adhere to the newly emerged males and females give them the appearance of a person peeling after a bad case of sun burn. Wheeler calls these ants "timid" but perhaps it would be better to describe them as docile. They do not seem particularly frightened when they are disturbed and they make little effort to escape and none to sting. The writer has picked up hundreds of specimens and has yet to be stung by one of them. This seems rather curious, since these ants are provided with a powerful sting, despite their small size. The sting is fully two-thirds as long as that of the smaller workers of *barbatus,* a species which stings atrociously, and certainly the presumption would be that *imberbiculus* and *pima* could use their stings effectively if they chose to do so. These ants forage at least ten months a year and probably, in a mild winter, all year long. When foraging they move at a slow but steady gait. They usually forage singly.

There follows the description of the female of *imberbiculus,* which has not hitherto been described or figured: The features cited in this description are those which could not be shown in the figure:

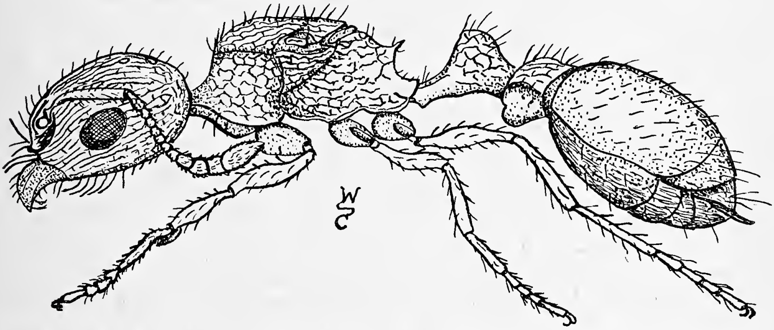

Fig. 1. Female of *Pogonomyrmex* (*Ephebomyrmex*) *imberbiculus* Wheeler.

Length of head (mandibles excluded) 1.2 mm.; length of thorax 1.75 mm.; overall length 4.5- 5 mm. The sides of the head behind the eyes slightly narrowing toward the occiput. Occipital border slightly concave in the middle. Middle of the clypeus scarcely projecting beyond the two prominent teeth which stand in front of the antennal fossae. Mandibles armed with five prominent teeth which decrease in size from the apical tooth inward, and a single much smaller tooth at the angle between the masticatory margin and the inner margin. The antennal scape in repose reaches the level of the lateral ocellus. Base of the scape with a conspicuous flange. Frontal lobes rather narrow in front, only slightly divergent behind and not projecting much above the antennal fossae. Frontal area large and crossed by a single median ruga. Clypeus with five longitudinal rugae. Color, when alive, a deep, ferrugineous red which fades to an orange red as the specimen dries.

Gynetype: a female from Arsarca Canyon, Chinati Mountains, Texas, in the writer's collection. A second female from the Davis Mountains, Texas, agrees well with the type in the characters cited above.

It seems worth commenting here on Wheeler's original concept of the diagnostic features of the subgenus *Ephebomyrmex.* As his principal criterion for establishing the group Wheeler cited the absence of a beard or psammophore on the under surface of the head. In the figure of *imberbiculus* which accompanied the original description of the worker of that species, (7) Wheeler made no attempt to depict the pilosity, either on the gula or elsewhere. But in the description he noted the presence of a group of erect hairs on the gula which did not form a "conspicuous" beard. In this stand Wheeler seems to have been influenced by Forel, who had set up a subgenus to receive the beardless species *mayri* (11). But the gular hairs of *P. mayri* are uniformly short and even those at the anterior edge of the gula do not project much beyond it. They cannot by any stretch of imagination be said to form a psammophore. Unfortunately this is not the case with all the species of *Ephebomyrmex.* Oddly enough Wheeler's two species *imberbiculus* and *pima* are the worst offenders in this respect. Each has a small, median psammophore on the anterior half of the gula which runs diagonally inward toward the midline of the head. It may be admitted that these groups of hairs are less regular in arrangement and much less conspicuous than the linearly-arranged lateral psammophores of some of the other species, but it certainly cannot be said that the gular pilosity of *imberbiculus* or *pima* is as scant as that of *mayri.* While our species of *Ephebomyrmex* do not have full beards, they certainly do have goatees, hence Wheeler's distinction is one of degree, not of kind. There can be little question that when Emery stated in 1921 (12) that the subgenus *Ephebomyrmex* is an artificial group, he had the above facts in mind. Emery pointed out that neither the absence of a psammophore nor the presence of a toothed epinotal flange at the insertion of the petiole distinguish the members of *Ephebomyrmex* from certain intermediate species ordinarily assigned to the subgenus *Pogonomyrmex.* Emery cited the South American species *silvestrii* and *brevibarbis* in this connection but he could have mentioned the North American species *huachucanus* with equal propriety. The psammophore in both worker and female of *huachucanus* is transitional both in degree of development and position. The hairs which form it are fairly long and, for the most part, linearly arranged, but this line of hairs runs diagonally inward from the insertion of the mandible to a point at the middle of the head which is a little in advance of the rear border of the gula. This gives a V-shaped median psammophore which is quite unlike that of most species in the subgenus *Pogonomyrmex,* where the hairs of the psammophore are arranged in a line along the outer edge of the gula and turn in toward the center of the head at its rear edge.

One can agree with Emery that the criteria which Wheeler used for the recognition of *Ephebomyrmex* are not well-chosen and one can further agree with him that substantial improvement in the situation will necessitate a better acquaintance with the sexual forms of this group. In this connection the writer would like to call attention to one interesting feature in the thoracic structure of the female of *imberbiculus.* The scutellum of the female of *imberbiculus* does not rise abruptly above the metanotum. Instead its rather thin rear edge forms, with the metanotum and the basal face of the epinotum, a single, sloping declivity which is broken only by the sutures at either side of the metanotum (see figure). In all species belonging to the subgenus *Pogonomyrmex* where the writer has been able to examine the female (*apache, badius, barbatus, californicus, huachucanus, occidentalis* and *subdentatus*), the scutellum rises well above the metanotum. This rise is usually abrupt and sometimes the rear face of the scutellum overhangs the metanotum. There is thus a break in the outline of the thorax at the metanotum and the dorsum of the scutellum is always at a level well above that of the metanotum or the anterior edge of the epinotum. As to whether these distinctions will hold uniformly through both subgenera remains to be seen, but if they do there should be less difficulty in defending the status of *Ephebomyrmex* as a valid subgenus.

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A NEW GENUS AND NEW SPECIES OF CHRYSOPIDAE FROM THE WESTERN UNITED STATES, WITH REMARKS ON THE WING VENATION OF THE FAMILY (NEUROPTERA)[1]

By Phillip A. Adams

Harvard University

In some material collected by the writer in southern Arizona in 1949, a single female specimen of a chrysopid was found, representing a previously unknown genus and species. The venation of this genus is remarkably like that of the Chrysopidae described from the Miocene shales of Colorado. Two other recent genera, *Triplochrysa* Kimmins and *Dictyochrysa* Petersen, similarly retain an archaic type of venation. Since these latter two genera have not been discussed in the light of the interpretation of the venation given by F. M. Carpenter (1935), they are compared in this paper with the new genus and with the Miocene genera.

Pimachrysa, new genus

Head: vertex moderately elevated; anterior tentorial pits large; labrum emarginate. Antennae slightly longer than fore wing, scape short, moderately swollen; flagellum filiform, the segments slightly longer than wide. Tarsal claws simple, without basal tooth. Fore wing: costal area rather narrow; subcostal cross-vein basad of origin of Rs; Rs arises basad of first intra-median cell. Intra-median cell subtriangular, with apex toward base of wing. Second medio-cubital cross-vein located proximally to furcation of MP. Two graduate series; Psm merges with inner series, strongly zig-zagged; Psc merges

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[1] Published with the aid of a grant from the Museum of Comparative Zoology at Harvard College.

with outer series, not so strongly zig-zagged. Anals not forked, run in a smooth curve to margin of wing. Jugal lobe prominent, one jugal vein present. Hind wing: jugal process small, costal area narrow. MP fused with Rs for a short distance, basal Banksian cell unusually large. Two gradate series; Psm weakly differentiated from inner gradates, not so strongly zig-zagged as in fore wing. Psc merges with outer gradates as in fore wing.

Generotype: *Pimachrysa grata* n. sp.

This genus is similar in its venation to *Triplochrysa* Kimmins, from which it may be distinguished by its having the first intra-median cell closed apically by a cross-vein, and by the occurence of only two gradate series in both wings.

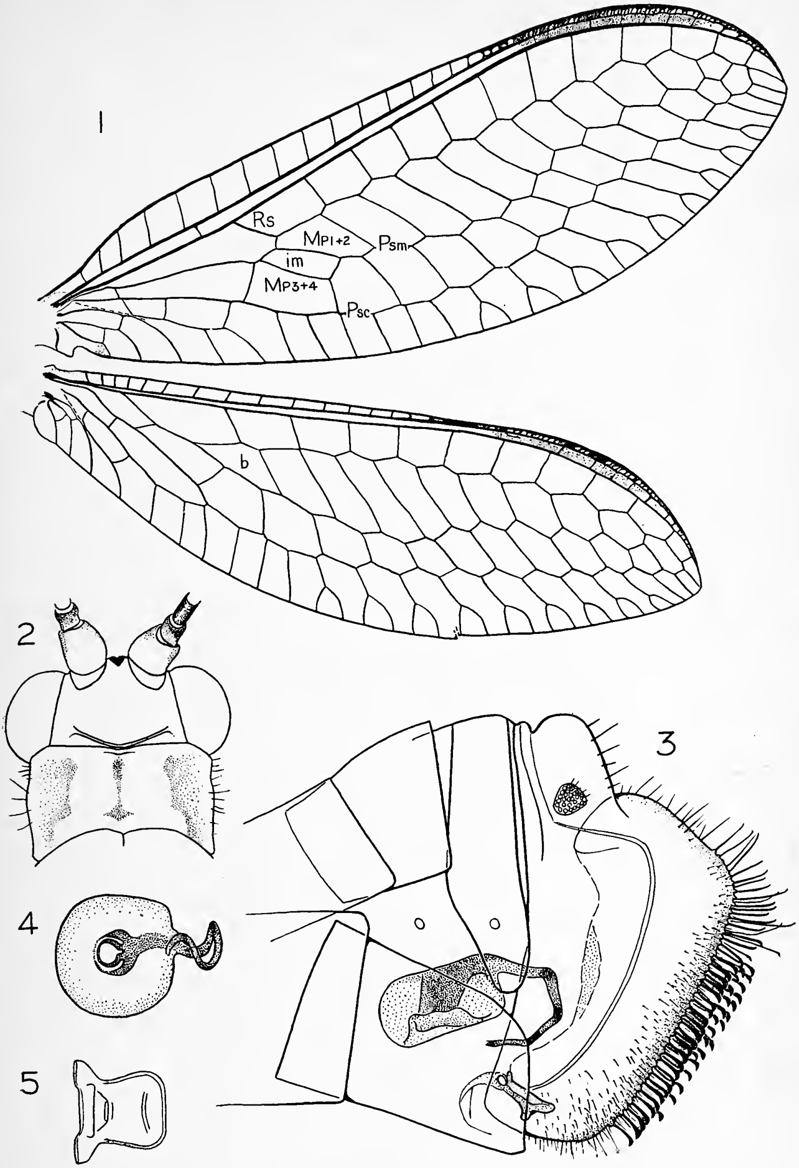
Pimachrysa grata n. sp.

Figs. 1-5

Head straw yellow, a shallow groove between bases of antennae black; maxillary and labial palpi pale at base, penultimate segment fuscous, last segment black. Antennae stout; scape pale, with medial, ventral, and lateral surfaces infuscated distally; condyle appears as dark longitudinal line on medial surface; pedicel short, black; flagellum black. Pronotum wide, anterior margin straight; whitish yellow with three fuscous stripes slightly convergent anteriorly. Meso- and metanota yellow, scuta infuscate posterolaterally. Cervical sclerites black; meso- and metapleurae bright yellow, with many areas fuscous. Legs ivory white; femora with a wide fuscous band before the knees. Tibiae slightly infuscated on lateral surface just beyond knee; tarsi a uniform light brown, last segment much darker than preceding. Legs uniformly clothed with short, dark, setae.

EXPLANATION OF PLATE 2

Pimachrysa grata n. sp. Fig. 1. Wings; im, first intra-median cell; Psm, pseudomedia; Psc, pseudocubitus; b, basal Banksian cell. Fig. 2. Dorsum of head and pronotum. Fig. 3. Terminal abdominal segments of female (lateral view). Fig. 4. Spermatheca (ventral view). Fig. 5. Subgenital plate (ventral view).



ADAMS — PIMACHRYSA GRATA

Wings: membrane hyaline, veins slender, setae few, short. Fore wing: costa fuscous near base, otherwise pure white completely around wing. Costal veinlets dark-fuscous; Sc white, slightly fuscous basally; R pure white its whole length; stigma white, costal area of stigma densely clothed with short dark setae. All other veins in basal area of wing white as far out as the cubital fork, thence becoming uniformly dark-fuscous. Hind wing: colored about as in fore wing, but with a slightly more extensive area of white veins. Venation as in Figure 1.

Abdomen: short, slender, with terminal segments greatly enlarged. Pale yellow above, with narrow median fuscous stripe, most prominent on second tergite, where it forms an elongate diamond-shaped mark. Sternites brown-fuscous with large central area and posterior margins yellow. Genitalia as in Figures 3-5. Gonapophyses laterales bear on their posteroventral margins three rows of heavy bristles having the ends broadened and strongly reflexed.

Length of antennae, 16 mm.; fore wing, 14 mm.; hind wing, 12.5 mm.; expanse 28.7 mm.; length of body, 7.5 mm.

Holotype: Madera Canyon, Santa Rita Mts., Arizona, 26 August, 1949, at light. P. A. Adams, collector. In the Museum of Comparative Zoology.

Pimachrysa appears to represent one of a group of relict genera with extremely primitive venation. Carpenter (1935) has revised the fossil Chrysopidae of the Tertiary; the resemblance of these forms to *Pimachrysa*, and to *Triplochrysa* and *Dictyochrysa*, is striking. These three genera are, without doubt, the most primitive of known living chrysopids, at least as regards the wing venation.

A characteristic common to these three genera, differentiating them from both the Tertiary forms and other Recent forms, is the position of the second medio-cubital cross-vein, basad of the furcation of MP. With the exception of *Hypochrysa*, in all other genera known to the writer, if this furcation is present, the cross-vein connects MP $3 + 4$ and CuA. Whether this basal position is a primitive or a specialized condition is debatable.

Paleochrysa, which is otherwise the most primitive described genus, has the quadrangular first intra-median cell characteristic of more advanced genera such as *Nothochrysa.* On the other hand, the occurence of an intra-median cell formed as in *Pimachrysa, Triplochrysa,* and *Dictyochrysa,* in such widely separated areas as North America and Australia, would seem to indicate that the basal position of the second medio-cubital cross-vein was broadly distributed in the past. It is entirely possible that the basal position has been secondarily derived; however, the simple bifurcate condition of MP found in these genera certainly appears to represent the more primitive situation. *Paleochrysa, Nothochrysa, et al.*, may then be representative of steps that have occurred in the evolution of more advanced genera, which possess a triangular cell, derived from the quadrangular first intra-median cell by fusion of MP $1 + 2$ and MP $3 + 4$. The apex of this type of triangle is directed apicad, not basad as is that of *Pimachrysa.* In *Hypochrysa,* since MP $3 + 4$ fuses with MP $1 + 2$ as in *Chrysopa,* the basal position of the cross-vein is presumably secondarily derived.

The first medio-cubital cross-vein of the fore wing is a remnant of a prominent medio-cubital y-vein, and is present in all recent Planipennia. Its absence from several of Carpenter's drawings of the Miocene genera seemed significant when viewed in the light of Kimmins' speculation (1952b) that, in the Apochrysinae, the cross-vein found replacing it in its usual position represents instead the remnant of MP $3 + 4$. An examination of the fossils used in the preparation of these drawings demonstrated, however, that this cross-vein is present in all three of the Miocene genera, and is located in its usual place, opposite the cubital fork.

The subcostal cross-vein has been omitted in Carpenter's drawings, with the exception of Figure 2 (*Paleochrysa fracta*), in which it should be located slightly distad of the first radial cross-vein, instead of where shown. In *Paleochrysa,* this cross-vein is always located approximately opposite the first radial cross-vein; in *Tribochrysa* and *Lithochrysa,* it is much closer to, but still distal to, the origin of Rs. In *Dictyochrysa,* it is barely proximal to Rs, while in more advanced forms it progresses toward the wing base. The position of this cross-vein in the genera herein treated correlates well with the degree to which archaic venational features are represented. Unfortunately, Martynov's illustration of the Jurassic *Mesypochrysa* does not include this vein; it would be interesting to see if it then occurred still farther out on the wing than in *Paleochrysa.*

The distad progression of the origin of Rs in the fore wing has been discussed by Carpenter. In all three of the recent relict genera, as would be expected, Rs originates basad of the fork of MP.

Members of the Jurassic family Mesochrysopidae demonstrate various degrees of development of the Pseudomedia and the Pseudocubitus. *Mesypochrysa* has a well-developed double gradate series, but both branches of MP run straight toward the wing margin; there is consequently no trace of a Psm or a Psc. *Mesochrysa,* because of its apically fused Sc and R, which results in a rather myrmeleontiod appearance of the wing apex, is to be considered as a specialized side-branch of the chrysopid stem. In this genus, however, both branches of MP show a tendency to turn posteriad, and a weakly developed Psm and Psc are present. The Miocene genera all have developed the strong elbow in the branches of MP characteristic of modern genera; *Triplochrysa* and *Dictyochrysa* represent a more primitive condition in this respect, the branches of MP running posteriad in an even curve. Psm and Psc are well developed in the Miocene forms, but retain the archaic zig-zagged condition; Psm in both wings runs into the inner gradate series. In *Triplochrysa,* the course of Psm has shifted somewhat toward the margin of the wing, and a third, inner, series of gradates occurs. Psc remains in a relatively unspecialized condition, merging with the outer gradates, and showing fairly strong zig-zagging. Psm in more specialized genera has a strong tendency to straighten, so that zig-zagging disappears;

in genera such as *Nothochrysa,* this "vein" merges with the outer gradate series, turning up slightly near its end. As the straightening tendency reaches its culmination, e.g. in *Chrysopa,* Psm runs straight to the margin of the wing, and turns slightly downward near its end. Psc in genera such as *Chrysopa* may become straightened out basally, and is interrupted by Psm apically.

The writer feels it most unlikely that, as suggested by Kimmins, *Dictyochrysa* could possibly have been ancestral to *Triplochrysa.* Admittedly, its venation reflects a most archaic condition. However, in the Planipennia, certain groups frequently become specialized by the multiplication of the number of cross-veins or branches of the longitudinal veins. Examples of this which come readily to mind are the Psychopsidae, *Drepanopteryx* (Hemerobiidae), and the Palparinae (Myrmeleontidae). These forms frequently retain a most archaic arrangement of veins, and hence furnish quite useful evidence for venational studies. The retention of these primitive characters, however, is not an indication that these forms are unspecialized and therefore eligible to be considered as ancestral to other groups. It is a result of a high degree of specialization by emphasis upon an amplification of the original system of venation, rather than specialization by reduction, or by modification of original pathways of veins by fusion. *Dictyochrysa* appears to constitute a case of this kind. There is no evidence that the network of hexagonal cells in the apical part of the wings is a primitive character; on the contrary, all the fossil forms have a relatively simple venation, with a normal number of cross-veins, and with oblong cells like those of modern representatives of the family. There is therefore no reason to assume that the simple venation of the fossil forms has become complex, as seen in *Dictyochrysa,* with subsequent reduction to the condition of simplicity seen in *Triplochrysa.*

It is the writer's opinion that consideration of the venational trends discussed above — the progression basad of the subcostal cross-vein, the apicad migration of Rs, the formation of the first intra-median cell, and the relationship of the gradates with Psm and Psc — can furnish much useful information concerning the phylogeny of the Chrysopidae. The archaic expression of these characters in the Recent genera *Dictyochrysa*, *Triplochrysa*, and *Pimachrysa* indicates that they constitute an extremely primitive, although not necessarily closely related, assemblage, similar in many respects to the Miocene genera.

The writer gratefully acknowledges the kindness of Prof. F. M. Carpenter in making possible the examination of fossil Chrysopidae from the collection of the Museum of Comparative Zoology.

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THE RELATIONSHIP OF TWO AFRICAN *Tetramorium* SPECIES (HYMENOPTERA: FORMICIDAE).—During 1955, Mr. Thomas Gregg, a student at Harvard University, made for me a small but select collection of ants in the vicinity of Epulu, Ituri Forest, in the Belgian Congo. The ants have been deposited in the Museum of Comparative Zoology at Harvard. Among the series were two nest samples of *Tetramorium,* of which the workers were a striking yellow in color, but with the alitrunk and petiole a contrasting blackish or piceous hue.

It was found that both series agreed in general with the description of *T. coloreum* Mayr (1901, Ent. Tidskr., 21: 273, worker; type loc.: Mungo R., Kamerun), while one of them corresponded more particularly to that of *T. coloreum* var. *postpetiolata* Santschi (1919, Rev. Zool. Afr., 7: 88, worker; type loc.: Penghe, Belgian Congo). The two series, while very similar at first glance, are distinguished by a number of characters. As noted by Santschi, *postpetiolata* has the postpetiole markedly broader than long and with a smooth and shining surface (in *coloreum,* not or just barely broader than long and with irregular longitudinal costulae or striae on the disc, extending onto the base of the gaster). Santschi also mentioned that the posterodorsal petiolar face is more rugose (and opaque) in *postpetiolata.* In addition, in my *postpetiolata* specimens, the petiolar node is distinctly thicker from front to rear, the alitrunk is narrower, lower and less suddenly constricted behind, and the propodeal and triangular metapleural teeth are both distinctly shorter than in *coloreum.* Also, in *postpetiolata,* the erect hairs are slightly longer, more abundant (particularly on petiole), more slender and have more tapered apices.

Since Santschi's chief distinctions appear to be maintained, and even supplemented, in the present sympatric samples, I am suggesting that *Tetramorium postpetiolatum* be granted **new status** as a species.

Mr. Gregg took the *T. coloreum* nest at Epulu from the upper side of a log covered with earth in the rain forest. The *T. postpetiolatum* series was taken in this vicinity, also in rain forest, in the soil beneath leaf litter. W. L. BROWN, JR., Museum of Comparative Zoology.

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PSYCHE

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THE BALTIC AMBER SNAKE-FLIES (NEUROPTERA)

By F. M. Carpenter[1]

Harvard University

The snake-flies, comprising the neuropterous suborder Raphidiodea, have had a long geological record. Like the scorpion-flies (Mecoptera), they appear to have been more extensively represented generically and specifically in previous geological periods than at present. They have been described from the Permian of Kansas and Russia (Carpenter, 1943; Martynova, 1952), the Jurassic of Turkestan (Martynov, 1925; Martynova, 1947), the Miocene of Colorado (Carpenter, 1936), and the Oligocene of the Baltic amber.

For some reason, they are exceedingly rare in the amber. Only one species has been reported in the literature up to the present time; this is Hagen's *Raphidia* (*Inocellia*) *erigena,* which was described just about a century ago (1854). My own efforts to secure amber snake-flies, extending over two decades, have yielded but four specimens. Since I have had these at hand for several years and especially since I have little hope of obtaining additional specimens in the near future, I am presenting here an account of this small collection.

Three species are represented by this new material: one of these is Hagen's *erigena,* which turns out to belong to *Fibla;* another is a new species of *Raphidia,* and the third is a very peculiar species, which I am assigning to *Inocellia.*

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[1] Published with the aid of a grant from the Museum of Comparative Zoology at Harvard College.

Family Raphidiidae

Genus *Raphidia* Linn.

This genus is now restricted, as far as is known, to the Old World, but it is well represented in Miocene deposits of Colorado (Carpenter, 1936).

Raphidia baltica, new species

Figure 1

Fore wing: length, 9 mm.; width, 2.5 mm.; costal space narrow, with only 5 crossveins (in type); pterostigma narrow. Hind wing: length, 8 mm.; width, 2.5 mm. Venational details are shown in the figure. Prothorax 2 mm. long, bicolored; body in general dark brown.

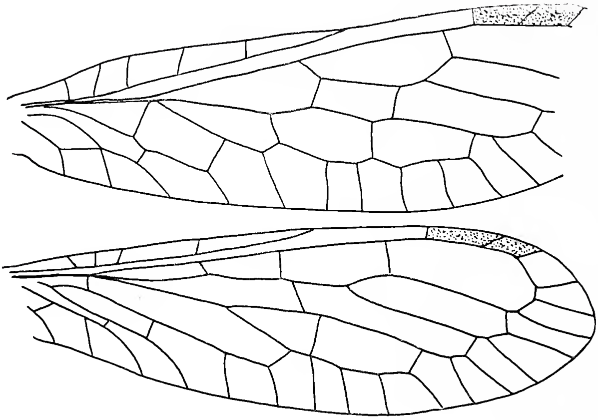

Figure 1. *Raphidia baltica,* n. sp. Fore and hind wings drawn from holotype, No. 5122, MCZ.

Holotype: No. 5122, in Baltic Amber Collection, Museum of Comparative Zoology. This is a complete female, in a somewhat distorted position, with the tip of the right fore wing broken away. This species is a typical *Raphidia,* as shown by the venational pattern, especially the nature of the basal piece of MA in the hind wing (see Carpenter, 1936). It is similar to several living species in its general appearance.

Family Inocelliidae

Genus *Fibla* Navas

Existing species of *Fibla* are known to occur only in parts of the Old World, although one extinct species has been found in the Miocene of Colorado.

Fibla erigena (Hagen)

Figure 2

Raphidia (*Inocellia*) *erigena* Hagen, 1854, Ver. Zool. Bot. Ges., 4:228; Hagen, 1856, in Berendt, Org. Reste, 2(2):83, plate 8, fig. 14.

Hagen's type of *erigena* is presumably lost, but two specimens in the Harvard collection undoubtedly belong here. They are the basis of the following account: Fore wing: length, 10-13 mm.; width 3.5 mm.; costal margin broad. Hind wing: length, 4.5 mm.; width 3 mm. Venational details are shown in the figures. Prothorax 1.8 mm. long, 1 mm. wide.

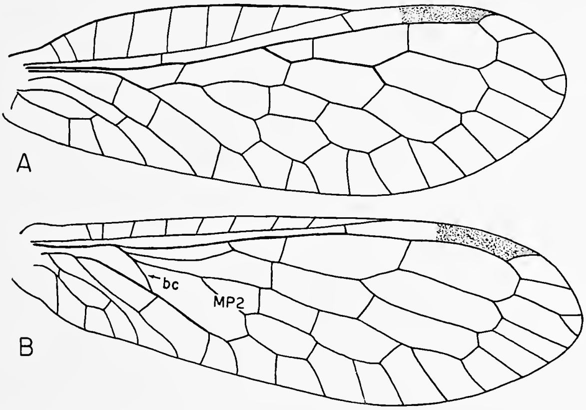

Figure 2. *Fibla erigena* (Hagen). A. Fore wing drawn from specimen No. 5120, MCZ. B. Hind wing drawn from specimen No. 5121, MCZ. For explanation of bc and MP2, see text.

The original Hagen specimen was apparently splendidly preserved; allowing for slight inaccuracies in Hagen's figure, I can recognize no significant differences between his insect and the ones now at hand, which are as follows: No. 5120, with the right wings, head and thorax very well preserved; the other wings and the abdomen have been broken away. No. 5121, a female, with the left wings and complete body (including ovipositor) well preserved.

This insect has the characteristics of an inocelliid, including the absence of ocelli and the pterostigmal crossvein and the presence of the forked MP2 and the rectangular head. Its assignment to *Fibla* is based on the nature of the basal piece of MA in the hind wing, as contrasted to that in *Inocellia* (see, for example, figure 2).

Genus *Inocellia* Schneider

This genus is widely distributed, mainly in the holarctic realm, but it includes relatively few species. Extinct representatives have not previously been known.

Inocellia peculiaris, new species

Figure 3

Fore wing: length 6 mm.; width 1.8 mm.; costal margin rather narrow, with only four crossveins. Hind wing: length 5.3 mm.; width, 1.6 mm.; the short vein (bc) from base of MP to CuA is perpendicular to CuA, not oblique. MP2 is without the usual fork occurring in inocelliids. Head, 1.4 mm. long; prothorax short, 1 mm. in length. General body color, dark brown.

Holotype: No: 5123; Museum of Comparative Zoology.

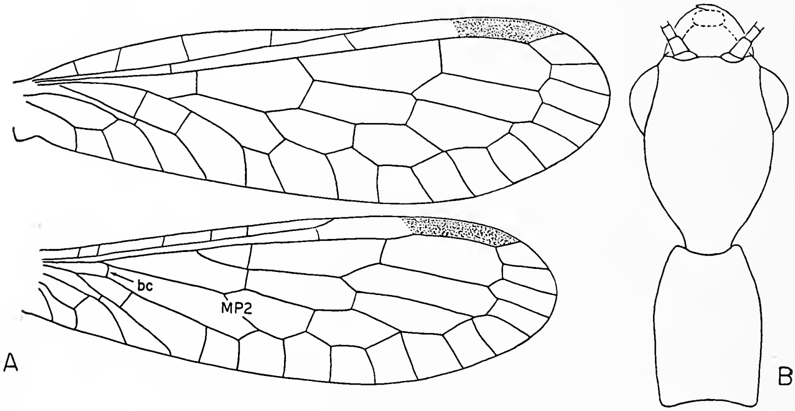

Figure 3. *Inocellia peculiaris,* n. sp. A. Fore and hind wings of holotype, No. 5023, MCZ. B. Head and prothorax of holotype. For explanaiton of bc and MP2, see text.

The specimen, a male, is well preserved, with all wings complete and the body structure showing in detail.

This species appears to have some features of both the raphidiids and inocelliids, and I have placed it in *Inocellia* only in preference to making a new genus for it. The ocelli are absent and the antennae are inserted well anterior to the compound eyes, as in the Inocelliidae; also, its pterostigma is without a transverse veinlet and the genital structures are inocelliid. On the other hand, the head is not so quadrate as that in living inocelliids, MP2 is unbranched, and the vein labeled bc is transverse, as in the raphidiids. Furthermore, the small size of the insect, with a wing expanse of 13 mm., is more like that of the raphidiids than of the inocelliids. However, I prefer not to erect a new genus for this one species, and since the more obvious characteristics, such as lack of ocelli and pterostigmal cross-vein, are inocelliid in nature, I have tentatively placed it in *Inocellia.*

Although the number of snake-flies known to us in the Baltic amber is still very small, it is interesting to note that the genus *Agulla* is not represented and that the genus *Inocellia* is represented by only a very peculiar species, which may, in fact, not belong there at all. This lends some weight to my previous suggestion (1936) that *Agulla* and *Inocellia* have evolved more recently than *Raphidia* and *Fibla,* which are well represented in the Tertiary of both the New World (Colorado) and the Old (Baltic amber).

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NEW ANT-LIONS FROM THE SOUTHWESTERN UNITED STATES (NEUROPTERA: MYRMELEONTIDAE)[1]

By Phillip A. Adams

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In the course of identifying material from the Southwest, the writer has encountered several new species and a new genus of Myrmeleontidae. Descriptions of these are given below, with a list and key to the species of the genus *Eremoleon* Banks. Sources of specimens are designated by the following abbreviations: CAS, California Academy of Sciences; CIS, California Insect Survey, University of California, Berkeley; UCD, University of California, Davis; UCR, University of California, Riverside; UCLA, University of California at Los Angeles; LAM, Los Angeles County Museum; MCZ, Museum of Comparative Zoology, Harvard. The kindness of the staffs of these institutions in lending material is gratefully acknowledged.

The terminology of the wing venation as used herein differs from the usual system (summarized by Markl)[2] in several fundamental aspects. Markl's study is an excellent and invaluable treatment of the comparative morphology of the wing of the ant-lions, but unfortunately his scope, a tribal revision, was so large as to have discouraged detailed investigation of venation in other families. The best clues to the homologies of the myrmeleontoid wing are to be found in the primitive myrmeleontoids — the Osmylidae and the Myiodactylidae. A thorough account of the reasons for the adoption of the present system will be given in a forthcoming paper, dealing with the venation of the order as a whole.

In both wings, MA has become coalesced with Rs; the "basal piece" (Figure 8, "b") is to be seen at the base of the fore wing between R and MP. In the hind wing the basal

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[1] Published with the aid of a grant from the Museum of Comparative Zoology, Harvard College.

[2] Markl, W., 1954, Verh. d. Naturforschenden Ges. Basel **65**:178-263.

part of MA is retained in the Osmylidae as a sinuate vein running between MP and Rs shortly after the latter has diverged from R; in the higher families this portion of the vein disappears. MA reappears, however, as the last branch from the "radial sector" (of previous authors, herein termed Rs+MA), differing often in being strongly convex, and branching much more than do the true branches of Rs. Comstock has termed the triangular sector which results from this branching the "radial cuneate area". Since the "radial sector" is a complex vein, the cross veins which lie behind it, between the base of the wing and its divergence from R, cannot be termed "radial cross veins"; they are in reality median cross veins. Because they have been used so much as a source of taxonomic characters, confusion might result in referring to them as median cross veins, hence the writer has adopted the term *presectoral cross veins* (Figure 8, "ps").

There has been much controversy over the homology of the cubitus in the hind wing, Comstock holding that the convex forked vein which appears analogous to the cubitus in the fore wing is actually $M_{3}+_{4}$. His system was based mostly on evidence from the tracheation and from the absence of the "oblique vein" ($MP_{3}+_{4}$) from the hind wing. This forked vein is homologous to what has been termed $MP_{3}+_{4}$ in the other superfamilies; but it is the belief of the writer that it is actually composed primarily of cubital elements. There is evidence which indicates that CuA_1 has, in the hind wing of all the Neuroptera, coalesced with M, resulting in a condition similar to that found in the Mecoptera, so that CuA_1 appears as the posterior branch of the vein which has been called MP. In this paper, the veins which Markl terms "A_1" and "A_2" are referred to as CuA_2 and $CuP+A_1$, respectively. In the ant-lions, A_1 is coalesced for a short distance with CuP; the base of A_1 although weak, is visible. Markl seems not to have noticed the double nature of this vein, although he shows the base of A_1 correctly in his figure 45. In the Osmylidae this coalescence has not taken place. The term *inner cubital veinlets* as used herein is equivalent to "anal veinlets" of previous authors.

Few workers have made reference to the internal male genitalia when doing taxonomic work on the Mymeleontidae. The writer has found that the structure of the gonarcus, and especially of the parameres, furnishes most useful characters; accordingly these are illustrated for all the species treated below, when male material was available. Within a species, there seems to be little variation in their size and structure; unfortunately, it will sometimes be found that closely related species have almost identical internal genitalia. Tjeder's terminology[3] is used.

Dorsally, there is present an arched sclerite, the *gonarcus,* which bears at its apex a small hood-like structure, the *mediuncus.* Loosely articulated with the mediuncus are the *parameres,* which often are produced to form hooks. Ordinarily, these structures will be found to lie in a pouch between the bases of the *ectoprocts* ("male appendages"); occasionally, this pouch will be found everted (Figure 32). The genital opening is on the ventral side of this sac, its position being marked by a small sclerite (Figure 32, dotted lines). As eversion takes place, the spatial relationships of the sclerites change markedly. In some species (e. g. *Hesperoleon* and relatives) the parameres have a thin region near their middle, the *hinge,* where they may fold when the genital sac is inverted. Upon eversion, they straighten out, and the points of the hooks become more divergent.

The reader is cautioned that, because of this folding, it was not possible to draw all the figures from the same viewpoint, and that, as a result, several of the figures are distorted. The side view gives a much better impression of the shape of the parameres than does the rear view, for this reason. In *Eremoleon* the parts are fairly rigid.

For critical examination, it is necessary to remove the gonarcus and parameres from the abdomen; these can easily be teased out after boiling the tip of the abdomen in KOH. The genitalia are stored in glass vials containing glycerine, pinned beneath the specimen. If the corks are boiled in paraffine, there is less danger of the glycerine soaking through to corrode the pin. This can also be minimized by piercing the cork at a 45 degree angle, so that

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[3] Tjeder, Bo, 1954, Ent. Medd. **27**:23-40.

the glycerine will remain at the bottom of the vial whether the specimen is stored in a flat tray, or in a box placed vertically on a shelf.

Among the measurements given are the lengths of the pterothorax and the third abdominal tergite. These lengths can be measured easily and accurately; their ratio gives a value useful in describing the amount of abdominal elongation.

Although the size of the labial palpi varies considerably within a given species, the size and shape of the terminal segment tends to be quite characteristic. In this segment is a sense-organ,[4] to accomodate which it is swollen to a greater or lesser degree. In the male, the terminal segment is often smaller than in the female.

Genus *Eremoleon* Banks.

Banks, 1901, Trans. Am. Ent. Soc. 27:365; 1928, Bull. Mus. Comp. Zool. 68: 69-71; Proc. Calif. Acad. Sci. 4th Ser. **24**: 143-144.

This genus is still too poorly represented in collections to enable a full-fledged revision; the following is simply a list of the described species, with a key and such figures as may be found helpful in identification.

Key to the Species of the Genus *Eremoleon*.

1. A very slender species, the antennae about 1½ times length of head and thorax together; third abdominal tergite 1.4 times length of pterothorax ...... *longior*
— More robust, the antennae at most equal to length of head and thorax together; third abdominal tergite at most equal to length of pterothorax 2
2. A deep black mark on base of fore wing, mesepimeral wing process black .... *nigribasis*
— No such mark, mesepimeral wing process brown or yellow 3
3. $CuP+A_1$ in fore wing curved forward, margin curved outward, so that the space between is wider in middle than at ends; prothorax wider than long ... *mexicana*

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[4] Eisner, T., 1953, J. Morph. 93:109-122.

— $CuP+A_1$ in fore wing straight or sinuate, the space between wider at base than middle; prothorax longer than wide 4

4. Mesepimeral wing process dark umbraceous; 12-16 branches of $CuP+A_1$ in fore wing .... *macer*

— Mesepimeral wing process yellow; 11 or less, usually 8-9, branches of $CuP+A_1$ in the fore wing 5

5. Antennal segments longer than wide; antennae about as long as head and thorax together, the pedicel and scape black; wings heavily spotted .... *gracile*

— Antennal segments wider than long; antennae shorter than head and thorax together, pedicel and scape pale; wings only weakly marked 6

6. Large species (fore wing 30 mm., or longer); fore tibial spurs as long as 2 tarsomeres; all setae light brown .... *insipidus*

— Smaller species (fore wing 28 mm., or less); fore tibial spurs as long as 3½ tarsomeres; most setae on legs, and many on thorax, black .... *pallens*

Eremoleon macer (Hagen)

Figures 21, 30

Myrmeleon macer Hagen, 1861, Synopsis of N. Amer. Neur. :236

Eremoleon macer Banks, 1901, Trans. Amer. Ent. Soc. 27:365; 1928, Bull. Mus. Comp. Zool. 68:70; 1938, Carnegie Inst. Wash. Pub. 491:235

Segura vitreus Navas, 1914, Ent. Zeitung 28:18

In the Museum of Comparative Zoology there is a pair of specimens from Mexico (Apatzingan, Michoacan, 12,000 feet, Aug. 11, 1941, H. Hoogstral, and Jacala, Hidalgo, 4,500 feet, June 22, 1939, Ralph Haag) which are quite similar to *macer* in general characteristics, but which have more slender wings, with fewer presectoral cross veins in the fore wing (7 or 8, but about 10 in *macer*), and with more branches of $CuP+A_1$ in the fore wing; the vertex is dark pruinose, with two well-defined rows of spots in the Jacala specimen. The genitalia are like those of *macer*. Despite the differences from *macer*, it does not seem advisable to consider them distinct without more material from this area. Should it then appear that they are distinct, the name *mexicana* Navas might be appropriate. The wing shape and markings are similar to those of *mexicana;* in the Apatzingan specimen the anal area in the fore wing is widened like Navas' figure (Figure 1b), but not to such a marked degree. The vertex and pronotal markings do not agree well with the figure.

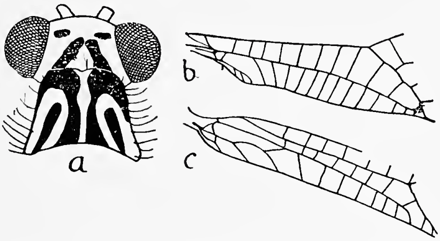


Figure 1. *Eremoleon mexicana* (Nav.) a. Head and prothorax, b. Axillary region of anterior wing, c. Axillary region of posterior wing (from Navas, 1925).

Segura vitreus has long been considered a synonym of *macer;* the description fits well except "Abdomen ♂ cercis manifestis, cylindricis," and "Abdomen longum, in ♂ alis longius . . .," characters which are not found in other species of *Eremoleon* or in related genera. Probably the type specimen, collected in 1871, has another abdomen affixed.

Eremoleon mexicana (Navas)

Figure 1 a, b, c

Novulga mexicana Navas, 1925, Mem. R. Acad. Ci. Artes Barcelona **19**:189-190, fig. 17.

Eremoleon macer Banks, 1936, Carnegie Inst. Wash. Pub. **491**:235

In all probability, this is *E. macer;* however, as mentioned above, the figure shows a differently shaped CuP+A_1 in the fore wing. According to the description, the wings are acute, and less prominently marked than in *macer,* there being only a small spot at the connection of CuP+A_1 and CuA_2, at the rhegma, and at the hypostigmatic cell. The hind wing is immaculate.

Eremoleon insipidus, new species

Figures 19, 20, 28

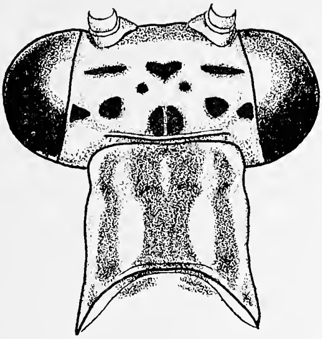
Head pale; a faint indication of an interantennal dark band; first row of vertex scars unpigmented — a dash on each side and double medial scar; behind is a pair of indistinct brown submedian spots; last segment of labial palpi large, strongly swollen (Figure 28); antennae pale, club infuscate, flagellar segments all broader than long. Pronotum gray-brown, a pair of small submedian spots before furrow; behind furrow a pair of wide median brown bands, broadly separated by pale posteriorly; a short lateral dark stripe each side. Nota mostly infuscate, a pair of broad brown stripes on mesoscutellum. Propleuron dark, mesanepisternum with a brown stripe below, rest of pleura pale; mesepimeral wing process light ochraceous. Coxae pale; a small basal brown spot; femora pale, very faintly spotted with brown; large apical brown spot on anterior side; tibiae lightly brown-dotted; tarsi pale. All setae, including long seta on fore femur, pale, darkest ones a light yellow brown in color. Fore tibial spurs only as long as 2 tarsomeres, hind spurs, 1½ tarsomeres.

First abdominal tergite pale, second dark with apical pale spot, third-sixth with small median pale spots at base and apex, and with large subbasal spot each side, broadly confluent medially and containing a dark spot each side. Apical tergites darker, with markings indistinct. Sternites pale to middle of 4th, beyond dark.

Venation largely pale; in fore wings most cross veins dark at ends; longitudinal veins dark where intersected by dark cross veins; each dark intersection surrounded by a small gray cloud in membrane; larger spots at apex of hypostigmatic cell, rhegma, and end of CuA_2. In hind wing venation paler, membrane scarcely marked, dark spots at apex of hypostigmatic cell and rhegma.

Explanation of Plate 3

Figures 3-7. Fig 3. *Hesperoleon minutus,* ♀, head and pronotum (Cathedral City, Calif.). Fig. 4. *H. infuscatus.* ♂, head and pronotum (Antioch, Calif.). Fig. 5. *H. fidelitas,* allotype, head and pronotum. Fig 5a. *H. fidelitas,* mesoscutellum. Fig. 6. *Eremoleon gracile,* holotype, ♀, head and thorax. Fig. 7. *Tyttholeon puerilis,* holotype, head and pronotum.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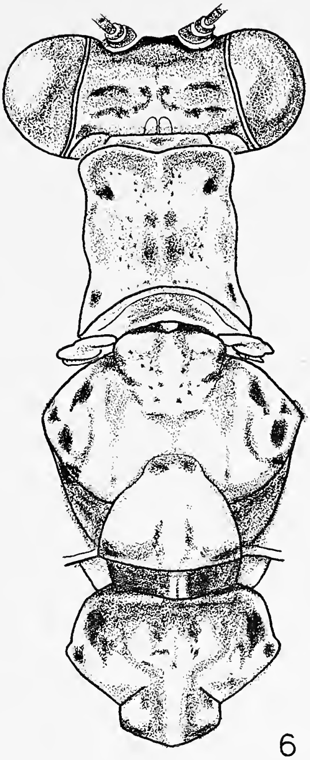
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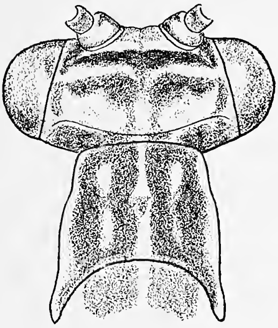
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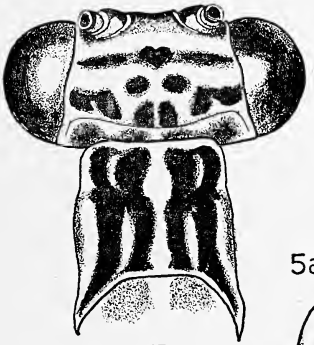
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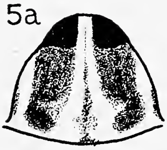
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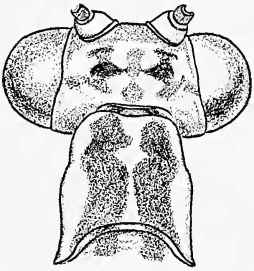
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Adams — Myrmeleontidae

Fore wing: broad, 5-7 presectoral cross veins, the last usually connected to first cross vein from RS+MA; 9-11 branches of RS+MA; 9-10 cross veins between CuA and CuP+A_1; 8-10 cross veins between CuP+A_1 and wing margin. Hind wing: cubital area broad, with four rows of cross veins.

Parameres (Figure 19) similar to those of *macer*, but the plates much farther apart, the inner margin strongly concave.

Body length, 24.-27.5 mm.; fore wing, length 30.5-35. mm., width 7.6-9.6 mm.; hind wing, length, 28.5-32. mm.; width 7.1-7.6 mm.; labial palpus, length 0.78 0.88 mm.; width 0.20-0.25 mm.; antenna 5.7-6.7 mm.

Holotype ♂: 5 mi. S. of San Miguel, L. Cal. VII-20-38, Michelbacher and Ross, in the Museum of Comparative Zoology. Paratypes: Riggs, Calif. 5-9-34 ♀, Sperry (MCZ); Borego Valley, Calif., VI-6-40, C. D. Michener (CIS); El Mayor, L. Calif., IV-19-39, 1♂ 1♀, E. S. Ross (CAS); Mejia Is., Angel de la Guardia I., Gulf of Calif.; VI-28-21, ♂, E. P. Van Duzee (CAS).

These specimens are an insipid pale brown in color, with few really distinct markings on head or thorax; nowhere is there any structure which is strongly pigmented — black is absent. The large, heavily swollen labial palpi (Figure 28) are characteristic. The holotype and the Mejia Isd. specimens are paratypes of *affine* Banks.

Eremoleon gracile, new species
Figures 3, 17, 29

Face pale; shiny dark interantennal band present, widely separated from first vertex row. First vertex row with a curved, dull black dash each side, and a pair of indistinct submedian brown dots; second row similar but fainter; behind a shiny black spot each side near eye, and an indistinct brown median mark. Labial palpi short, pale. Scape and pedicel shiny-black, flagellum slender, the segments slightly longer than wide, reddish brown, the tip strongly swollen, much darker.

Thorax mostly pale, notum marked as in Figure 3; meso- and metepisterna largely infuscate, epimera largely pale; expansion of mesepimeral wing process light yellow. Fore coxa pale with small basal fuscous spot; mid and hind coxae infuscate laterally; femora pale, very faintly dotted at base of some setae, apical shiny black bands; tibiae dotted with dark, bearing postbasal and apical black bands. Tarsi pale, 5th tarsomere narrowly dark-tipped. Fore spurs equal three tarsomeres, hind spurs two; setae mostly black, many white on femora.

First abdominal tergite pale with small dark preapical dot; second with pale basal band and apical dot; third-seventh dark-fuscous, a large pale spot each side, broadly connected medially, apical segments pale. First sternite with a black spot each side, second, third and base of fourth pale, apex of fourth, fifth, sixth and seventh fuscous.

Wings: venation as in Figure 17. Base of wing pale, venation largely pale, many cross veins dark wholly or at ends; longitudinal veins interrupted with dark at intersections of many cross veins; dark spots as indicated on figure.

Measurements (mm.): body length 21; abdomen 15; head and thorax 6.3; pterothorax 4.0; third abdominal tergite 3.4; antenna 6.8; fore wing 25.5 long, 6.6 wide; hind wing 24.0 long 5.5 wide; third segment, labial palpus 0.48 long, 0.12 wide.

Holotype ♀: Riverside, California, August 31, 1939, Paul De Bock (UCR): Deposited in the California Academy of Sciences.

Eremoleon nigribasis Banks

Figures 24, 27

Eremoleon nigribasis Banks, 1920, Bull. Mus. Comp. Zool. 64:329; 1928, *ibid.* 68:71; Proc. Calif. Acad. Sci., 4th Ser. 24:143

Eremoleon affine Banks, 1942, Proc. Calif. Acad. Sci., 4th Ser. 24:144, **new synonymy**
Utah, New Mexico, Arizona, Baja California.

The type of *E. affine* Banks, as well as the paratypes from 5 mi. S. of San Miguel and Venancio, Baja Calif., are pale individuals of this species in which the black mark on the wing base is indistinct or absent.

Eremoleon pallens Banks
Figures 18, 26

Eremoleon pallens Banks, 1941, Psyche 48: 101-102

The type series was collected from a mine shaft on Pichaco Peak, Arizona.

Eremoleon longior Banks
Figures 22, 23, 25

Eremoleon longior Banks, 1938, Carnegie Inst. Wash. Pub. 491: 235

A cave-dwelling species from Yucatan, Mexico. Its slenderness is combined with great fragility.

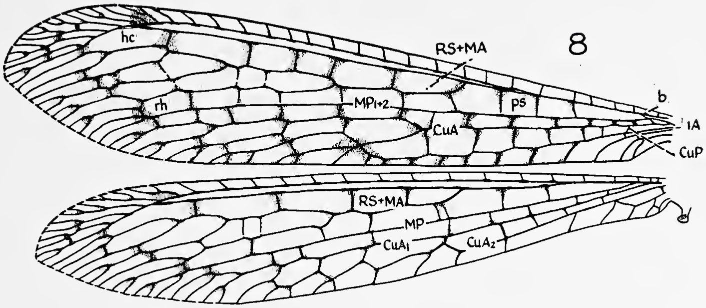
Hesperoleon texanus Banks
Figures 42, 43

Hesperoleon texanus Banks, 1903, Proc. Ent. Soc. Wash. 5:175

This species has not previously been recorded from California. California specimens are larger than more eastern specimens, with longer antennae. Oklahoma specimens have the third abdominal tergite 1.5 times the length of the pterothorax, while in the California males this ratio was 1.7 and 1.9. The difference in color is striking, the Southern California specimens being much darker. Material from Riverside shows a gradation in size down to that of typical *texanus*, and a ♀ from Olanche, California (MCZ), is intermediate in its coloration between the paler *texanus* and the darker southern specimens. Some means of measurements of the California specimens follow (in mm.):

Explanation of Plate 4

Figures 8-17. Fig. 8. *Tyttholeon puerilis*, ♂, wings: b— basal piece of MA, ps— presectoral cross veins, hc— hypostigmatic cell, rh— rhegma (San Felipe Can., Calif.). Fig. 9. *Maracandula bellula*, gonarcus and parameres, posterior view (Skyforest, San Bernardino Co., Calif.). Fig. 10. Same, lateral view. Fig. 11. *Tyttholeon puerilis*, gonarcus and parameres, lateral view (San Felipe Canyon). Fig. 12. Same, posterior view. Fig. 13. *Hesperoleon minutus*, holotype, apex of abdomen, lateral view. Fig. 14. Same, ventral view. Fig. 15. *H. minutus*, gonarcus and parameres, posterior view. Fig. 16. Same, lateral view. Fig. 17. *Eremoleon gracile*, holotype, wings.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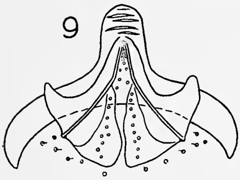
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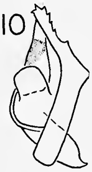
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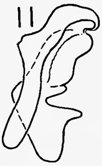
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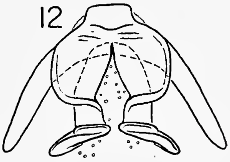
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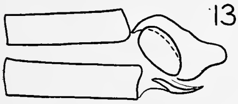
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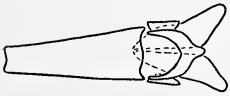
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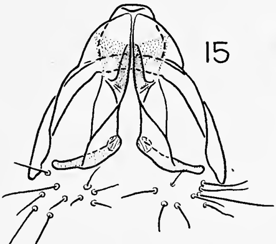
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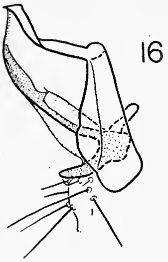
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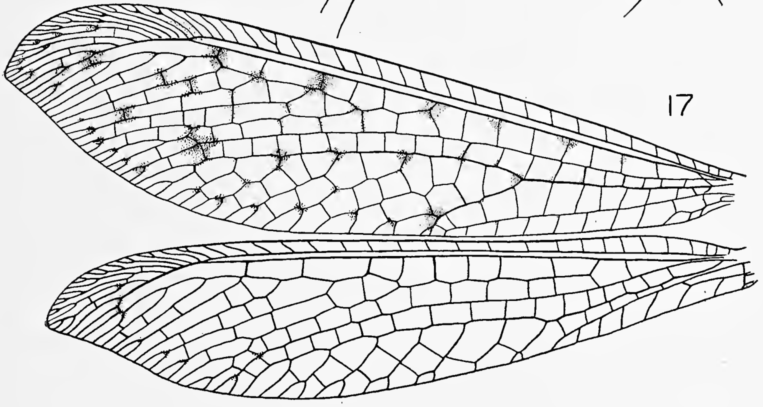
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ADAMS — MYRMELEONTIDAE

Body length, ♂ 37, ♀ 24; abdomen ♂ 30.2, ♀ 17.2; pterothorax ♂ 3.9, ♀ 3.7; fore wing, length ♂ 25.3, ♀ 24.2. width ♂ 6.6, ♀ 6.1; labial palpi (terminal segment) 0.76 long, 0.20 wide; antennae ♂ 7.25, ♀ 4.8; third abdominal tergite ♂ 7.2, ♀ 5.1.

In California, *texanus* is most likely to be confused with *H. niger* Currie, from which it can be separated by the dots on the mesoscutellum, and by the markings of the coxae (banded with pale in *texanus*, mostly black in *niger*). The gonarcus and parameres of these species are shown for comparison; *niger* (Figures 36, 37) has a conspicuously longer mediuncus, and lacks bristles on the lateral margin of the paramere between the hook and the hinge.

Calif. specimens examined: *Inyo Co.*: Olanche, ♀, F. A. Eddy (MCZ). *San Bernardino Co.*: Mill Creek, 6,000 ft., VII-23-29, ♂, P. H. Timberlake (UCR). *Riverside Co.*: Riverside IX-27, X-7, 8, 1948, 3 ♀♀, P. H. Timberlake (UCR); Keen Camp, San Jacinto Mts., IX-2-1950, ♀ (UCLA). *Los Angeles Co.*: IX-20-54, ♂, R. X. Schick (UCLA).

Hesperoleon fidelitas, new species

Figures 5, 5a, 33, 34

Face pale, occasionally a pair of dark dots on lateral mar-

EXPLANATION OF PLATE 5

Figures 18-32. Fig. 18. *Eremoleon pallens,* paratype. gonarcus and parameres, posterior view (Pichaco Peak, Ariz.). Fig. 19. *E. insipidus* holotype, gonarcus and parameres, posterior view. Fig. 20. Same, lateral view. Fig. 21. *E. macer,* gonarcus and parameres, posterior view (Cuernavaca, Mexico). On the right is shown a portion of the characteristic cobblestone sculpture on the surface of these plates in *Eremoleon.* Fig. 22. *E. longior,* paratype, gonarcus and parameres, posterior view (Xtoloc Cenoto Cave, Chitzen Itza. Yucatan). Fig. 23. Same, lateral view. Fig. 24. *E. nigribasis,* gonarcus and parameres, posterior view (Tucson, Ariz.). Fig. 25. *E. longior,* tip of right labial palpus (same specimen as Fig. 22). Fig. 26. *E. pallens,* paratype, ♂, tip of right labial palpus. Fig. 27. *E. nigribasis,* ♂, tip of right labial palpus (Douglas, Ariz.). Fig. 28. *E. insipidus,* tip of right labial palpus, holotype. Fig. 29. *E. gracile,* holotype tip, of right labial palpus. Fig. 30 *E. macer,* ♂, tip of right labial palpus (same specimen as Fig. 21). Fig. 31. *Hesperoleon deflexus,* holotype, gonarcus and parameres (everted), dorsal view. Fig. 32. Same, lateral view.

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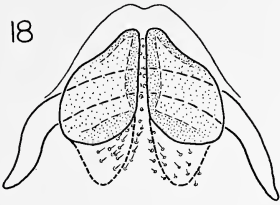

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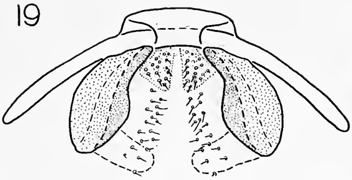

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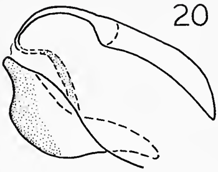

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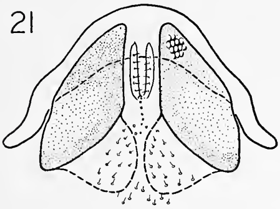

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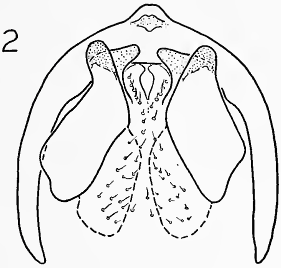

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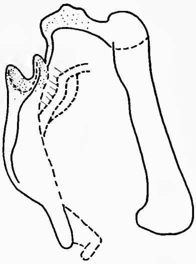

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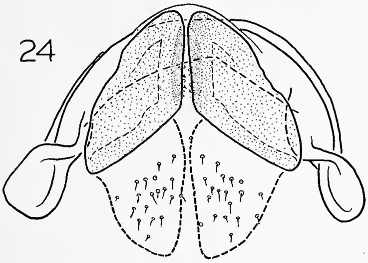

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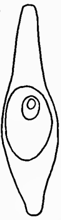

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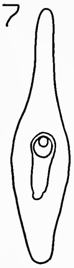

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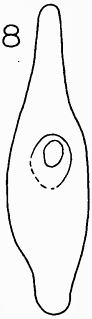

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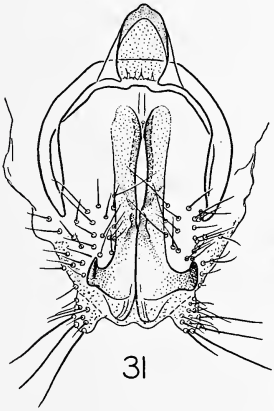
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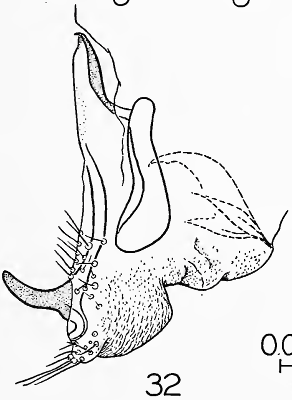
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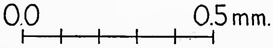

Adams — Myrmeleontidae

gins of clypeus; dark antennal band notched below, with prominent median extension, above widely separated from first vertex row. First vertex row a median triangle and a dash each side, often connected; second a pair of submedian spots and a dash each side; posterior to these spots a dark triangle, with apex anteriad. Scape dark ventrally, pedicel dark laterally, flagellar segments dark with narrow apical pale bands. Maxillary palpi usually infuscated, labial palpi pale, the third segment dark, moderately swollen. Median pronotal stripes converge at furrow, then diverge and recurve; lateral stripes curve out at furrow then back toward, and sometimes touch, median stripe; a short sub-marginal stripe usually present. Mesoscutellum with a dark stripe and posterior dot each side, sometimes connected; metascutellum with a single dark mark. Pleurae mostly dark. Coxae dark with pale band; fore femora pale, dark posterior stripe; mid and hind femora dark with pale basal and preapical rings; mid femora with pale dorsal and posterior stripes. Tibiae pale, dark postbasal, preapical (except hind femur) and apical bands; a thin dark stripe on ventral sides of mid and hind femora; tarsal segments 1, 2, 3, and 5 pale, with dark apical bands, 4 sometimes wholly dark. Hind tibial spurs a little longer than first tarsal segment. Femoral setae mostly white, tibials about equally black and white; on pleurae and nota white except one or two dark on marginal pronotal stripe; on abdomen mostly white, in the male shorter and with much greater number dark on segments 6-9 than in the female.

Abdomen (♂): dark, tergites 1-8 with a pale stripe on each side, which is widened at the middle and end of each segment, becoming obscure on the apical segments. Ventral median pale stripe at apex of 3rd and 4th segments, and at base of 4th and 5th segments. Length of segment 8 approximately three times width at base; ectoprocts slender, straight, slightly divergent, and bluntly rounded, greatest length approximately 2/3 that of segment 8. Gonarcus and parameres: gonarcus arms widely divergent; mediuncus short.

(♀): dark, tergite 2 pale at base and apex, tergites 3-7 with paired pale spots at base (except on 3rd), middle, and apex; sternites dark.

Wings: Fore wing: costa pale, other longitudal veins alternately dark and pale; cross veins irregularly dark and pale; many of the dark sections surrounded by dark-suffused areas in the membrane, especially around $MP_{3}+_{4}$ (M_2 of Markl, *et al.*), a spot between $MP_{1}+_{2}$ and $MP_{3}+_{4}+CuA_{1}$ between $MP_{3}+_{4}$ and rhegma, a line of cross veins up from rhegma toward the wing apex, and a line up from the end of CuA_2. In some specimens the wing is heavily spotted, in others only slightly so. Hind wing: unmarked except for dark spot on basal side of stigma; veins mostly dark, the longitudinals interrupted with pale.

Fore wing: 3 presectorals (rarely 4), 10-13 branches of Rs+MA, 11-14 basal cubital cross veins, usually 3-4 connected, 9 or 10 branches of $CuP+A_1$, 1-5 (usually 2-3) connected. Hind wing: 2 presectorals; 9-14 (usually 11) branches of Rs+MA; 6 or 7 inner cubital veinlets.

Measurements (mm., means in parentheses): body length ♂ 29.5-35.0 (33.0), ♀ 21.0-27.0 (24.2); abdomen ♂ 26.5-29.0 (27.0), ♀ 15.5-21.0 (18.4); fore wing, length ♂ 19.5-22.0 (20.8), ♀ 21.5-24.0 (23.5), width ♂ 4.6-5.6 (5.4), ♀ 5.8-6.5 (6.2); antennae ♂ 5.4-6.9 (6.2), ♀ 4.7-6.7 (5.7); terminal segment, labial palpi, length ♂ 0.62-0.69 (0.67), ♀ 0.67-0.92 (0.71), width ♂ 0.14-0.20 (0.17), ♀ 0.19-0.25 (0.19); third abdominal tergite ♂ 5.2-6.7 (5.9), ♀ 4.1-5.0 (4.4).

Sonora: Nogales, ♂ (MCZ).

Arizona: *Cochise Co.*: near Douglas, VIII-19-40, 4 ♂ 1 ♀, E. C. Van Dyke (CAS); San Pedro River, Fairbank, Sept. 6, 1927, ♀, J. A. Kusche (CAS); Huachuca Canyon, Sept. 3, 1950, ♂, R. Langston (LAM); *Santa Cruz Co.*: Madera Canyon, Aug. 16-20, 1949, 3 ♂ 2 ♀, P. Adams, col.; Box Canyon, Santa Rita Mts., Ariz., Aug. 21, 1949, ♂ (*holotype*), Aug. 25, 1949, ♀ (*allotype,* both in the Museum of Comparative Zoology), Aug. 25, 1 ♀, 2 ♂, Aug. 21, 2 ♂, P. Adams, col.; *Pima Co.*: Tucson, 16 mi. S., Aug. 11, 1924, ♂, E. P. Van Duzee (CAS); Tucson, 15 mi. E., 2600 ft., VIII-18-50, ♂, Cazier *et al.* (AMNH); Tuscon, VIII-27-38, ♀, D. J. + J. N. Knull (MCZ), X-15-22, 1935, 4 ♂, 2 ♀, Bryant (MCZ); Baboquivari Mts., VIII-15-22, ♀, D. C. Poling (CAS); *Maricopa Co.*: Wickenburg, VII-20-38, ♂, D. J. + J. N. Knull (MCZ); *Yavapai Co.*: 9-20-40, ♀, G. Willett (LAM).

California: *Riverside Co.*: Morongo, Sept. 28, 1944, at light, 2 ♀, Timberlake (UCR); *San Diego Co.*: San Felipe Creek, Sept. 10, 1938, 3 ♀, Timberlake (UCR); *San Bernardino Co.*: 10-15-38, ♂, K. E. Stager (UCLA); Yermo, 10-4-49, at light 2 ♀, J. M. Stern; Providence Mts., 10-7-40, ♂, C. Henne (LAM); *Inyo Co.*: Aberdeen, Owens Valley, 4125 ft., VIII-2-1937, 3 ♂ 2 ♀, Rehn, Pate, and Rehn (MCZ); Independence, VIII-23-52, 3 ♀ (UCLA).

This species is very close to *H. texanus,* and appears to replace it over the south center of its range. It may be differentiated from *texanus* by the markings of the legs, which are always evenly and prominently infuscated (dotted in *texanus*), and by the short mediuncus in the male. The pattern on the thorax is about the same as *texanus,* except for the submarginal pronotal stripes, seldom present in *texanus.* The vertex pattern is the same, but the spots are more sharply delineated than in most specimens of *texanus.*

In the past, specimens of *fidelitas* have mostly been confused with *intermedius,* which has no dots on the mesoscutellum, and a single dark band across the vertex (the anterior vertex row has become fused with the antennal band).

Hesperoleon deflexus, new species

Figures 2, 31, 32, 41

Head capsule and mouthparts largely pale; a dark interantennal mark, which below is confined to area between antennal bases, with an anterior dark median line, and above fades out near anterior vertex scars; vertex scars usually not pigmented, consist of anterior transverse line, followed by a pair of spots (unpigmented in holo- and allotype, brown in Yermo specimens) and a posterior row of a median triangle and a transverse line each side. Labial palpi (Figure 41) extremely long and slender, apical half of terminal segment distended, area surrounding sensory orifice infuscate. Antennae short, pale brown apically. Pronotum pale, a faint pair of convergent narrow median stripes behind furrow, and a pair of lateral black dots on furrow. A pair of short basal stripes on scutella, fused on metascutellum. Pleura mostly pale; legs pale, apical dark bands on third, fourth, and fifth tarsal segments. Hind spurs as long as 1 ½ tarsal segments. Femoral chaetae white (some black on hind femora); tibial chaetae black.

Abdomen (♂): much longer than wings; third and fourth segments strongly curved downward. Basal half pale, apical half brownish with a faint dorsal pale stripe each side. Ectoprocts produced, upcurved, forcipate. Paramere hooks viewed from below spread at right angle basally; tips recurved, parallel; hooks flattened laterally, blunt. Many setae on membrane beside parameres up to level of hinge. Female abdomen short; a pale dorsal stripe each side, wider at base, middle and apex of tergites. Venation mostly pale, longitudinal veins often interrupted with black at intersections with cross veins; in fore wings a dark spot at base of creamy stigma, outer end of hypostigmatic cell, a few along CuA before fork, one at MP $_{3+4}$, halfway between MP_{3+4} and rhegma, and at rhegma. Hind wing: stigma creamy, longitudinal veins less marked with dark than fore wing, no spots.

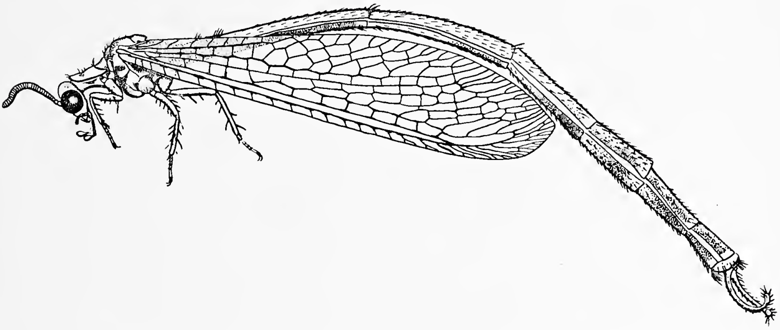

Figure 2. *Hesperoleon deflexus,* holotype. male.

Fore wing: 3 presectorals; 8 or 9 branches of Rs+MA; 8-10 cubital cross veins, sometimes 1 or 2 connected; 7 or 8 anal veinlets, none connected. Hind wing: 2 (rarely 3) presectorals, 6-8 branches of Rs+MA, 5 (rarely 4) inner cubital vienlets.

Measurements (mm., in order: ♂ holotype, ♂ paratype, ♀ allotype, ♀ paratype): body length 31.7, ——, 20.5, 20.0; length of abdomen 27.2, ——, 15.5, 20.0; fore wing length 17.0, 18.5, 18.5, 21.0; width 3.8, 4.6, 5.3, 5.6; third segment, labial palpus, length 1.08, 1.16, 1.27, —— ; width 0.24, 0.23, 0.31, —— ; antennal length 3.25, ——, 3.5, —— ; length of pterothorax 2.76, 2.95, 3.04, 3.2; length of third abdominal tergite ♂ 5.9, 5.9.

Holotype ♂ and allotype ♀: Baker, San Bernardino Co., Calif., Aug. 23, 1952 (UCLA). Type deposited in the California Academy of Sciences, allotype in the UCLA Collection. Paratypes: Yermo, San Bernardino Co., Calif., 10-4-49, 1 ♂ 1 ♀, J. M. Stern (Adams Collection).

This is a pale yellow species, somewhat resembling *H. pallidus* in color. The elongate labial palpi immediately distinguish it from all other species of *Hesperoleon* save *longipalpis* (Hagen).[5] In *longipalpis*, the vertex marks are well pigmented, even in pale specimens; the antennal band on pale specimens consists of a spot under, and one lateral to, each antennal base. The ventral spots become confluent medially on darker specimens. In *deflexus*, the antennal band does not extend below the antennal bases, and the lateral spot is weak, connected to the antennal band above. In *longipalpis*, the male has short ectoprocts, long in *deflexus*. The internal genitalia are similar, *longipalpis* having somewhat longer and sharper paramere hooks.

Hesperoleon minutus, new species

Figures 6, 13-16

Face pale, interantennal band straight-margined above, below emarginate, often with median extension toward clypeus. First vertex row a short band each side, and median wide cordate mark. Behind is a pair of submedian dots, then a pair of lateral dots on each side; posteriorly a triangular dark mark. Labial palpi about 1.5 times the length

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[5] *Hesperoleon longipalpis* (Hagen) 1888 **nov. comb.** Banks made this species the type of his genus *Scotoleon*; it is merely a *Hesperoleon* with long labial palpi.

of fore tarsus, the terminal segment dark, strongly swollen; maxillary palpi pale; scape pale, dark below; pedicel infuscated dorsally; flagellar segments dark with wide apical pale bands.

Median pronotal stripes united behind furrow; before furrow divergent, usually separated by pale. Lateral stripes well separated from medians, narrow, anterior ends curved mesad. Marginal stripes absent. Mesoscutellum with two stripes, narrow anteriorly, well separated. Metascutellar stripes fused for about ½ their length.

Fore coxae pale with basal and apical dark areas on lateral surface. Mid and hind coxae dark basally, grading to pale apically. Femora dotted with dark, the dots often confluent, particularly on posterior side of fore femur, anterior side of mid femur, and on hind femur; tibiae with dark subbasal (faint on hind leg), preapical (absent on hind leg), and apical bands; fore and mid tibiae dotted with dark. Tarsomeres pale with apical dark bands, third and fourth often wholly dark.

Abdomen (♂) : dark, second tergite with basal and apical pale spots; third, fourth, and fifth with a pale band each side, wider at base, middle, and apex of segments; sixth, seventh, and eighth tergites with pale basal, intermediate, and apical pale spots each side. Ectoprocts short, conical, divergent. Posterior margin of ninth sternite with tooth-like projection. Gonarcus and parameres (Figures 15, 16) : mediuncus long; inner margin of parameres curves outward at hinge to form a high, thin strut, bracing hook. (♀) : dark, second tergite pale basally and apically, third to seventh tergites with pale basal, intermediate, and apical spots each side, third and fourth sternites pale apically.

Setae on legs mostly white, on thorax white, on abdomen short, white, a few dark on apical segments. Hind spurs as long as 1 ½ tarsomeres.

Wings: venation pale, interrupted with dark at intersections of cross veins; most cross veins dark. Dark marks at base of stigma, both ends of hypostigmatic cell, along CuA, in a line from rhegma toward tip of wing, and at end of CuA_2. On hind wing a dark spot at base of stigma, otherwise unmarked.

In fore wing 3 presectoral cross veins (rarely 2), 6-9 branches of Rs+MA, CuF at or before origin of RS+MA; 8-10 cubital cross veins, not anastomosed; 8 or 9 anal veinlets, not anastomosed. Hind wing; 1-3, usually 2, presectorals, 5-8 branches of Rs+MA, CuF before origin of Rs+MA.

Measurements (means, in mm.): body length ♂ 17.6, ♀ 16.7; abdomen ♂ 13.7, ♀ 12.0; fore wing, length ♂ 13.5, ♀ 13., width ♂ 3.5, ♀ 4.3; pterothorax ♂ 2.3, ♀ 2.7; third abdominal tergite ♂ 3.2, ♀ 3.2; antennae ♂ 3.6, ♀ 3.7; third segment, labial palpi, length ♂ 0.68, ♀ 0.83, width ♂ 0.19, ♀ 0.21.

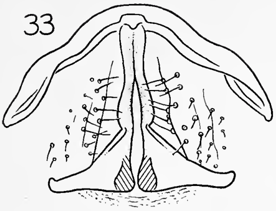
California: *Riverside Co.*: Cathedral City, VII-24-50, ♂, L. W. Isaak (UCD) (*holotype*, deposited in the California Academy of Sciences), VII-21-52, ♀, B. W. Tinglof (UCLA); Indian Wells, VI-17-52, ♀, VII-11-52, ♀ (UCLA); Blythe, 17 mi. NW, VII-26-46, P. D. Hurd and W. F. Barr (CIS); Palm Springs, VIII-8-56, ♂, L. A. Stange (Stange Coll.). *Imperial Co.*: Fort Yuma, 6-15-48, ♂, 6-13-48, ♀, W. B. Andahl (MCZ), June 1948, ♀, R. Coleman (CIS).

Arizona: *Yuma Co.*: Welton, VI-28-50, 2 ♂, 1 ♀, R. F. Smith (AMNH).

Baja California: San Felipe, VI-18-39, Michelbacher and Ross (CAS).

EXPLANATION OF PLATE 6

Figures 33-46. Fig. 33. *Hesperoleon fidelitas,* holotype, gonarcus and parameres, posterior view. Fig. 34. Same, lateral view. Fig. 35. *H. minusculus,* gonarcus and parameres, posterior view (Whitewater, Riverside Co., Calif.). Fig. 36. *H. niger,* gonarcus and parameres, posterior view (3 mi. N. of Payson, Gila Co., Ariz.). Fig. 37. Same, lateral view. Fig. 38. *H. minusculus,* gonarcus and parameres, lateral view. Fig. 39. *H. infuscatus,* gonarcus and parameres, posterior view (Antioch, Calif.). Fig. 40. Same, side view. Fig. 41. *H. deflexus,* allotype, head. Fig. 42. *H. texanus,* gonarcus and parameres, posterior view (sac inverted). (Mill Creek, San Bernardino Mts.. Calif., 6000 ft.). Fig. 43. Same, lateral view. Fig. 44. *H. infuscatus,* apex of abdomen, laterial view (Cajon Pass, San Bernardino Co., Calif.). Fig. 45. Same, ventral view. Fig. 46. Scale for gonarcus and parameres only.



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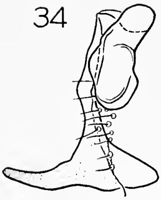

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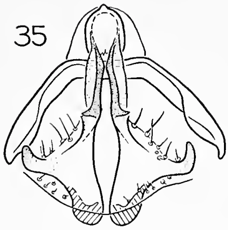

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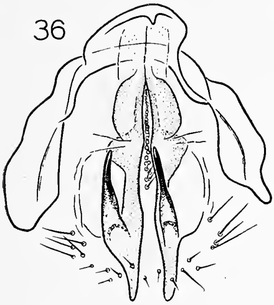

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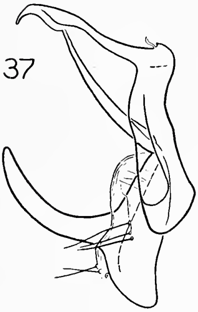

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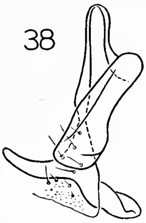

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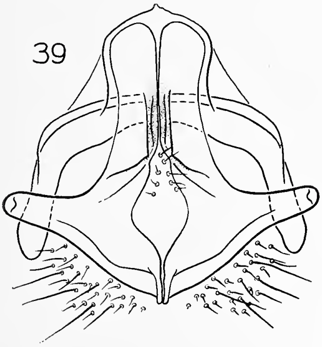

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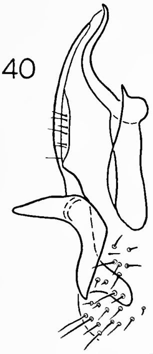

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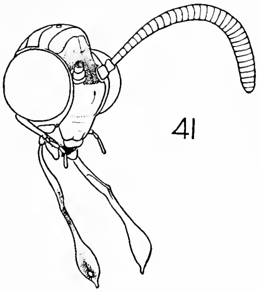

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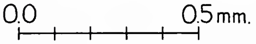

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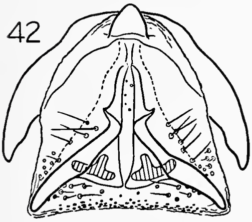

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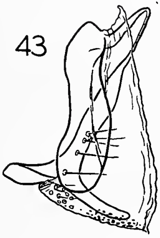

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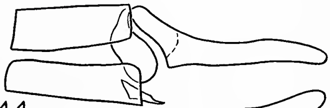

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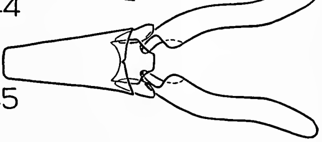

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Adams — Myrmeleontidae

A little smaller than *H. apache* Banks, and not closely resembling any other species of *Hesperoleon.*

Hesperoleon infuscatus, new species

Figures 4, 39, 40, 44, 45

Face pale, antennal band straight-margined below, with a thin line extending toward clypeus. First vertex row far forward, a strongly curved band, separated medially from antennal band by a pale spot; in most specimens the ends fused with antennal band. Second vertex row often connected medially with first, consists of an irregular, medially thickened band each side, often connected. Labial palpi slender, the apical segment slender, pointed, shiny-fuscous; maxillary palpi dark. Scape dark below, pale above; pedicel dark, flagellum dark, last ten (more or less) segments with broad apical pale bands on ventral side. Pronotum distinctly broader than length at center, submedian stripes fairly straight; laterals very wide behind furrow, narrowly separated from medians by pale, before furrow narrow and curving to fuse with medians at anterior margin. Space between bands suffused with fuscous at, and sometimes behind, furrow. Submarginal stripe a thin line curving back from furrow, often absent. Mesoscutellum with two long, well-separated dark stripes, metascutellar stripes fused for about two-thirds their length. Coxae pale medially, dark laterally; fore femur dark-striped posteriodorsally, mid and hind femora wholly dark but for ventral pale stripe. Fore tibia infuscated posteriorly, with dark subbasal and apical bands; mid tibia with dark basal, subbasal, preapical, and apical bands; hind tibia with subbasal and apical bands, and a thin ventral dark line. Tarsal segments pale, dark-banded apically, segments three and four more so than others.

Abdomen (♂): dark, with dorsal pale stripe each side extending to sixth segment. Ectoprocts long: (about 1 ½ times as long as 8th abdominal tergite, which is short, 1.3 times as long as high) extend straight back, viewed from side; from above, bent into lyriform curve. Mediuncus arms spread widely; parameres form a flat plate from the lateral margins of which the hooks emerge and bend straight back. (♀): the pale stripes thinner, may extend to tip of abdomen, or be absent.

Setae on legs mostly black (some white on coxae); on thorax mostly white, stiff, short; on abdomen mostly white, short, male with many long black setae on apical segments. Hind spurs as long as 1 ½ tarsal segments.

Wings: venation of fore and hind wings mostly dark, the longitudinal and some cross veins interrupted with pale; membrane narrowly brown-fuscous bordering dark veins; dark spots at inner side of stigma, along R at intersections of cross veins, along CuA, at rhegma, in apical field, and at end of CuA_2. Hind wing similarly marked, but not so heavily.

Fore wing: 3 presectoral cross veins (rarely 4 or 5), usually the outer one connected to first cross vein beyond origin of Rs+MA; Rs+MA 8-11 branched; 11-15 basal cubital cross veins, 3-10 (usually 5 or 6) connected; 9-12 (usually 10 or 11) anal veinlets. Hind wing: 2 or 3 presectorals; Rs+MA 8-11 (usually 9 or 10) branched; 5-7 inner cubital veinlets.

Measurements (means, in mm.): body length ♂ 35.8, ♀ 26.7; abdomen ♂ 29.5, ♀ 20.2; fore wing ♂ 25.4, ♀ 26.9, width ♂ 6.3, ♀ 6.9; antennae ♂ 7.0, ♀ 5.7; third segment, labial palpus, ♂ 0.77, ♀ 0.85, width ♂ 0.17, ♀ 0.21; pronotum, length at center, ♂ 1.12, ♀ 1.19, width ♂ 1.81, ♀ 1.81; pterothorax ♂ 4.0, ♀ 4.4; third abdominal tergite ♂ 6.5, ♀ 6.2.

California: *Contra Costa Co.*: Antioch, V-24-49, 2 ♂ (one the *holotype*), 1 ♀ (*allotype*), J. W. Mac Swain (CAS); V-24-49, ♂, P. D. Hurd (CIS), VI-4-42, 1 ♀, 2 ♀, E. C. Van Dyke (CAS); VI-20-37, ♀, E. S. Ross (CAS); V-27-50, ♀, S. F. Bailey and R. M. Bohart (UCD); VI-8-39, 4 ♀, R. M. Bohart (CIS); VI-2-40, ♀, B. Brockman (CIS); V-20-33, ♀, E. O. Essig (CIS). *San Bernardino Co.*: Cajon Pass, VI-16-46, 3 ♂, 3 ♀, E. G. Linsley (CIS).

This species has a dark brown facies, similar to that of *H. curriei* Banks, from which it may be distinguished by the short 8th abdominal segment in the male, which is longer than the ectoprocts in *curriei*, by the parameres, which are not formed as hooks, like those of *curriei*, and by the evenly infuscated femora — dotted in *curriei*. It is much more robust than *brunneus*, the ectoprocts of which have a preapical lobe on the median side, and the femora of which are dotted.

Tyttholeon, new genus

Figures 7, 8, 11, 12

Belongs to the Brachynemurini.

Labial palpi short, apical segment not swollen; antennae stout, strongly clavate. Legs fairly stout, tibial spurs absent, first tarsal segment two-thirds length of next three together. Abdomen much shorter than wings, of same length in male as in female. Many long white setae present on femora, coxae, and thorax (except metanotum).

Fore wing: costal area narrow, the cells more than twice as long as high; Rs+MA originates only slightly proximal to cubital fork; cubital fork acute. A_1 straight, connected to CuA_2 by one or two cross veins; A_2 unbranched; A_3 forked near margin. Banksian lines absent. Hind wing: costal area narrow; only one row of cross veins between cubital veinlets; CuA_2 reaches margin before CuF; at most one cross vein between CuA_1 and CuA_2 beyond fork. Banksian lines absent. Pilula axillaris present in male.

Tyttholeon is most likely to be confused with *Maracandula* Currie, since both of these genera lack spurs. In *Maracandula,* the first tarsomere is longer than the following three together. The venation is much less dense in *Tyttholeon,* and Rs+MA originates farther out on the wing; in *Maracandula* the costal cells are higher than long. The white setae on legs and thorax are not nearly so long as the macrochetae of *Maracandula*. There is no similarity between the internal genitalia. *Maracandula* (Figures 9, 10) has on the paramere a lateral, heavily sclerotized ligulate lobe, and a sharp ridge on the posterior face. In *T. puerilis* the parameres are folded in a complex manner, but have no conspicuous heavily sclerotized hooks or lobes.

Generotype the following species:

Tyttholeon puerilis, new species

Figures 7, 8, 11, 12

Face pale, brown spot above posterior articulation of mandible and at joint of cardo and stipes; brown band between bases of antennae, emarginate below; vertex with an anterior row of three brown spots, middle row of two black marks connected by a line, and a posterior row of three brown spots. Last segment of labial palpi short, slender, curved, fuscous. Antennae short, heavily clavate; scape pale with apical fuscous ring; pedicel dark; flagellum 23-24 segmented, the first two or three segments more or less fused, shiny-fuscous basally, reddish brown in middle; a dark band at base of club, club yellow-buff.

Pronotum pale, a single dark band each side, narrower in front of furrow, often interrupted at furrow. Scutelli pale with bilobed anterior brown spot and thin median posterior black line. Coxae with basal and preapical brown spots, connected on mid and hind coxae. Femora pale, an apical dark stripe on posterior side of fore-femur, anterior side of mid and hind femora. Fore and mid tibiae with subbasal and preapical dark bands, hind tibiae pale. Tarsomeres pale with narrow apical dark bands.

Abdomen (♂): brown, first tergite dark, second with narrow pale band and a pair of large posterior pale spots, third and fourth tergites with paired basal, intermediate, and apical spots, remaining segments with basal and apical spots only. Gonarcus and parameres (Figures 11, 12). Ectoprocts short, slightly produced posteriad below. (♀): tergites dark with a pair of apical pale spots on each.

Many prominent setae on thorax, coxae, and femora. Most tibial setae black. Abdominal setae white, black on ectoprocts and terminal segments of female.

Wings: longitudinal veins pale, interrupted with dark at intersections of cross veins. Cross veins almost all dark, the membrane beside them bordered with dark, giving an effect of uniformly distributed short transverse brown dashes over wing; somewhat paler on hind wing.

Fore wing: 3 presectorals, Rs+MA 4-6 branched; 6-9 basal cubital cross veins; 6-10 anal veinlets. Hind wing: 1 or 2 presectoral cross veins; Rs+MA 4-6 branched; CuA_1 5-8 branched; 4-7 basal cubital cross veins; 3-5 inner cubital veinlets.

Measurements (mm. means in parentheses): body length 10.2-14.5 (12.0); abdomen 6.8-10.0 (8.2); fore wing, length 13.0-17.7 (14.4). width ♂ 2.8-3.9 (3.24), ♀ 3.1-4.8 (3.6); last segment, labial palpus 0.23-0.34 (♂ 0.30, ♀ 0.25); antennae 2.3-2.8 (2.6); pterothorax 1.9-2.8 (2.27); third abdominal tergite 1.5-2.5 (♂ 2.02, ♀ 1.84); pronotum, length at middle 0.56-0.85 (0.69), width 0.75-1.14 (0.95).

California: *Mono Co.*: Near Topaz, 7-15-37, ♂, J. A. Comstock (LAM); *Inyo Co.*: Furnace Creek, Death Valley IV-18-49, 2 ♂, 1 ♀, O. Bryant (CAS); Death Valley, IV 1920, ♀, J. D. Gander (CAS). *San Bernardino Co.*: Providence Mts., VI-1-37, ♂, R. H. Andrews (LAM); Needles, V-8-39, Van Duzee (CAS). *Riverside Co.*: Palm Springs, VI-27-39, 2 ♂, 4 ♀, E. G. Linsley (CIS) (*type* ♂ and *allotype* ♀ in the Calif. Acad. of Sciences). *San Diego Co.*: Borego, IV-9-40, 1 ♂ 1 ♀, Sperry (MCZ); San Felipe Canyon, IV-18-25, ♂, at light Timberlake (UCR).

Arizona: *Yuma Co.*: Mohawk, IV-10-47, 2 ♂ 2 ♀; Sperry (MCZ); Aztec, VI-16-54, 1 ♂ 5 ♀, Stange & Menke (Stange Coll.).

A TECHNIQUE FOR SHIPPING HIPPOBOSCID PUPARIA (DIPTERA)[1]

By I. Barry Tarshis
812 Montclaire Ave., Frederick, Maryland

Special techniques have been developed for shipping dipterous insects. Geigy (1948) devised and used a cold temperature cabinet which was kept at 8.0° C. (46.8° F.) for shipping adult tsetse flies of the species *Glossina palpalis* from Tropical Africa (Congo) to Basle, Switzerland, via air express. Brennan and Mail (1954) successfully shipped adult mosquitoes of the species *Culex tarsalis* in a cold temperature cabinet that employed Sno-Gel Refreezants (Model R10-8) for temperature control. Adult hippoboscid flies of the species *Pseudolynchia canariensis* were successfully shipped via air express in cardboard mailing tubes for a distance of several hundred miles by the writer (Tarshis, 1953). (This method was only successful when transit took but a day to a day and a half and the temperature was moderate.) The author (Tarshis, 1954) also transported live hippoboscid flies (*Stilbometopa impressa* and *Lynchia hirsuta*) in a cold temperature cabinet, maintained at around 7.0° C. (44.6° F.), distances of 70 to 300 miles in an automobile.

During studies now being conducted by the author on the biology of Egyptian hippoboscids, an attempt was made to again ship live adult flies in mailing tubes, but the flies always arrived dead. The great distance and consequent time involved in shipping flies from Egypt to Maryland readily explains this lack of success. No attempt was made to ship the flies in refrigerated con-

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[1] The author wishes to express sincere appreciation to Lt. Com. Harry Hoogstraal, Head, Zoology Dept., NAMRU — 3, Cairo, Egypt for obtaining and sending the puparia and for his continuing help and interest in this work.

tainers, as was accomplished in the above described works, since the cost of such containers and their shipment would be prohibitive; it is also doubtful if any commonly available refrigerants would maintain the necessary low temperature over such a prolonged period (10 to 15 days).

The problem of how to ship live adult hippoboscid flies such a long distance was obviated when experiments showed that puparia of the flies could be shipped this distance economically, simply and most successfully via air express.

The puparia were packed in the following manner for shipment. Several puparia were loosely wrapped in a piece of cleansing tissue and then the tissue-wrapped puparia were put into a shell vial which had a small piece of cotton in the bottom. The number of puparia in a vial would vary with the size of the puparia and the vial. For these shipments a maximum of five puparia of *Hippobosca longipennis* and three puparia of *H. equina* were placed in each 15 × 40 mm. vial. The puparia could also be put one or two at a time unwrapped into the vials with cotton under and over each succeeding one or two puparia. The vial was plugged with cotton or capped with a plastic screw-on cap. Five or six vials were then placed into a cardboard mailing tube padded all around the inside and bottom with cotton to prevent the vials from breaking and the puparia from being severely jarred.

Upon arrival in Frederick, Maryland, the puparia were removed from the vials and placed into individual rearing vials (25 × 55 mm.) covered with 10-mesh nylon bobbinette. The vials containing the puparia were then placed into an incubator set at 26.5° C. (79.7° F.). Adult flies of *H. longipennis* emerged from puparia in from 26 to 31 days (from the date of collection in Egypt to date of emergence in Maryland). Adult flies of *H. equina* emerged in 29 days under the same conditions. This shipping method could be employed for puparia of all viviparous flies.

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TWO CASES OF INTESTINAL MYIASIS IN MAN PRODUCED BY HERMETIA (DIPTERA: STRATIOMYIIDAE). —In the late summer of 1955 a man living in Tucson brought in a larval *Hermetia,* probably in its final instar, that had been passed with the stools. He reported that he had had a series of symptoms that might be traced to the myiasis, beginning with gastric upset several months before, passing through diarrhea and ending in uneasiness in the lower tract. The specimen was alive when he brought it in but, unfortunately, it escaped. It agreed well with *Hermetia* larvae in our collections but a specific name could not be assigned. This year, October 15, 1956, another man brought in a larva passed with the stools and in this case reported that he had noticed no symptoms at all. The larva was active at first but soon became quiescent and had obviously pupated. A female adult of *Hermetia illucens* (L.) emerged on the morning of October 23. Since both of these cases occurred within the area of metropolitan Tucson, in an area of about 200,000 population, myiasis by this fly may be more common than has been reported. Both cases were in residents in semirural areas, the man who played host for the 1955 specimen not having been outside the area for at least six months before the larva was recovered. The 1956 infestation may have originated somewhere else, since the man infested had returned from an extended trip in Mexico the month before. — FLOYD G. WERNER, University of Arizona, Tucson, Arizona.

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PSYCHE

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THE INDO-AUSTRALIAN SPECIES OF THE ANT GENUS *STRUMIGENYS* FR. SMITH: THREE NEW PHILIPPINE SPECIES[1]

By William L. Brown, Jr.

Museum of Comparative Zoology, Harvard University

This paper is a further contribution in a series which, when complete, will cover the Indo-Australian portion of the world fauna of the dacetine ant genus *Strumigenys* Fr. Smith. Previous parts, the first two of which include explanations of the abbreviations used for citing measurements and indices, are in *Psyche* 60: 85-89 (1953), 60: 160-166 (1954) and 61: 68-73 (1954).

The last reference just cited contains the description of *S. chapmani* Brown, from the Philippines, a species that is very difficult to assign to any species group. There are also known from the same islands a member of the *szalayi* group (*australis* or near); an undescribed species, apparently nearest *S. koningsbergeri* Forel; a member of the "Labidogenys" complex, probably new, and four species of the *godeffroyi* group, including *S. godeffroyi* Mayr and the three forms described here for the first time. This makes a total of eight known *Strumigenys,* which is undoubtedly only a fraction of the number actually to be found in the Philippines.

So far as can be determined from the present samples, the Philippine *Strumigenys* fauna is Indo-Malayan in affinities, with also an element (*australis*) of probable Papuasian

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[1] Published with the aid of a grant from the Museum of Comparative Zoology at Harvard College.

origin. As elsewhere in the East Indies, species endemism is high.

Strumigenys esrossi, new species

Holotype worker: TL 2.4, HL 0.62, ML 0.28, WL 0.60; CI 72, MI 45.

Head and mandibles in general form much like those of *godeffroyi*; the occipital lobes with a feeble indication of dorsal depression and another extremely feeble depression in the center of the cephalic dorsum at eye level. Mandibles only very feebly arcuate; dorsal tooth of apical fork nearly twice as long as the ventral; the latter parallel and with two small acute intercalary denticles on its inner margin. Preapical spiniform tooth distant by about 1½ times its own length, situated at approximately the apical third of the length of the shaft, a little more than half as long as the dorsal apical tooth. Alitrunk slender, pronotum depressed, forming a nearly straight gentle slope in profile, continuous with the anterior mesonotum; posterior mesonotum rather strongly and broadly concave, continuous with the very feebly convex propodeal dorsum; metanotal groove absent. Propodeal teeth spiniform, but enveloped in infradental lamella, which is acute at their tips and broad and weakly convex below; spongiform tissue not or extremely slightly developed on the lateral faces of the lamellae. Petiolar node long and low, gently rounded above and with a gentle anterior slope. Spongiform tissue reduced to moderate posterolateral flaps and a strong mid-ventral band. Postpetiole moderate in size, nearly twice as broad as petiolar node, convex, finely and densely striolate-punctulate longitudinally, opaque. Anterolateral spongiform appendages less well developed than in *godeffroyi.* Basigastric costulae a broad band of extremely fine, dense longitudinal striolation extending about half the length of the basal tergite, and behind this extending briefly as indefinite traces, although the surface here is generally smooth and shining. Mandibles fairly smooth, shining. Rest of body densely punctulate and opaque, including sides of alitrunk.

Pilosity consisting, except for a few short clavate hairs at the gastric apex, entirely of short, appressed, whitish spatulate hairs, only moderately distinct on the head, where they are largest posteriorly; reduced, few and scarcely visible at all on alitrunk; a few, inconspicuous, on the petiolar and postpetiolar nodes. Hairs on scape border slender spatulate, subappressed and directed toward the scape apex. Gastric dorsum with very indistinct, small, fine appressed hairs, (color sordid yellowish ferruginous; dorsum of head feebly darkened in the middle. ,

Holotype [California Academy of Sciences] one of 21 workers taken at San José, Mindoro I., Philippine Islands, from a nest in a small cavity in the soil, 3 inches below the surface (E. S. Ross leg.).

Paratype workers: 20 workers from type nest series; numerous workers from near Dumaguete, Negros Oriental, Philippines (probably chiefly from the Cuernos Mts.) (J. W. Chapman and D. Empeso); one worker from MCZ miscellany. Victoria, Luzon (Pierce leg.); one worker from Jolo I., Philippines, from stomach of *Rana microdisca leytensis* in MCZ. TL 2.2-2.7, HL 0.58-0.65, ML 0.26-0.30, WL 0.58-0.68; CI 70-74, MI 45-46. The larger workers are often lighter and more yellow in color. Paratypes in CAS, USNM, MCZ.

Female, from type nest series: TL 2.8, HL 0.67, ML 0.29, WL 0.69; CI 75, MI 43. Mesonotum with a feeble median sulcus; pilosity as on head, except for a pair of short, tapered, erect hairs on anterior scutum. Nodes broader than in worker; petiolar node about as broad as long. Gaster more opaque, the striolae stronger and extending nearly the whole length of the basal tergite; coarser at extreme base. Anterior gastric dorsum with a widely spaced pair of very small erect clavate hairs. Medium ferruginous; ocelli small, with blackened callus at each. Male unknown.

This species is so far known only from the Philippines, where it is widespread and apparently rather common. It combines features of the *godeffroyi* and *szalayi* groups, but seems best placed with the former group. It is strongly distinct in sculpture and pilosity. From *S. phytibia* sp. nov., another Philippine species with striate pospetiole, *S. esrossi* differs in the more proximally placed preapical tooth, the slightly more arcuate mandibles, different pilosity, and other details.

Strumigenys uichancoi, new species

Holotype worker: TL 2.2, HL 0.55, ML 0.26, WL 0.53; CI 72, MI 47. Shape of head, mandibles and antennae very much as in *S. frivaldszki* as figured by Emery in his original characterization of that species. The mandibles are slender, and the preapical tooth is straighter, and is placed slightly farther from the apical teeth, at or a little basad of the apical quarter of the ML. Promesonotum weakly convex, posterior mesonotum very weakly depressed (less so than in *godeffroyi*) and in profile forming an uninterrupted straight or extremely feebly convex dorsal outline with the propodeum. Metanotal groove completely obsolete on the dorsum. Propodeal lamellae moderate in size, with short upper teeth, each embedded in fairly thick lamelliform angles, so that the upper corners of the lamellae are obtuse; below this, the lamellae gradually widen ventrad (to nearly twice the dorsal width at the position of the teeth) and are here convex. The lamellae are smaller and narrower above, and without definite development of spongiform tissue on their lateral faces, but otherwise similar to those of *godeffroyi*. Petiolar node a little longer than broad, subglobose, with moderately steeply sloping anterior face; broadly rounded above as seen from the side. Lateral spongiform lobes much narrower and less well developed than in *godeffroyi*, anterior nodal face not nearly so steep. Postpetiolar disc small, convex, smooth and shining.

Sculpture of alitrunk weak, entirely effaced on the sides, which are consequently smooth and shining, and almost gone on much of the pronotum, which is moderately to fairly strongly shining. Petiole opaque. Basal gastric costulae few (11-12), extending 1/5 or less the length of gastric tergite I, well separated and irregular in length. Rest of gaster smooth and shining.

Pilosity consisting of short, very fine hairs, feebly subspatulate and appressed or subappressed on the anterior part of the cephalic dorsum and the anterior scape borders, erect and quite abundant on the posterior half of the head, finer, erect and sparse on the alitrunk, nodes and gaster. A few hairs are slightly longer: on humeral angles, mesonotum, and gastric dorsum, appearing flagellate, but the tips looped back on the shafts to suggest a false spatulate condition in the present specimen.

Holotype a unique [USNM] taken in U. S. Plant Quarantine (No 686, 10385) at Honolulu from a fern plant originating in the Philippine Islands. Closely related to *godeffroyi,* but differing in smaller size, pilosity and placement of the preapical tooth, among other characters.

Strumigenys phytibia, new species

Holotype worker: TL 2.5, HL 0.60, ML 0.29, WL 0.65; CI 69, MI 48. Closely resembles *godeffroyi,* with straight mandibles and slightly recurved preapical tooth set less than its own length away from the dorsal apical tooth. Clypeus with anterior border only extremely feebly concave, almost straight. Posterior mesonotum gently concave. Propodeal teeth acute and elevated, but each is encumbered in a thin, areolate infradental lamella which becomes broadly convex below, the lamellae with a few barely perceptible strands of spongiform tissue on their lateral faces. Petiolar node subcircular seen from above, broadly rounded above and with steeply sloping anterior face as seen from the side. Postpetiolar disc convex, broader than long, its surface completely, distinctly and regularly longitudinally costulate and opaque.

Gaster with rather coarse basal costulae interspersed with fine parallel striation extending to about the midlength of the first segment; remainder of gastric surface smooth and shining. Pronotum very indistinctly substriate over punctulation in a longitudinal direction, definitely opaque. Head, alitrunk, legs and petiole densely punctulate, opaque; fore coxae and a ventral strip along mesopleura smooth and shining.

Pilosity of alitrunk similar in plan to that of *godeffroyi,* but much reduced, the hairs smaller, fewer and more nearly appressed. Humeral and mesonotal paired flagellate hairs extremely fine, as are also the lateral and posterior occipitals. Ground pilosity of head abundant, extremely fine and inconspicuous, appressed or nearly so and directed anteriorly and medially. A half dozen or fewer weak erect flagellate hairs on the gastric dorsum. Spongiform appendages covering less than half the sides of the nodes, generally less well developed than in *godeffroyi.*

Holotype taken in U. S. Plant Quarantine at Honolulu (No. 8807) from plants of *Grammatophyllum multiflorum* originating in the Philippine Islands; deposited in USNM.

Paratypes: Three workers with the same data as for holotype do not vary in measurements by much more than the usual maximum error. CI 67-68, MI 48-49. [USNM, MCZ.]

Alate female paratype, same data as for holotype: TL 2.7, HL 0.62, ML 0.28, WL 0.72; CI 74, MI 45. Like worker, with usual caste differences. Mesonotum evenly and densely punctulate, no costulae or median sulcus; mesepisterna and fore coxae shining. Petiolar node broader than long. Forewing with only R+Sc, stigma and 2r well defined; basalis oblique, indistinct; M+CuA and CuA indistinct, some other veins indicated by weak creases. Forewing L ca. 2.0 mm.

THE COLLEMBOLA OF LEBANON AND WESTERN SYRIA. PART I.

GENERAL CONSIDERATIONS AND THE FAMILY ONYCHIURIDAE

By K. Christiansen
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The Collembolan fauna of the eastern end of the Mediterranean is still very poorly known. Brown (1926) made the first major contribution by describing twelve species taken by Buxton and Evans in the region of Amara and Baghdad in Iraq. Handschin (1942) recorded all but one of these species from Palestine, and added 26 additional forms. In his recent paper upon the Collembola taken during a speleological expedition in Lebanon, Cassagnau (1951) added 25 new forms to this list. In addition to these major works a number of smaller papers have been published upon new material or further records.

The series of papers, of which this is the first, will constitute a description of over 80 species collected from Lebanon and Western Syria. More than 35 are new to science or new records for the Near East. Collections upon which this study was based were made from over 100 localities including most of the major habitats of the region. Caves were poorly represented, but these have already been extensively investigated by Cassagnau (*op. cit.*).

Acknowledgements

The material described in these papers was collected during my three-year stay at the American University of Beirut, and I wish to thank the staff of that organization for their financial aid and encouragement in the completion of the project. The collecting, handling, and sorting of material was greatly aided by a number of

students, particularly Mr. Raja Asfour and Mr. Muhammed Salaymeh. I particularly wish to thank Dr. H. Gisin for his helpful comments.

Description of Localities

Lebanon and Western Syria comprise an area of extremely variable topography and ecology. The most prominent physical feature of the area under consideration is the Lebanon Mountain Range. This range reaches its highest peak (10,131 ft.) in North Central Lebanon and gradually decreases in height northward. Between these mountains and the sea is a narrow coastal plain which widens from south to north. In Lebanon a second parallel mountain range, the Anti-Lebanon Mountains, marks the Western border of this country. Between these two ranges lies the central valley of the Bekaa, which continues in the North as the North Syrian Plain. The single common ecological factor is that most of the area is greatly impoverished by almost every conceivable type of land overuse. Many of the mountainous areas are largely denuded of soil due to excessive grazing by goats and the resultant erosion. Most of the valley or plains regions suffer from chronic nitrogen and mineral lack, while most of the desert flora is kept in a condition of abnormal dwarf growth by the excessive grazing of the Bedouin flocks. The few nearly natural regions left are largely limited to the rare forests of the larger mountain peaks of Lebanon, the pine forest of Northern Latakia, and the deeper reaches of the desert. Except for the mountain areas, rainfall is completely seasonal, being limited to the winter months. The rainfall varies from 34 inches in Beirut to less than 3 inches in some regions of the Syrian Desert. In both cases most of the rain falls between November 1st and May 1st, and rain in July or August is unheard of. The effect of this is that the Collembola vary in both abundance and occurrence according to areas and seasons. In the more humid areas Collembola are abundant whereever food material occurs in the rainy season. In drier regions they are very rare in most areas. In all parts of the country numerous refugia exist with year-round moisture of a sufficiently high level to support a more or less permanent population. Such refugia occur along the banks of rivers, in the moist beds of dry streams, or the edges of ponds and lakes. Most commonly they are found around the borders of the numerous springs of the mountainous regions. In extreme desert regions only a few xerophilic species can be found far from the limits of these refugia. The swamps or lake shore refugia frequently show an impoverishment of collembolan fauna, possibly due to their periodic inundation. Almost all of the Lebanese and Syrian level arable land is under heavy cultivation. Most of the species occurring in such areas are migrants or agriculture-tolerant forms. On the whole the fauna in this region is impoverished, although an occasional wood lot or hedge-row may be quite rich in some forms.

The lower slopes of the Lebanese Mountains are largely covered by small xerophytic brush and a few strands of hardy grass. Wherever enough soil and enterprise remain, terraces are built and fruit, wheat and other crops are grown. A few planted and more or less carefully parked pine forests exist in a few regions, especially in southern Lebanon. All of these habitats have extremely limited collembolan faunas, although a large percentage of indigenous forms occurs. The richest faunas occur in the high Lebanese Mountains. These areas were probably one time entirely forested, with spruce forests in the northern areas, and cedar in the central and southern regions. At the present time only four forests of any size are left, the remainder of the slopes being kept in a barren rocky condition with poor herb grass-low shrub covering. The existing forests are: a large spruce forest in the Halba region of northern Lebanon; the Hadeth, Ain Zahlte, and Barouk cedar forests in central and southern Lebanon. All of these forests are growing on limestone substrates mostly on or near mountain peaks. The forest soil consists generally of a thin layer of duff, beneath which is a shallow black or gray humus. Below this layer limestone appears, frequently as bedrock. The forests tend to be open, with undergrowth limited to the edges and cleared central valleys. The spruce forest was largely cut over by the British in 1945, so that only a few large trees remain. Most of this forest land is now clothed with second growth of small spruces and shrubs. The Hadeth cedars are being heavily but sporadically cut at the present time. but the other two forests have been largely uncut for the last twenty years. Most of these forest lands support some fauna in the deeper soil layers, even during the driest seasons.

In addition to the forest regions a large number of steep valleys occur where rain and surface water maintain continuous moist conditions. Such areas usually have a lush mesophytic flora, which is of striking contrast to the barren overgrazed xerophytic vegetation of the surrounding mountains. Such areas have an abundant collembolan fauna and because they are isolated by large stretches of dry, impoverished territory, the fauna of each valley is usually somewhat unique.

A last major habitat type is represented by the Northern Latakian Pine Forest. This large forest is situated directly below the Turkish border and is continuous into Southern Turkey. The area on the whole is similar to the mountain forests of Lebanon except for 1.) the development of a true podsol, and 2.) the existence of isolated patches of beech-oak mesophytic forest. These last areas have probably the richest collembolan faunas of any region of the Near East with many forms being represented from these areas only. These patches of deciduous forest occur apparently only at regions of excessive ground water and remain humid during most of the year. In this, and other respects, these patches of mesophytic woods resemble the isolated humid valleys of the high Lebanon Mountains, but are infinitely richer in fauna, possibly due to their existence in the center of the well populated pine woods area.

General Zoogeographical Considerations

The collembolan fauna of this area belongs to four major distribution groups. In order of their representation in the fauna, these are: 1.) Circum-Mediterranean; 2.) Holarctic-Cosmopolitan; 3.) Xerophytic North African and 4.) Central European. In addition to these there are a number of forms of dubious zoogeographical associations. There are a large number of species (as far as is now known) limited to the area. It is no surprise that the great majority of this last group occurs in the relatively untouched forest areas and deep valley mesophytic regions, while the lowland farm areas show a great preponderance of widespread forms. Determining which forms are indigenous and which have been introduced is made utterly impossible by the antiquity of commerce and agriculture in the area, as well as our lack of knowledge concerning distribution mechanisms in Collembola.

SYSTEMATIC PORTION

Four species of the family Onychiuridae have been previously reported from the region. These are: *Onychiurus fimetarius, O. armatus, O. octopunctatus,* and *Metaphorura bipartita.* In the present paper two of the above are again recorded and six additional species are found: *Stenaphorura quadrispina, Onychiurus ambulans,* and four new species of *Onychiurus.*

Onychiurus levantinus n. sp.

Plate 7, Figures 5-8

Description of holotype (female): Color white; body elongate sub-cylindrical with sixth segment strikingly smaller than remainder; antennae with line between third and fourth segments indistinct; sensory organ of third antennal segment with five protective papillae, a pair of slightly curved rods and a pair of knob-covered oval organs; P.A.O. of 35 closely packed simple lobes in the form of a narrow ellipse; integument uniformly granulate, only slightly coarser on dorsal surface of head than remainder of body.

Following the chaetotaxy system developed by Gisin (1952), the holotype has the following formulae: 1st thoracic segment: i3m; abdominal segment two: M SS 'M'; abdominal segment five: M SS 'M. The relationship between setae M and S of abdominal segment five is 19/12 with the anterior border of the anal horns taken as 10.

The unguis is untoothed with the empodial appendage having a long filiform extension slightly exceeding the apex of the unguis. The anal horns are curved and stout, about as long as the hind unguis. A small but well developed cuticular fold exists in the region of the furcula. Pseudocellar formula: Dorsal surface — 32/022/333420. No pseudocelli seen on ventral surface of animal.

Variation and Discussion.[1] The number of lobes on the P.A.O. varies from 28 to 36, with even smaller numbers occurring on obviously immature specimens. The male specimens never display any special ventral organ. The pseudocelli are constant except for a pair of ventrals appearing occasionally on the head. The lateral pseudocelli on the third thoracic segment, and the lateral posterior pair on the fourth segment, are not always clearly visible, but further examinations have led me to believe that this is a matter of technique and that they are always present. The chaetotaxy of the first thoracic segment varies a

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[1] Unless otherwise stated, the variation mentioned in each of these sections is that found in normal specimens of apparent sexual maturity.

EXPLANATION OF PLATE 7

Figs. 5-8. *Onychiurus levantinus* n. sp. Fig. 5. Third antennal segment organ paratype (male). Organ length 18 micra. Fig. 6*. Posterior border fifth abdominal segment, specimen from "The Cedars," Lebanon. Side view. Fig. 7. Tergum first thoracic segment, same specimen. Side view. Fig. 8. Posterior margin second abdominal segment, same specimen. Figs. 9-11. *Onychiurus butrosi* n. sp. Fig. 9. Side view third antennal segment organ, specimen from Hermel, Lebanon. Length of sensory clubs 4 micra. Fig. 10. Ventral view, same organ and specimen. Fig. 11. P.A.O., same individual. Magnification as above. Figs. 12-15. *Onychiurus fazii* n. sp. Fig. 12. Claw, specimen from Latakia, Syria. External edge unguis 36 micra. Fig. 13. Third antennal segment organ, specimen as above. Organ length 20 micra. Fig. 14. Sensory clubs of third segment organ, another specimen from Latakia. Fig. 15. Sensory clubs as above, specimen from Ain Z'halte, Lebanon.

* Dotted lines in figures 6, 7 and 8 represent limits of variation of setae bases in more variable setae.

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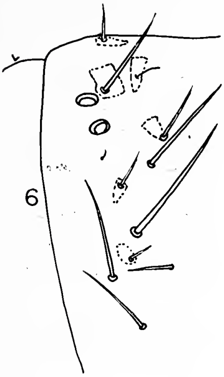

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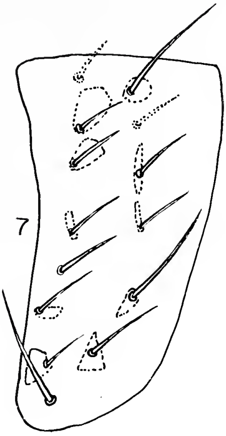

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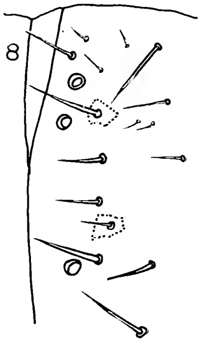

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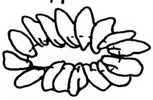

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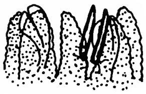

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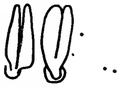

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great deal. All of the following chaetotaxy formulae are to be found (Gisin, 1952): ilm, i3m, i2—, and i3—. The formula i3m is by far the most common and may be considered typical of the species. The relationship of the M/S setae of the fifth abdominal varies from 17/10 to 19/12, with 18/11 being the commonest form.

The species is distinguished from all others of the *armatus* group by a combination of characters, particularly the presence of 2 pairs of pseudocelli on the posterior borders of the head and fifth abdominal segment, the absence of ventral pseudocelli, and the relationship of M/S.

Type locality: Ain Z'halte Cedars, Lebanon, X-28-53. Also taken from: Vicinity Becharra Cedars, Lebanon, VII-1-52; "The Cedars," elev. 1900 m., Lebanon; Vicinity Bludane, Syria.

Onychiurus armatus Tullberg

Onychiurus armatus Tullberg, 1869, Akad. Afhandl. Uppsaler. Pp. 1-20.

I have found this species from a single locality: Ain Z'halte Cedars, Lebanon. Cassagnau reports it from six localities in Lebanon, but the localities he reports it from make it appear probable that he is including under this name both *armatus* and *O. levantinus*.

Onychiurus octopunctatus Tullberg

Onchiurus octopunctatus Tullberg, 1876, Ofver. Kongl. Vet.-Akad. Forhand. 33:23-42.

Two specimens of this species were reported from Lebanon by Cassagnau.

Onychiurus butrosi n. sp.

Plate 7, Figures 9-11

Description of holotype (male): Color extremely pale yellow; body stout, somewhat swollen posteriorly; last three abdominal segments not clearly separated; head with a number of long, straight or slightly curved setae largely confined to the lateral and posterior portions; first thoracic segment with a single row of setae as described for *O.*

zschokkei;[2] fifth and sixth abdominal segments with a number of very long setae prominent on the sixth, where they make a brush-like cluster at the end; anal horns small and similar in structure to small setae; third antennal sense organ with four slender protective papillae, and a single peg-like sensory rod; two large, flat sensory clubs, irregularly clavate in dorsal (or ventral) view, but slender capitate structures when seen laterally; fourth antennal segment with a small but definite bulb in a subapical pit and 16 large, curved, slightly blunted setae present on the apical part; no ventral organ present; P.A.O. of 18 irregular tubercles arranged in a rough ellipse; claw simple, untoothed with empodial appendage acuminate and reaching about half distance from base to apex of unguis, pseudocellar formula: dorsal surface — 32/122/223320, ventral surface — 1/000/001100.

Variation and Discussion. This species is very similar to *O. zschokkei* in general structure. The chaetotaxy, P.A.O., and general appearance are all similar. It differs in the structure of the third antennal segment sense organ, and the range of variation in the number of lobes of the P.A.O. In the present species this ranges from 14-20, whereas in *zschokkei* it varies from 20-30. There appears to be a great deal of variation in the pseudocelli of *butrosi;* however, it is difficult to determine how much of this is a matter of technical difficulties and how much is real variation. The commonest condition appears to be that described for the holotype. The second thoracic segment may have two and the second abdominal segment one pseudocellus. Abdominal segments three and four occasionally have two pseudocelli on each side of each segment.

Type locality: "The Cedars," Lebanon, elev. 1900 m. Also taken from: American University Campus, Beirut, Lebanon, V-29-52; Barouk Cedars, Lebanon, VI-14-53; Vicinity Bludane, Syria.

Onychiurus fimetarius Linné

Onychiurus fimetarius Linné, 1766, Systema Naturae, ed. 12. 1(2):1013.

Cassagnau reported this species from five localities.

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[2] Extracts from a paper upon *O. zscokkei* by H. Gisin now in press.

I did not recover the species even in collections from the same locality. This difference might be due to collection techniques, as I never used the earth washing method, but it appears more likely that there is a difference of identification. In any case the occurrence of this species, as separate from the new forms described in this paper, must be tentative.

Onychiurus archivari n. sp.

Plate 8, Figures 16-25

Description of holotype (female): Color white; setae on ventral surface of second through fourth abdominal segments very small and numerous; a single large seta on the lateral margin of each thoracic tergite; large setae of dorsal surface becoming larger and more numerous rearward; on fifth and sixth abdominal segments they form double transverse rows; anal horns well developed, about half as long as unguis, slightly curved and situated on very small integumentary rings which have non-confluent bases; pseudocelli equipped with small closing teeth; third antennal sense organ of four slender protective papillae, a pair of slender curved rods, and two smooth pine-tree-shaped sensory knobs; a single small bilobed knob appears on the fourth antennal segment in a deep pit slightly below the apex; ventral surface of fourth antennal segment equipped with numerous small smooth

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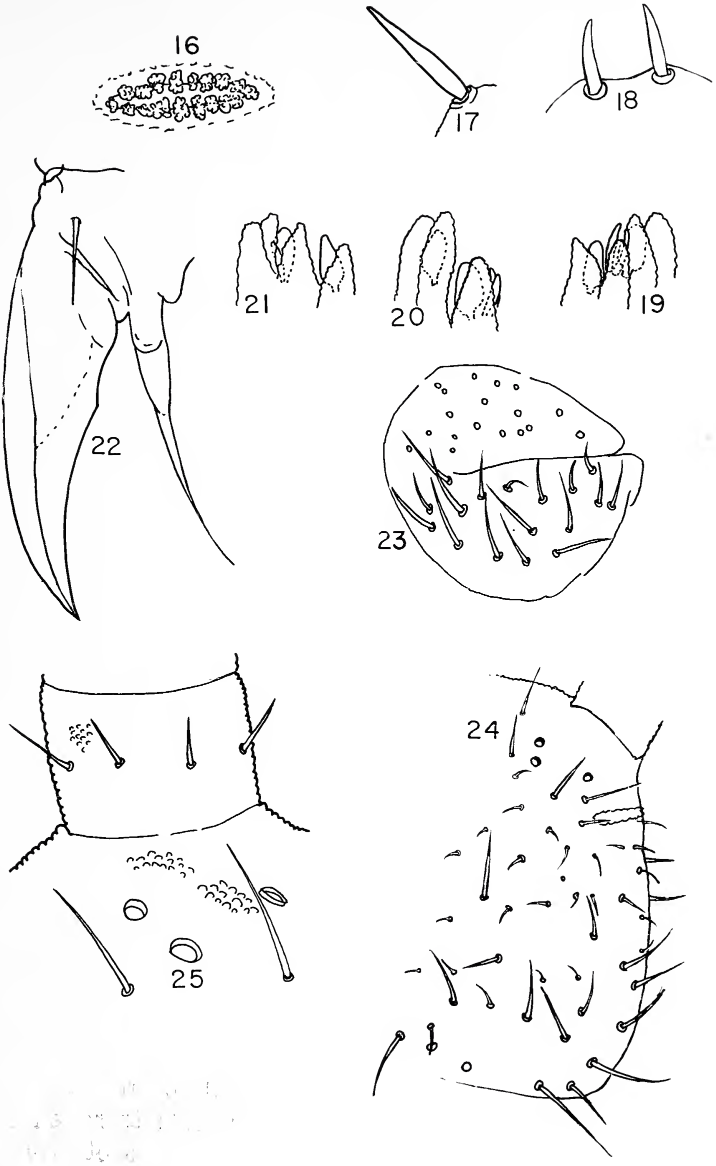
Explanation of Plate 8

Onychiurus archivari n. sp. Fig. 16. P.A.O., specimen from Ain Z'halte Cedars, Lebanon. Organ length 28 micra. Fig. 17. Anal spine of same specimen. Length 20 micra. Fig. 18. Anal spines paratype. Length 19 micra. Fig. 19. Third antennal segment organ, specimen from Ain Z'halte Cedars, Lebanon. Organ length 22 micra. Fig. 20. Third antennal segment organ of paratype. Magnification as above. Fig. 21. Third antennal segment sense organ another paratype. Fig. 22. Left hind claw holotype. External edge unguis 49 micra. Fig. 23. Male genital plate paratype. Organ length 38 micra. Fig. 24. Dorsal surface of head of paratype. Fig. 25. Right antennal base, specimen from Ain Z'halte Cedars, Lebanon.



Christiansen — Onychiurus

setae, dorsal surface with many long curved ones, those near the apex somewhat heavier and blunter than the remainder; P.A.O. of 14 complex lobed papillae, arranged in an elongate ellipse; claw untoothed, apical filament of gradually acuminate empodial appendage exceeding level of apex of unguis; integument of antennal bases not clearly distinguishable from that of remainder of head; no furcula remnant visible; pseudocellar formula: 32/123/333330; no ventral pseudocelli seen; bases of coxae each with a pair of pseudocelli.

Variation and Discussion. The sensory knobs of the third antennal sense organ vary from more or less triangular as described to an almost circular shape. Most specimens have triangular or oval organs or some compromise between these. The number of pseudocelli varies a good deal. The condition described for the holotype is that found on the majority of adult specimens. The first three abdominal segments may have four or, rarely, five pseudocelli. The coxal bases often appear to have a single pseudocellus, but this may be due to the structure of this organ which tends to hide the pseudocelli in integumentary folds. The number of lobes in the P.A.O. varies from 12 to 18.

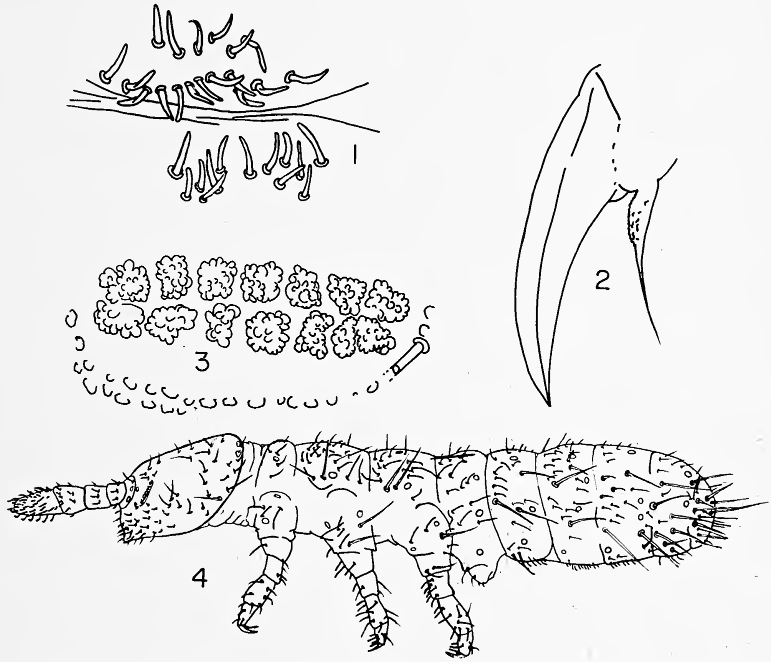
This species is a member of the *ambulans* group and is unique in its absence of ventral pseudocelli. Among the species of this group it appears to be most closely related to *boldorii* and *stillicidii,* but differs from both of these by the complete absence of a ventral organ on the adult males, in addition to the distribution of the pseudocelli.

Type locality: Barouk Cedars, Lebanon, VI-14-53, elev. 1700 m. Also taken from: Hadeth Cedars, Lebanon, elev. 1700 m., VII-19-53; Ain Z'halte Cedars, Lebanon.

Onychiurus fazii n. sp.

Text-figure 1; Plate 7, Figures 12-15

Description of holotype (male): Color pale yellow; body stout, bluntly rounded and expanded posteriorly. For chaetotaxy see figures. Anal horns absent; third antennal segment sense organ with four granulate protective papillae, a pair of subcylindrical rods, and a pair of flattened, ovoid, bifid, sensory knobs; P.A.O. with 16 complex lobed sensory papillae arranged in a narrow ellipse; tubercles of the integument very coarse on head and dorsal surface of body, smaller on antennae with line of demarcation sharp; unguis untoothed; empodial appendage expanded basally but without lamella; filamentous extension of appendage, reaching three-quarters distance from base to apex of unguis; fourth antennal segment without unusually thick setae, but with well developed subapical bulb in a deep pit; pseudocellar formula: dorsal surface — 32/123/333330, ventral surface—0/000/111100; each leg base has a pair of pseudocelli; no clear ventral organ (see discussion below).



Text-figure 1. Characteristic structures of *Onychiurus fazii* n. sp. 1. Male ventral organ, specimen from vic. Sidon, Lebanon. 2. Hind unguis, specimen from Ain Z'halte Cedars, Lebanon, external edge 58 micra. 3. P.A.O., same specimen, length organ 60 micra. 4. Habitus paratype, length 2.4 mm.

Variation and Discussion. This species is one of the most variable known in the genus. At one point I decided that it actually represented two separate species, but further studies showed that the various differential characteristics varied individually from population to population making it impossible to separate out two clear entities. Unfortunately, the samples available at present are small, and any final settlement of the taxonomic status of the several variations seen in this species must await careful analysis of further collections.

The most striking variation concerns the male ventral organ. Some populations lack this entirely even in adult specimens, while other populations have a well developed ventral organ (see figure) consisting of a number of finger-like setae situated around the border of the second and third abdominal segments. In some populations, apparently, adult males exist both with and without this organ. The ventral pseudocelli may be entirely absent, while in a few forms a single pair of ventrals occur on the head. The dorsal surface of the third and fourth abdominal segments may have four pseudocelli, while the leg bases may have only one or one on the first pair and two on the remainder. The apical filament of the empodial appendage may exceed the apex of the unguis or only reach to its middle. The chaetotaxy also varies a great deal, particularly in the posterior parts of the abdomen. It is quite possible that larger series will show this to be a species complex rather than a single variable form.

Type locality: American University Campus, Beirut, Lebanon, X-53. Also taken from: Chamlane, Lebanon, XII-13-53; Ain Z'halte Cedars, Lebanon, XI-2-53; Latakia, Syria, just below Turkish border, VII-2-53.

Metaphorura bipartita Handschin

Metaphorura bipartita Handschin, 1920, Verh. Naturf. Gesel., Basel. 32:1-37.

The specimens of this species appear to be very typical. Cassagnau found it in two places, Jezzine, 6-XI-51, and Sources de Habani, 22-XI-51. I located it in two other places, 14 km. South of Sidon and Ain Z'halte, Lebanon.

Stenaphorura quadrispina Börner

Stenaphorura quadrispina Börner, 1901, Zool. Anz. 24(133):1-15.

The specimens of this form (about 12) all came from a single collection: Ain-Tiffaha (vicinity Quaranita), Lebanon, VII-31-52, elev. 1500 m. They differ from the forms described by Stach by having the anterior horns more than half as long as the posterior pair.

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FLIGHT ACTIVITIES OF THE ANT *DOLICHODERUS* (*HYPOCLINEA*) *MARIAE* FOREL[1]

By Mary Talbot

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Often some reference is made to the "flight" of a species of ants as if all the males and females left the colony on one day. W. M. Wheeler, in his 1905 account of the genus *Dolichoderus*,[2] said of *D. mariae*: "August 20 is approximately the date of the nuptial flight of this species." Today it is generally understood that there are usually a number of flights. This study shows that *D. mariae* is conspicuous in this respect.

In 1954 a long series of flights of a colony of *D. mariae* was observed at the Edwin S. George Reserve, Livingston County, Michigan. This colony was a large one, which nested in a blackberry patch (*Rubus allegheniensis* Porter) on a slope facing northwest above Southwest Swamp. The nest had been made by digging out the sandy soil around a blackberry stalk to form a central cavity below ground. Where this was bridged across by roots and stems, great masses of ants rested and placed their brood. Above this they had built a beautifully constructed little igloo, which extended the central cavity aboveground. It was four inches high and seven inches across and was made of dried leaves, small twigs and grass blades, all lightly put together and held in place by the stems which passed through it. Two blackberry stalks and many grass stems (*Poa compressa L.*) extended above it. Entrances were scattered all over the mound but were inconspicuous be-

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[1] The work was assisted by a grant from the Edwin S. George Reserve Scholarship Fund. Facilities of the Reserve were made available by Dr. T. H. Hubbell, Acting Director, and Dr. Irving J. Cantrall, Curator of the Reserve.

[2] Wheeler, W. M., 1905. The North American Ants of the Genus *Dolichoderus*. Bull. Amer. Mus. Nat. Hist., 21: 305-319.

cause they were simply openings in the mass of stems and leaves.

The nest was found on August 10, 1954, at 10 o'clock in the morning (Eastern Standard Time), and it was a most interesting sight at that time. The whole mound was completely covered with a milling mass of the vivid red and black workers together with three or four dozen equally bright females. Some workers were foraging, but most seemed to be merely "promenading" in the sun, and a few even carried pupae or larvae about with them. Females seemed to have no urge to climb upward above the mound, and if one started down toward the ground, workers would touch or pull her until she walked up to the top again.

The next day males as well as females were promenading with the workers, and it was suspected that a flight might have taken place earlier that morning. To check this assumption, the colony was observed at 8 a.m. the following day. Although the morning was sunny, the temperature was only 55°F and as a result no ants were in sight. At 9 o'clock (58°) a few workers, males and females, were moving slowly on the mound, and by 9:30 a.m. (58.5°) some were climbing blackberry and grass stems directly above the nest. Workers were touching some of the winged ants on the side or back in a fashion which caused them to move upward, but most climbed with no urging. Some ants fluttered their wings as they walked about, but none flew until 9:45 a.m. (65°) when four females flew at one time. Many males and females had come from the mound and had climbed upward on blackberries or grasses, but no more flew, for by this time the mound was in partial sunshine and the temperature rose abruptly to 74°F. By 9:55 a.m. all had come back down, and there was a mass of winged ants and workers on the mound similar to the one seen the day before. Since this does not constitute a good flight, it is suspected that it was the first of the series.

The flight the next day (August 13) was a typical one with many males and females leaving the colony. At

8:30 a.m. (60°) the mound was covered with ants, and a steady procession of males and females was climbing above the nest. Again, workers seemed to push some from behind. The first male flew at 8:34 a.m. (61°) and was followed by a continuous stream of others. Females kept fluttering their wings but did not begin to fly until 8:55 a.m. (65°). In the meantime, tops of berry leaves and blades of grass became greatly crowded with the winged ants, males predominating over females. As both continued to fly, there came to be more females then males on the berry bushes, for males stopped coming from the nest before females did. By 9:30 a.m. (66°) the last male had flown and there were no more winged ants on the mound, but females continued to fly from plants until 9:50 a.m. (69°). Toward the end of the flight, workers became active again, but this time they tapped winged ants in such a way that the latter moved downward.

From this day, ants continued to fly each morning unless the weather prevented. Eighteen flights were watched in the 27 days between August 12 and September 7. Bad weather prevented flights on four days, and on five days no observations were made. Perhaps flights began before August 12, and they certainly continued after September 7, when observations ceased, because there were still males and females in the colony.

During this time an amazing number of ants flew. It was hard to count flying ants, but estimates were made for numbers leaving the nest per minute at various times during flying. At least 15,000 flew from the colony. Largest flights occurred on August 20 and 22 and September 1 and 5, when an estimated 1550, 4370, 1750, and 1500 flew. Smallest flights were on August 12 (4), August 17 (33) and August 26 (57). On the latter two days the weather was unfavorable. The flight on September 6 (the last complete one observed) released over 900 ants — evidence that numbers had not been greatly depleted at that time.

It soon became apparent that the wide fluctuation of time of day of the flights was determined by temperature

(Table I). After a cold night flying was delayed, but if the night had been warm it began while the morning light was still dim. Ants were not found outside the nest at 55° or lower but could walk on the mound at 56° or 57°. Sometimes they could begin climbing slowly at these temperatures, but usually the migration upward did not start until 59° was reached. Males and females both climbed at these low temperatures, but at first males greatly outnumbered females on the leaves. Fortunately, the position of the nest, on a slope facing northwest, kept it in shade during early morning and allowed temperatures to rise slowly enough so that a difference in the reaction of males and females could be distinguished. Males could begin flying as early as 58° but they usually waited until the temperature reached 59° or 60°. Only once did they delay beginning their flight until it was above 64°. That was a morning of dense fog when none flew until 67°. Females never began flying before 63°. When temperatures rose rapidly after a cold night, the two might begin flying at almost the same time, but if temperatures hovered between 58° and 63°, males might fly for 20 or 30 minutes before females began. One overcast morning there was an exclusively male flight because temperatures never rose above 64°, and all of the females walked back down from the vegetation into the nest. The earliest that males began to fly was 5:28 a.m. (67°) and the latest

Table I. Temperatures at which flight activities occurred for the ant *Dolichoderus mariae* Forel. Edwin S. George Reserve, Livingston County, Michigan. 1954.

		Range	Median
Winged ants began to emerge from nest		56°-58°F	57°F
Winged ants began to climb grasses		56°-61°F	59°F
Beginning of flights			
	male	58°-67°F	60°F
	female	63°-67°F	64°F
End of flights			
	male	63°-71°F	66°F
	female	67°-74°F	69°F

was 9:23 a.m. (64°). Extremes for beginnings of female flights were 5:30 a.m. (67°) and 10:40 a.m. (64°).

Flights varied greatly in their duration, depending upon how fast the temperature rose. The longest flight lasted from 5:28 a.m. to 8:05 a.m., but it started early in a dense fog, and later, after both males and females were flying, flight was interrupted for an hour because wings became too wet to be used. One of the shortest flights, lasting 32 minutes, was one of the abundant ones. This occurred on September 1 after two days of bad weather, and an estimated 1750 ants flew. It was a sunny morning and the temperature rose very rapidly from 9:03 a.m. (58.5°) to 9:35 a.m. (72°). On this day males flew for 22 minutes from 9:03 a.m. to 9:25 a.m. (69°) and females for 21 minutes from 9:14 a.m. (63.5°) to 9:35 a.m.

The ending of flights varied greatly as to time. Males have stopped flying as early as 6 a.m. or continued as late as 9:45 a.m.; females as early as 6:25 a.m. or as late as 10:45 a.m. Flights could be stopped by rising temperature; no males were seen to fly at temperatures above 71° nor females above 74°. But often flights ended well below these temperatures. On the four days when the most ants flew, flights stopped at the following temperatures: August 20 — males 64°, females 67°; August 22 — males 66°, females 67°; September 1 — males 69°, females 72°; September 5 — males 70°, females 70°. Perhaps on fine mornings all those which were mature flew before the critical temperature was reached. Sometimes practically all those which climbed vegetation flew; yet at other times many returned to the nest. It seems probable that *D. mariae* flights began shortly after the first winged ants emerged from the pupal stage, and flights continued as others emerged. Darkening sky and lowering temperature could end flights, and on these days many males and females returned to the nest.

Flights were prevented on two days by rain, and on two others, apparently, by high winds. On these latter days, males and females were slow about climbing and after standing about for a while, returned to the nest even though temperatures were favorable.

Workers took an interesting part in flight. During the first days when females were walking on the mound, workers paid no attention to them unless they tried to walk down off the nest. Soon the urge to go upward became well-developed in males and females, and most of them climbed plants directly above the mound without urging. However, workers climbed grass blades and touched some from behind in such a way that they moved upward. In contrast, when flights were slowing for the day, or when weather became adverse, workers became very active in patrolling grasses and touching, or perhaps biting, males and females in a way that induced them to walk downward. Occasionally a worker carried a male, holding it by the dorsal side of the petiole so that the male was upright and to one side of the carrier. More rarely females would be carried, but usually they were simply "herded" down. Often a great many workers would patrol mound and grasses after a flight. Apparently they did not contact winged ants by sight because, if a male moved out of touch, workers walked about at random until they touched it again. Sometimes workers cooperated — three were seen hunting one male, and four worked together to pull a female down a stem. Only once did workers try to prevent a flight. On September 4 at 7 a.m. (59°) for about five minutes, they prevented the males and females from climbing until they pushed their way above the ring of workers on berry stems and grasses and succeeded in having a weak flight.

Spiders profited by flights. On five occasions a spider was seen to capture a male and carry it away, and occasionally a male would fly into a small web attached to grasses near the nest.

VEROMESSOR LOBOGNATHUS IN NORTH DAKOTA (HYMENOPTERA: FORMICIDAE)[1]

By George C. Wheeler and Jeanette Wheeler
Department of Biology, University of North Dakota

In our field studies on the ants of North Dakota we have been in the habit of identifying our collections of *Pogonomyrmex* by casual inspection with the unaided eye. This seemed adequate, since there is only one species of this genus in the state and since we knew of no other ant that could be confused with *Pogonomyrmex.* But after reading Gregg's interesting paper[2] on *Veromessor* we hurriedly re-examined our material under magnification. (See Fig. 1.). Among a hundred nest-series of putative *Pogonomyrmex occidentalis* (Cresson) we discovered one of *Veromessor lobognathus* (Andrews). This is only the sixth collection of this species, but it extends the range northward by 450 miles. Since almost nothing is known about its habits and ecology we hoped that our field notes would contribute something, but we found them disappointingly laconic: "Under flat rock 32 x 20 x 2″ lying on north wall of east-west valley. ATYPICAL." The word "atypical" is significant for it shows that at the time we regarded the ant as *P. occidentalis* and a *Pogonomyrmex* nest under a rock was something we had never seen. Our error was not detected until the autumn or winter of 1955. Consequently we could not return to the site until the summer of 1956. By that time southwestern North Dakota had suffered a year of drouth and ants (except *P. occidentalis*) were scarce and hard to find. We revisited the same hillside and literally "left no stone unturned"; in fact we turned them over twice — the second time after the late summer rains. But we found no trace of the

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[1] This study was aided by a grant from the Louis W. and Maud Hill Foundation.

[2] Gregg, R. E. 1955. The rediscovery of Veromessor lobognathus (Andrews) (Hymenoptera: Formicidae). Psyche 62: 45-52.

coveted *Veromessor*. If moisture conditions improve, we plan to resume our search next summer.

THE LOCALITY

Billings County, North Dakota. T. 140 N., R. 102 W., sec. 1. On an ordinary map it can be located four miles north-northeast of Medora, in Roosevelt National Memorial Park (South Unit). The site is in the heart of the Little Missouri Badlands. June 12, 1954. Collected by G. C. and J. Wheeler, No. 556. Altitude approximately 2500 feet above sea level.

HABITAT

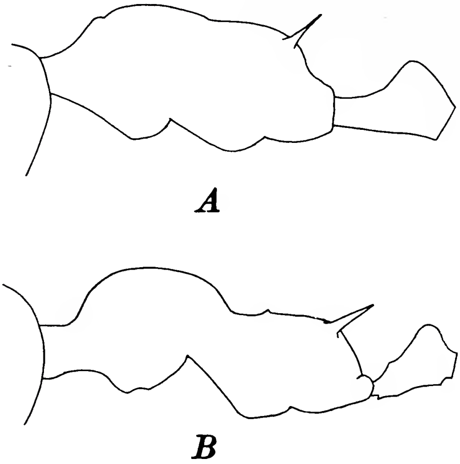
The nest was discovered in a tributary valley entering the valley of the Little Missouri River from the east. This tributary valley is short, narrow, steep-walled and about 200 feet deep at the mouth. At the bottom is a small intermittent stream with little or no flood plain. The soil is a sandy silty loam.

The south wall of the tributary valley is densely covered with a thicket of Rocky Mountain red cedar (*Juniperus scopulorum* Sarg.). The thicket floor is covered with duff and moss and is relatively humid.

In marked contrast, the nearby north wall — as the result of greater insolation — is treeless and sparsely beset with grass and low shrubs, such as sagebrush (*Artemisia frigida* Willd. and *A. tridentata* Nutt.), saltbushes (*Atriplex* spp.) and rabbitbrush (*Chrysothamnus graveolens* Nutt.). Yucca (*Yucca glauca* Nutt.) and prickly pear (*Opuntia polycantha* Haw.) are present but very scarce. The most abundant and conspicuous ant is the western harvester (*Pogonomyrmex occidentalis*). Scorpions (*Vejovis boreus* Girard) are common under rocks.

Our colony of *Veromessor lobognathus* was found under a rock halfway up the north wall. Its occurrence on a slope with southern exposure is significant in interpreting the distribution of this species, i.e., why a southwestern species occurs so far to the north. "The Upper Austral Zone, the Upper Sonoran, or semiarid subdivision of which penetrates only into the warmest corners of the

State, is in no part sufficiently extensive to be marked by entirely characteristic mammals, birds, or plants. In its narrow strips along the Missouri Valley below Bismarck, down the Missouri and Yellowstone Valleys to Williston, along the Little Missouri Valley above the Killdeer Mountains, and on many dry, warm slopes between these areas, it is strongly characterized. So near the edge of a zone, however, the slight inclination of a slope to the north reduces the heat received from the sun's rays sufficiently to change the flora and fauna in part or wholly to that of the colder, higher zone, while a steep slope facing the direct rays of the sun will attract many species of the warmer, lower zone above their normal limits."[3]



Text figure 1. Thoracic profiles of (A) *Pogonomyrmex occidentalis* (Cresson) and (B) *Veromessor lobognathus* (Andrews), both x8.8.

THE LARVA

Genus VEROMESSOR Forel

Body curved ventrally, thorax only moderately stout. Body hairs sparse and short; of three types: (1) the shortest and most numerous, tip simple or bifid; (2) longer,

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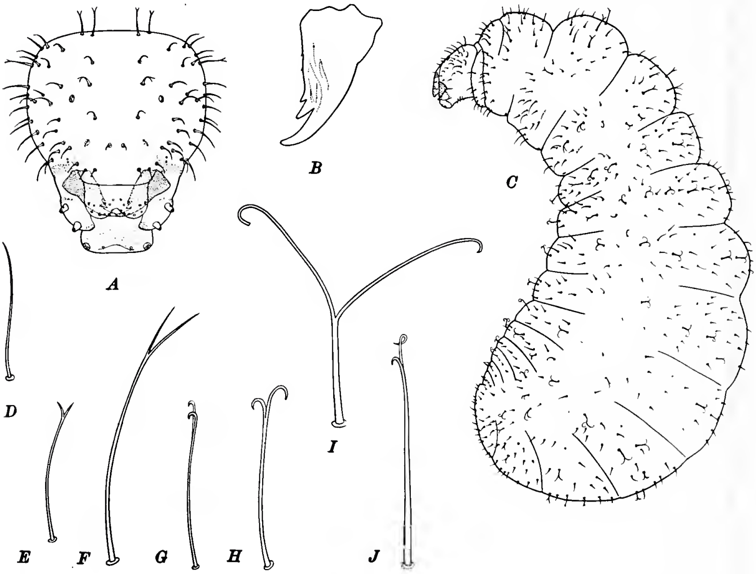
[3] Bailey, Vernon. 1926. A biological survey of North Dakota. U.S. Dept. Agric., Bureau of Biol. Survey, North American Fauna, No. 49, p. 8.

with the tip bifid; (3) also longer, bifid, the branches short to long and recurved at the tip. Antennae minute. Head hairs moderately numerous, short, with the tip simple or bifid. Mandibles with the apex forming a long large round-pointed tooth which is curved medially; the two medial teeth prominent and round-pointed; a few spinules on the medial surface. Maxillae with the apex spinulose. Labium moderately spinulose. Dorsal portion of hypopharynx with sublongitudinal ridges; ventral portion spinulose, the spinules minute and in numerous subtransverse rows.

Veromessor lobognathus (Andrews)

(Text figure 2)

Body length (through spiracles) about 6.8 mm. Stout; diameter greatest at abdominal somite V, diminishing gradually to the anterior end and rapidly to the posterior end, which is broadly rounded. Whole body curved ventrally. Anus ventral. Lateral longitudinal welts present. Leg, wing and gonopod vestiges present. Spiracles small; the mesothoracic the largest. No spinules seen on the integument. Body hairs sparse, short and uniformly distributed. Of three types: (1) 0.036-0.094 mm long, with the tip simple or bifid, on every somite, the most abundant type; (2) 0.094-0.156 mm long, with bifid tip, on the thorax and abdominal somites IX and X; (3) 0.078-0.156 mm long, bifid, with the branches short to long and recurved at the tip, on the metathorax and abdominal somites I-IX. Cranium subrectangular in anterior view, with the occipital angles rounded, slightly broader than long. Antennae minute, each with three sensilla, each of which bears a spinule. Head hairs moderately numerous, slightly curved; short (0.036-0.086 mm long), with the tip simple or bifid. Labrum small, bilobed, breadth nearly twice the length; anterior surface of each lobe with 10 sensilla; ventral border with a few minute spinules; posterior surface spinulose, the spinules minute and in short arcuate rows, the rows transverse dorsally and longitudinal ventrolaterally; posterior surface with two isolated sensilla and a cluster of three sensilla on each lobe. Mandibles rather small; heavily sclerotized; subtriangular in anterior view; the apex forming a long, rather large tooth which is curved medially; medial surface with two rather large round-pointed teeth on the distal half and a few ridges bearing spinules on the proximal half; anterior surface with a few longitudinal ridges. Maxillae with the apex spinulose, the spinules minute and in short arcuate rows; palp paxilliform with one lateral sensillum (bearing a spinule) and four apical (two small and bearing a spinule each and two larger and encapsulated) sensilla; galea digitiform, with two apical sensilla. Labium with the anterior surface spinulose, the spinules minute and arranged in short transverse rows; palp a boss with five apical sensilla; an isolated sensillum between each palp



Text figure 2. Larva of *Veromessor lobognathus* (Andrews). A, head in anterior view, x47; B, left mandible in anterior view, x117; C, larva in side view, x14; D and E, type 1 body hairs, x217; F, type 2 body hair, x217; G and H, type 3 body hairs (with short branches) in side and surface views, x217; I and J, type 3 body hairs (with long branches) in surface and side views, x217.

and the opening of the sericteries; the latter a short transverse slit in an anteroventral depression. Dorsal portion of the hypopharynx with sublongitudinal ridges, ventral portion spinulose, the spinules minute and in numerous subtransverse rows. (Material studied: six larvae from the nest cited above.)

Since this is our only representative of the genus we do not know whether it differs as much from its congeners as does its adult. It does, however, resemble the larva of the closely related genus *Novomessor*.

THE SYNONYMY AND RELATIONSHIPS OF THE ANT PSEUDOLASIUS BAYONI MENOZZI. — The synonymy is as follows:

Pseudolasius Bayonii Menozzi, 1924, Ann. Mus. Civ. Stor. Nat. Genova, 51:224, figs. 5, 6, worker max. Type loc.: Bugala, Sesse I., Victoria Nyanza.

Pseudolasius bayoni, Menozzi, 1932, *ibid.,* 56:115, worker min. from type collection.

Pseudolasius myersi Weber, 1943, Bull. Mus. Comp. Zool., 93:389, pl. 16, fig. 35, worker. Type loc.: Lotti Forest, w. slope Imatong Mts., Equatoria, Sudan. **New synonymy.**

Pseudolasius myersi occipitalis Weber, 1950, Amer. Mus. Novit., 1443:2; figs. 1-18, workers max., min., larva, egg, polymorphism, biology. Type loc.: Busnia, Uganda. **New synonymy.**

When Weber described *myersi* and *occipitalis,* he was unaware of Menozzi's *bayoni* descriptions of 1924 and 1932, as is shown by his omission of this name from his list of the African *Pseudolasius.* Two minor workers from the *bayoni* type nest series have now been compared with two syntypes of *myersi* in the Museum of Comparative Zoology, and agreement is good. The race *occipitalis* appears from the description to be nothing more than the major worker of the same species. *P. bayoni* normally has six mandibular teeth counting the large apical tooth. Menozzi counted five teeth, but may have excluded the apical. Some specimens, especially in a series from near Epulu, Belgian Congo (T. Gregg), tend to have a small seventh offset tooth developed near the basal angle. The related *P. gowdeyi* Wheeler is larger and usually has five mandibular teeth, although occasionally a minute sixth intercalary or basal tooth is present. — W. L. BROWN, JR., Museum of Comparative Zoology, Harvard University.

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NOTES ON THE ANT *LEPTOTHORAX PROVANCHERI* EMERY

BY PAUL B. KANNOWSKI

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The ant, *Leptothorax provancheri* Emery (= *L. emersoni* Wheeler, *L. e. glacialis* Wheeler, and *L. e. hirtipilis* Wheeler), is interesting because of its peculiar habits, rare occurrence, and unusual distribution. It has long been known as an inquiline in the nests of *Myrmica brevinodis* Emery, and, until recently, it was thought that this relationship was obligatory on the part of *provancheri.* Cole (1954, p. 241) indicates that this species is able to live independently (under stones), at least in the mountains of New Mexico. The habits of *provancheri* were first noted by Wheeler (1901). He had discovered that its nests were intimately connected with the galleries and chambers of *Myrmica brevinodis* nests. In this and a later paper (1903a) on *provancheri,* Wheeler presented an interesting and detailed analysis of the symbiotic relationship between *provancheri* and its host.

Wheeler stated that the nests of these two ants were found in the Litchfield Hills near Colebrook, Connecticut, "under some small stones that were rather deeply imbedded in the moss bordering the exposed glaciated rock of the hilltop" (1901, p. 432). The habitat of *provancheri* was later expanded by Wheeler (1903b, p. 231) to include nests with *M. brevinodis* "in the hummocks of moss (*Polytrichum commune*), under stones, bits of wood, etc., in rather damp, grassy bogs."

The ants of three sphagnum bogs in Livingston and Washtenaw counties, Michigan, have been under study for the last four years. The occurrence of several species of *Myrmica* in various plant communities of the bog sere has been noted, including *M. brevinodis* and *M. fracticornis* Emery. In spite of intensive observations on approximately 300 *Myrmica* colonies, no nests of *provancheri* have been found.

On the morning of July 22, 1955, several hours were spent in Mud Lake Bog, Section 7, Munro Township, Cheboygan County, Michigan, searching for nests of *M. fracticornis*. Colonies were found in an immature leatherleaf community, which was characterized by a continuous sphagnum surface and numerous small clumps of shrubs and small trees, composed largely of leatherleaf, highbush blueberry, black spruce, and tamarack. The remains of some dead coniferous trees indicate that this is probably a disclimax community produced by a fire sometime within the last twenty years.

The hummocks of moss at the base of the south edge of a clump of the trees and shrubs named above contained a populous colony of *fracticornis*. While this nest was being sampled, several workers of *provancheri* were discovered moving about the galleries and chambers of the nest. Seven *provancheri* workers were collected and kept alive with a small portion of the *fracticornis* colony. Other workers of *provancheri* were carefully watched in order to find the location of their nest. These workers were soon lost, and their nest was not located. Most likely it was somewhere on the periphery of the *fracticornis* nest, and it may have been destroyed or displaced during collecting.

Smith (1951, pp. 821-822) cites records for *provancheri* and its synonyms from four New England States, Colorado, and Alberta, Canada, and it also occurs in North Dakota (Kannowski, 1956). The present record is the first from Michigan and, together with the North Dakota locality, ties together a previously discontinuous distribution. Cole's record from New Mexico is the only extension to the geographic range of this ant given by Creighton (1950, pp. 279-280). The range of *provancheri* is blanketed by the ranges of both of its known host species (see Creighton, *op. cit.*, pp. 96 and 100). Therefore, *provancheri* could have a much more extensive range than that which is presently known. The rarity and limited distribution of this species seem to be due to three factors: 1) very few areas within its hypothetical range have been studied intensively; 2) *provancheri* workers may easily be overlooked because of their small size and relatively few numbers (in comparison with the numbers of the host species); 3) because of environmental factors, its range is more restricted than that of its hosts.

The apparent absence of *provancheri* in bogs in southeastern Michigan indicates that the factors governing its distribution are different from those governing the distribution of the two host species. The bogs that have been studied in Livingston, Washtenaw, and Cheboygan counties are composed of similar plant communities, and the edaphic conditions are similar. Climatic conditions seem similar except for the extremes of temperature found in the two regions. Summer temperatures in southeastern Michigan are higher than those of Cheboygan County, and these high temperatures occur for longer periods of time. The temperatures in southeastern Michigan may be too high for the proper development of *provancheri* colonies, although this factor may not be critical in the case of the two species of *Myrmica.* The presently known range of *provancheri* strongly suggests an adaptation to regions of cool temperatures.

Myrmica fracticornis has not previously been recorded as the host of any inquilinous ant, probably as the result of insufficient study of ants in the moist environments of northeastern North America. Additional records should turn up in the future. It also seems probable that other species of *Myrmica* may be found as hosts of *provancheri.*

Seven *provancheri* workers were kept for about two months in an artificial nest with a small fragment of the *fracticornis* colony, including one queen, four alate females, three males, about 50 workers, and a small quantity of larvae and pupae. Random observations of the mixed nest during this time showed that the *provancheri* workers were accepted by the *fracticornis* colony; no evidence of hostility between the two groups was ever observed. The two groups utilized separate areas for nest sites, but each permitted the other within its own area. The *provancheri* workers were seen to "shampoo" the backs and heads of *fracticornis* workers and females and to receive regurgitated food in return just as Wheeler (1901) had observed to occur between *provancheri* and *brevinodis.* The *provancheri* and *fracticornis* workers were also observed feeding together on honey, syrup, and water that was placed in the chambers, but only the *fracticornis* workers were seen to feed upon the bodies of freshly killed insects (roaches, flies, lacewing-flies, and collembolans) that were also introduced into the nest.

From the above observations it seems evident that *provancheri* is in an early stage of social parasitism as indicated by its ability to live independently in part of its range, whereas in other parts it requires the presence of *Myrmica* nests. In those areas where it lives as an inquiline it is also probable that the colony-founding female seeks first a suitable environment (one that is both moist and cool), and, once there, seeks a *Myrmica* nest. In Michigan bogs the choice of *Myrmica* nests in the open mat zone is largely restricted to *brevinodis* and *fracticornis.*[1] In other areas (North Dakota, for instance) *Myrmica brevispinosa* Wheeler may occur in the same or similar environments as those occupied by *brevinodis* and *fracticornis.* The rarity of *provancheri* and *fracticornis* combinations may indicate that *fracticornis* tolerates the inquilines less frequently than *brevinodis* does. The similarity of the behavior of *fracticornis* and *brevinodis* in response to the "shampooing" by the *provancheri* workers suggests that this behavior pattern may be common to other more closely related species of *Myrmica.*

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[1] A third species of *Myrmica* of uncertain identity is also present in southeastern Michigan bogs.

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THE ARMY ANT AENICTUS EXIGUUS CLARK A SYNONYM. The description and figure of *Aenictus exiguus* Clark, 1934, Mem. Nat. Mus. Vict., Melbourne, 8:21, pl. 2, fig. 1, worker (type loc.: Cairns district, northern Queensland) agree well enough with samples from Queensland, New South Wales, and New Guinea of *Aenictus turneri* Forel, 1900, Ann. Soc. Ent. Belg., 44: 75, worker (type loc.: Mackay, Queensland), except for the low measurement ("1.7 mm.") given by Clark for his types. This measurement, like others that have been checked from Clark's ant descriptions, appears to be excessively small, even for such a size-variable species as *turneri*. Particular similarities in the critical characters of head and mandible form, and shape of propodeum and ventral process of petiole, all indicate that *Ae. exiguus* must be considered a **new synonym** of *Ae. turneri*. Brown, 1952, Psyche, 58: 123, had already placed *Ae. deuqueti* Crawley as a synonym of *Ae. turneri* after examining type material. — W. L. Brown, Jr., Museum of Comparative Zoology.

FURTHER NOTES ON THE GENUS *EREMOLEON* BANKS, WITH A NEW SPECIES (NEUROPTERA: MYRMELEONTIDAE)[1]

By Phillip A. Adams
Biological Laboratories, Harvard University

The material described below was not seen by the writer in time for inclusion in the list of species of *Eremoleon* given in a previous paper (Psyche **63**: 82-108, 1957).

Eremoleon cerverinus (Navas) **new comb.**

Figure 1 a, b, c

Belen cerverinus Navas, 1921, Broteria **19**:119 (Genotype *Belen* Navas 1921).

A small species, somewhat like *E. macer* in appearance. Antennal segments all broader than long. Vertex and pronotum as in fig. 1a. Setae on head and thorax all white, on legs, mostly black. Apical segment of fore tarsus approximately as long as four preceding segments, cylindrical, with ventral setae evenly spaced. Mesepimeral wing process light brown.

Abdominal tergite 2 dark, 3-7 pale basally, apical halves black. Paramere plates rhomboidal, sculptured area not extending over entire surface of plate (fig. 1b).

Wings slender. Fore wing with 9-11 veinlets from $PCu+A_1$ to hind margin; in holotype 4-5, prestigmatic costal veinlets connected. Cubital field of hind wing with three rows of cells. Venation mostly pale, many cross veins dark; small brown spots at rhegma and base of stigma.

Measurements (mm.): fore wing 24. long, 6.2 wide; hing wing 23. (♂) — 23.5 (type) long, 5.0 wide; antennae 4.2 (type); 3rd abdominal tergite 3.0 (♂).

The holotype (No. 15125) and a ♂ from Rio Almendares, Habana, Cuba, Cervera col., are in the Museum of

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[1] Published with the aid of a grant from the Museum of Comparative Zoology at Harvard College.

Comparative Zoology. To the type has been affixed a ♀ abdomen from a specimen of another species.

E. macer may be differentiated from *cerverinus* by its more slender labial palpi, and by its having a swelling, bearing a dense brush of setae, on the ventral side of the apical tarsomere. *E. pallens* has no distinct vertex markings, has black setae on the pronotum, and four rows of cells in the cubital area of the hind wing.

The character upon which Navas based his genus *Belen*, anastomosis of several prestigmatic cross veins, is present in the holotype, but not in the male. There being no other character of generic significance separating *cerverinus* from the other species of *Eremoleon*, *Belen* must be considered a synonym of that genus.

Eremoleon sectoralis, new species

Figure 1 d, e

Lower face and mouthparts pale, frons and vertex fuscous. Vertex scars brown-suffused; pattern like that of *cerverinus* (fig. 1a), but two lateral spots of second vertex row are fused. Scape shiny brown, pedicel brown above. Palpi (fig. 1e) slender. Thorax brown-fumose above, pale yellow below, no distinct macular pattern. Mesepimeral wing process honey-yellow. Legs pale, brown-dotted at setal bases; brown bands at apex of femur, near base and at apex of tibia, and at tip of last tarsomere. Fore tibial spurs equal 3½ tarsomeres in length, hind spurs, 2½ tarsomeres. Apical segment of fore tarsus cylindrical, length 0.37 times that of entire tarsus. Abdomen brown-fuscous, without distinct markings; 2nd and base of 3rd sternite, and segments 7-10, pale.

Setae mostly dark, except some pale on frons, clypeus, cervical sclerites, meso- and metapleurae, base of fore coxa, and 2nd and 3rd abdominal sternites. Pronotal setae shorter than those of *cerverinus*, and more numerous behind furrow. Setae on apex of 9th abdominal tergite, and posteroventral portion of 10th, short (less than 0.14 mm. long), black, stout, decumbent; tips flattened, expanded, blunt.

Wings (fig. 1d). Basal costal veinlets widely spaced; cross veins absent from first few branches of Rs. Venation

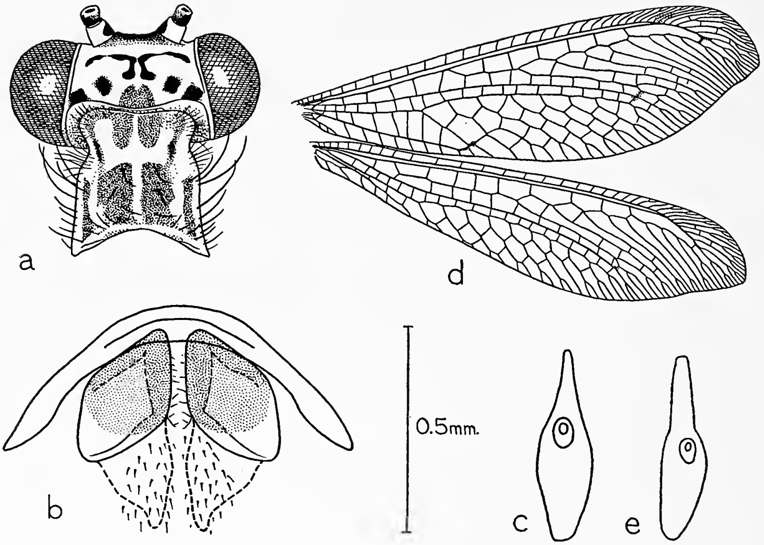

Fig. 1. *Eremoleon cerverinus* (Navas): a — vertex and pronotum, b — gonarcus and parameres, c — last segment, labial palpus. *E. sectoralis* n. sp.: d — wings, e — last segment, labial palpus. Scale for figs. b, c, e only.

mostly brown, some pale streaks along main veins of fore wing and C, Sc and R in hind wing. Faint brown spots at stigma, apex of hypostigmatic cell, rhegma, and end of CuA_2 in fore wing, at rhegma in hind wing.

Measurements (mm.): body length, 22.; abdomen 16.5; fore wing length 23.; pterothorax 3.9; 3rd abdominal tergite 3.6.

Holoytpe ♀: 5 mi. S. San Miguel, L. Calif., 20-VII-38, Michelbacher and Ross, in the California Academy of Sciences. This specimen is a paratype of *E. affine* Banks (= *E. nigribasis* Banks).

The wing shape and lack of cross veins between the first few branches of Rs are characteristic of this species. *Sectoralis* resembles *E. pallens* Banks, which differs in having broader, pointed wings, with 4 rows of cells in cubital field of hind wing, pale pedicel and scape, no dark dots on legs, and long (up to 0.36 mm.), pointed, straight setae on 9th abdominal tergite of ♀.

DESCRIPTIONS AND RECORDS OF NEOTROPICAL CONOPIDAE (DIPTERA)

By Sidney Camras
Chicago, Illinois

The first part of this paper may be considered an addendum to my work on New World *Conops* and allies (1955, Proc. U.S. Nat. Mus., **105**, 155-187). A number of other apparently new forms have been seen; but I am awaiting more material, or the opportunity for a revisional study in the case of *Zodion.*

Diconops, subgen. nov.

Belonging to the genus *Conops*, but having a relatively long and narrow second abdominal segment. Second abdominal segment (female) dorsally, about three times as long as wide, sides parallel. Third segment about three-fourths as long as second, apex nearly two times as wide as base. One propleural bristle on the type species, none on the other species. Posterior margin of eye more concave than usual. Polished triangular area at posterior margin of eye nearly absent.

Type: *Conops trichus*, sp. nov.

This subgenus could be placed in *Physoconops*, as a group lacking the ocellar tubercle; but I consider the absence of the ocellar tubercle more characteristic of the genus *Conops* than the wide abdomen.

The male is as yet unknown.

Conops (Diconops) trichus, sp. nov.

Holotype ♀: Brazil: Nova Teutonia, Santa Catarina, Nov. 1952, F. Plaumann (author's collection).

Vertex yellow, rounded anteriorly, black laterally. Front yellow with black "T" pattern. Face and upper grooves yellow. Lower face and grooves, and cheeks black. Facial grooves and orbital yellow pollinose. Occiput black. Antenna mainly black. Reddish yellow on third segment medially and on the first segment. First antennal segment four times as long as wide. Second segment nearly twice as long as first. Third segment about three-fourths as long as second. Arista three segmented, without lateral process on the second segment. Proboscis nearly twice as long as head; black, with yellow on apical ventral half.

Thorax black. Gold pollinose faintly on dorsum, with distinct areas medial to the humeri, at base of wings, and at the scutellum. Pleura with distinct yellow pollinose stripe. Legs brownish yellow, partly black on coxae, apical tarsal segments, and most of claws. Wings yellowish hyaline, with brownish yellow pattern between first vein and third vein and vena spuria. Yellow in costal, subcostal, and first basal cells. Calypters and halteres brownish yellow.

Abdomen black, yellow at fused junction of second and third segments. Apical margin of third segment, fourth, fifth, and sixth segments yellow pollinose, more distinct at distal margin. The hairs on the third to sixth segments more distinct than usual. Theca and genital segments shining black. Subapical genital segment mainly reddish. Theca as long as wide, and relatively thin.

Size: 14½ mm. (without antenna).

Paratype ♀: same data, Dec. 1952.

Similar to the holotype. Posterior femora darker at basal half. Theca yellowish anteriorly.

Size: 15½ mm.

This species keys to *Physoconops gracilior* (Camras, 1955, Proc. U. S. N. M., **105**:186) but differs in the color of the vertex, facial grooves, cheeks, etc., in addition to the generic difference.

Conops (Diconops) geminatus, sp. nov.

Holotype ♀: Peru: Monson Valley, Tingo Maria, Dec. 11, 1954, E. I. Schlinger and E. S. Ross (California Academy of Sciences, San Francisco).

Vertex yellow, black on each side forming a velvety black triangular mark on each side of the front with the black "T" pattern of the front. Remainder of front, face, and upper facial grooves yellow. Cheeks and remainder of facial grooves black. Facial grooves, orbitals and interrupted post-vertical stripe gold pollinose. Occiput black. Antenna black. First antennal segment four times as long as wide. Second segment nearly two times as long as first. Third segment one and one-half times length of first. Arista three segmented. Lateral process on second segment indistinct. Proboscis two times length of head, black with yellow on about distal ventral half.

Thorax black, with considerable gold pollen on dorsum covering it completely in certain views. In other views, there are three black stripes on the dorsum. A distinct gold pollinose pleural stripe is connected with the gold pollen of the dorsum. Legs yellow; blackish partly on coxae, base of hind femora, tarsi, except base of first tarsus, and claws. Wings hyaline, brownish pattern between costa, and third vein and vena spura. The dark pattern in the first posterior cell is confined to less than the anterior half. Calypters dark yellow. Halteres bright lemon yellow, brown at base of stem.

Abdomen black, yellowish at junction of second and third segments. Gold pollinose at junction of first and second, second and third, and distal margins of remaining segments. Fifth, sixth, and base of seventh segments gold pollinose. Genital segments and theca dark reddish yellow. Theca as long as wide.

Size: 8½ mm. (without antenna).

This species is similar to *trichus* but differs mainly in the color of the front, thorax, and wings. Although very different in appearance, they are probably geographical representatives. This species keys to *Physoconops antennatus* (Camras, 1955, Proc. U. S. N. M. **105**:186) but differs in generic and color characters.

Physoconops parsonsi Camras

1955, Proc. U. S. Nat. Mus., **105**, 171.

The types of this species had been erroneously placed in the U.S. National Museum Collection. P. J. Darlington, Jr., called our attention to this, and the types have been returned to the Museum of Comparative Zoology.

Physoconops pictus (Fabricius)

In the above mentioned paper (p. 166), the specimens from Havana, Cuba, and Manneville, Haiti, recorded from the U.S. National Museum, likewise belonged to the Museum of Comparative Zoology, and have been returned to that collection.

Physoconops (*Shannonoconops*) *apicalis* Camras

1955, Proc. U.S. Nat. Mus. **105**, 172.

This distinctive form was described from a male from Mato Grosso, Brazil, and a female from Peru. Since then, I have received a male and a female from Nova Teutonia, Santa Catarina, Brazil, collected by F. Plaumann.

Physoconops analis (Fabricius)

This name replaces *Physoconops angustifrons* (Williston) in my review (1955, Proc. U.S. Nat. Mus. **105**, 178).

This important change of names has been made in my paper on New World *Physocephala* (1957, Ann. Ent. Soc. Am. 50, 217), but is repeated here as it is apt to be overlooked.

Zodion rossi, sp. nov.

Holotype ♂: Mexico: San Luis Potosi; 40-50 miles N. W. C. del Maiz, Nov. 20, 1948, E. S. Ross (California Academy of Sciences, San Francisco).

Head pale yellow. Sides of upper front and vertex dark reddish. Center of ocellar tubercle black. Upper occiput blackish, lower occiput yellow. Antenna deep yellow, somewhat orange on third segment. First segment very short, shorter than wide. Third segment slightly longer than second. Arista black. Proboscis one and one-half times length of head; black, brownish at base. Palpi slightly longer than width of proboscis at base.

Thorax yellow. Dorsum black with grayish yellow pollinose submedian and sublateral lines. These lines joining posteriorly. The sublateral line is interrupted in the middle by the transverse suture. Humeri, light yellow. Scutellum deeper yellow, with a large tuft of black hairs on each side. Apical margin of scutellum slightly concave.

Pleura mainly yellow. Sternopleura mainly black. Legs mainly yellow, dark reddish distally and dorsally on the femora. Tibiae more yellowish in the middle. Apical tarsi and apical half of claws black. Wings hyaline, yellow at base. First posterior cell long petiolate. Calypters light yellow. Halteres light yellow, dark reddish at base.

Abdomen mainly deep yellow with paler yellow distal margins. Blackish red on first, basal two-thirds of second, about basal one-half of third, and basal centers of fourth and fifth segments. Sides of second and third segments yellow. Genital segments darker yellow.

Size: 5 mm.

Allotype ♀: Same data.

Similiar to the holotype. Dorsal third of front and vertex rufous. Abdomen more predominantly dark rufous on most of the segments dorsally, yellow laterally and on distal margins. Median longitudinal yellow band on fifth, sixth and seventh segments. Genital segments black. Theca apparently as long as wide. Size: 5½ mm.

Paratype ♂: Same data. (Retained in author's collection).

Similiar to the holotype, but somewhat more rufous on vertex and abdomen. Size: 4½ mm.

This very distinctive form differs structurally from the other species of *Zodion* in the scutellum and wing venation, and could be placed in a separate subgenus.

Scatoccemyia, gen. nov.

Similar to *Occemyia* but having a markedly thickened anterior cross vein, shorter, thicker antenna, more quadrate shaped head, a fronto-facial black mark, more prominant rows of bristles on ventral surface of femora, more pollinose (less shiny black) coloration, and more hairy appearance.

Type: *Scatoccemyia plaumanni,* sp. nov.

This genus resembles a Scatophagid. Since the genus *Occemyia* has not been found in South America as yet, this genus may be replacing it on that continent.

Scatoccemyia plaumanni sp. nov.

Holotype ♂: Brazil; Santa Catarina; Nova Teutonia, September 1955, F. Plaumann (author's collection).

Vertex black, darker laterally and on ocellar tubercle. Three distinct ocelli. Front rufous, darker near vertex. Face, facial grooves, and cheeks yellow, rufous in some areas, blackish in center of grooves. A black mark at the fronto-facial junction which is lower than antennal base, more than usual, due to antennal base being higher than usual. This gives the more quadrate shaped head when viewed from the side. A black line along oral margin. Cheeks more than half of eye-height. Occiput blackish above, dark yellow below, yellowish gray pollinose. Antenna, including arista, black. Medial surface of second antennal segment dark reddish. Basal half of third antennal segment bright rufous. First antennal segment as long as wide. Second segment two times length of first. Third segment two times length of second. Proboscis black, geniculate at middle. Middle segment two times length of head.

Thorax black, brownish pollinose. Dorsum with indistinct dark lines. Legs mainly black, basal half to three-fifths yellow. Anterior surface of anterior femur dark yellowish. Ventral apical margin of anterior and middle femora dark yellow. Tibiae partly yellowish, especially at base and center of posterior tibia. Tarsi partly yellowish. Apical tarsal segment and apical half of claws black. Wings hyaline, faintly brownish along the veins. Stigma at apex of first and second veins yellowish. Anterior cross-vein markedly thickened in the middle. First posterior cell widely opened. Opening slightly longer than anterior cross vein. Calypters pale yellow. Halteres yellow, dark reddish at base of stem.

Abdomen black, yellowish gray pollinose more distinct laterally and along distal margin of each segment. Distal margin of fourth and fifth segments and most of sixth segment dark reddish. Genitalia mainly black.

Size: 5½ mm. (without antenna).

Stylogaster lopesi, sp. nov.

Holotype ♀: Brazil: Santa Catarina; Nova Teutonia, Dec. 7, 1949, F. Plaumann (author's collection).

Ocellar triangle shining black, nearly equilateral, and nearly touching the frontal lunule. Front velvety black. Orbitals, face, and cheeks yellowish white pollinose. Facial keel with narrow black line. Occiput black above, gray pollinose laterally and below. Antenna dark yellowish, brighter on inner ventral surface of third segment. Arista black. First antennal segment as long as wide; second segment four times as long as first; third segment as long as second, gradually narrowing apically. Proboscis black, yellowish on apical third of distal segment. Apical segment about three times length of head.

Thorax black, yellowish on humeri and pleura at base of wing. Dark yellowish at posterior calli. Anterior and middle coxae yellowish black, posterior coxa deep black. Trochanters mostly black. Anterior and middle legs yellow except blackish at base of femora, apical tarsi, and claws. Posterior femur black with narrow yellow band just proximal to the middle. Posterior tibiae black with distinct white preapical band, which is entirely white haired. Posterior tarsi and claws black. Wings dusky hyaline, slightly brownish anteriorly. First posterior cell widest at distal third and wider than submarginal cell. Calypters whitish yellow. Halteres yellowish, reddish at apex and base of stem, the club blackish.

Abdomen black, yellowish in two spots at base of first segment and triangular basal sides of remaining segments. These pale areas are largest on third and fourth segments. Hairs on sides of first segment white. Those on second segment mostly white but with some black bristles. Ovipositor mainly black, reddish on narrow first segment, narrow base of second segment, and narrow base of third segment. Third segment white on distal three-fifths, reddish yellow at apex with black genital structures. Ovipositor black haired except for proximal one-half to two-thirds of white area on apical segment.

Size: 16 mm. (without antenna). Ovipositor 7 mm.

Allotype ♂: Brazil: Nova Teutonia, Oct. 1952, F. Plaumann (author's collection).

Similar to holotype. Sixth and seventh abdominal segments black. Genitalia yellow. Two patches of yellow hairs on dorsum of seventh segment. No black bristles on sides of second segment. Size: 10 mm.

Paratype ♀: Brazil: Nova Teutonia, Nov. 9, 1951, F. Plaumann (Natural History Museum, Basle, Switzerland).

Similar to holotype. Dark areas somewhat more extensive. Size: 15 mm. Ovipositor 7 mm.

Paratype ♂: Brazil: Nova Teutonia, Oct. 1954, F. Plaumann (author's collection).

Similar to the allotype. Size 11 mm.

Paratype ♂: Brazil: Nova Teutonia, Nov. 1950, F. Plaumann (author's collection).

Similar to the allotype. Size 10½ mm.

This species keys to Curran's couplet 7, differing from the alternatives in the female by having the apical segment of the ovipositor black haired proximally and apically, and white haired on about the middle third. In the male, this species differs from the alternatives at couplet 7, by having the basal three-fifths of the posterior tibia entirely black.

Named after H. de Souza Lopes in recognition of his fine work on this genus.

A SUPPLEMENT TO THE REVISIONS OF THE DACETINE ANT GENERA *ORECTOGNATHUS* AND *ARNOLDIDRIS*, WITH KEYS TO THE SPECIES[1]

By W. L. Brown, Jr.

Museum of Comparative Zoology, Harvard University

The Orectognathiti are a small group of dacetine ants found in the Australopapuan area, grouped into two genera, *Orectognathus* Fr. Smith and *Arnoldidris* Brown. Previous revisions (Brown, 1950, 1953) have recognized nine species in the first and four in the latter genus; of these, I had been able to study directly only six species of *Orectognathus* from satisfactory material and under favorable conditions. Recently, however, I have been able to see additional material collected by E. O. Wilson in New Caledonia and New Guinea, and in eastern Australia by Father C. Mercovich and myself. Furthermore, through the kind help of Curator Elisabetha Bajári of the Hungarian National Museum, I have been loaned the types of *Orectognathus csikii* Szabó, *Arnoldidris biroi* (Szabó), *A. horvathi* (Szabó) and *A. chyzeri* (Emery). During a hurried visit to the British Museum, I saw the type of *Arnoldidris longispinosus* (Donisthorpe), but was unable to make a proper sketch or notes beyond the affirmation of the species as a true *Arnoldidris* of the *biroi* group.

In the present paper, I propose to add two new orectognathite species and to offer notes on the characters, biology and distribution of some older ones. For the sake of a complete treatment and full keys, I have included notes and a figure of the manuscript species as derived from the characterization of (*O. nigriventris*) by Father Mercovich. It may be some time before the formal description of Father Mercovich's species appears in print, and neither he nor I intend that the preliminary informa-

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[1] Published with the aid of a grant from the Museum of Comparative Zoology at Harvard College.

tion concerning the species offered here should be considered as constituting publication of (*O. nigriventris*).

The aid of Curator Bajári, Father Mercovich and Dr. Wilson in preparing this supplement is gratefully acknowledged. The abbreviations of measurements and indices, and also of places where specimens are deposited, are as in my other works on the dacetines, including the *Orectognathus* revision (Brown, 1953).

Arnoldidris biroi (Szabó)

A single worker taken by Wilson at Wamuki, about 800 m. altitude, Mongi Watershed, Huon Peninsula, New Guinea, agrees well with a type from the Hungarian National Museum. Wilson's worker was taken from a shrub in rain forest, foraging during daylight hours.

Arnoldidris horvathi (Szabó)

The type collection of this ant, possibly the most bizarre formicid known, remains the only sample known. The type confirms the figures of Szabó in all important respects.

Arnoldidris szentivanyi sp. nov.
(Figures 1, 2)

Holotype worker: TL 6.1, HL 1.38, HW 1.18 (CI 86), scape L 0.92, max. diameter of eye 0.27, ML 0.80 (MI 58), WI 1.66 (occipital lobes overlap pronotum about 0.17 mm., an amount duly subtracted from TL), petiole L in side view 0.83, postpetiole L 0.35, gaster L 1.25, propodeal spine L 1.12, gaster W 1.02, pronotal W 0.71 mm.

Form as shown for the paratype in Figure 1 and Figure 2. Occipital lobes each bordered dorsolaterally by a round-edged carina, indicated in the figures. Mesepisternum on each side extended as a shallow translucent lobe overlapping the upper posterior part of the fore coxa. Metapleural lobes rounded. Petiole very slender, gently arched,

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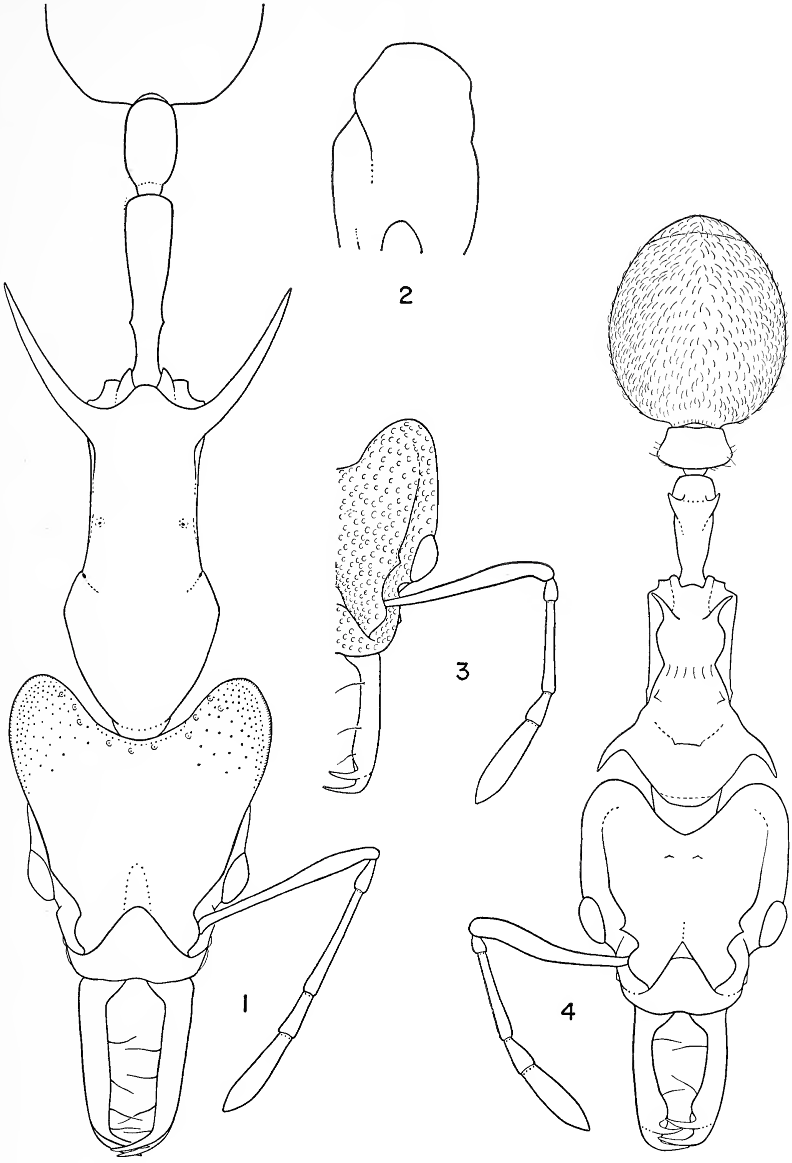
EXPLANATION OF PLATE 1

Figures 1 to 4. Figure 1, *Arnoldidris szentivanyi* sp. nov., paratype worker, dorsal view. Figure 2, same, side view of posterior half of head. Figure 3, (*Orectognathus nigriventris* Mercovich ms.), worker from type series, dorsal view of half of head. Figure 4, *O. phyllobates* sp. nov., holotype worker, dorsal view. All to same scale. Drawings by Nancy Buffler.



Brown — Arnoldidris and Orectognathus

its anterior peduncle very slightly depressed, the nodal portion approximately circular in cross section.

Body generally smooth and strongly shining; underside of head with strong, crowded but separate foveolae; a few small, inconspicuous foveolae on dorsum of head in zone bordering occipital excision, but most of upper surfaces of occipital lobes with no more than small, widely-spaced punctures. Pubescence and pilosity absent from body generally, except for the sensory setae of labrum and mandibles, the short hairs at gastric apex, and a dilute reclinate pubescence of the antennae, legs and mouthparts, most noticeable toward the extremities.

Color rich medium brownish-red; vertex and a median area just behind clypeus almost imperceptibly shaded; mandibles, antennae, legs and gaster clear yellow; mandibular apices, dorsolateral margins of occipital lobes, propodeal spines and both nodes ferruginous yellow.

The holotype [MCZ] was collected with seven worker and two dealate female paratypes at the village Ebabaang, altitude about 1400 m., in the Mongi Watershed, Huon Peninsula, New Guinea, April 18, 1955 (E. O. Wilson leg.). The seven worker paratypes [MCZ, HNM, USNM]: TL 5.9-6.4, HL 1.31-1.43, HW 1.12-1.23 (CI 85-87), ML 0.74-0.82 (MI 57-58), WL 1.59-1.75 mm. Color of head and alitrunk varies from light to rather dark reddish-brown; infuscation of vertex absent to fairly distinct. Propodeal spines vary slightly in length, angles of elevation and divergence, and in strength of their arch as seen from the side; in some specimens the tips are a little more strongly deflected ventrad than in others.

One of the two dealate females: TL 6.5, HL 1.43, HW 1.28 (CI 90), ML 0.80 (MI 56), WL 1.76 mm. Similar to worker, with the female differences usual for dacetines. Compound eyes only slightly larger than in worker; ocelli small but distinct. Meso- and metanota together forming an abruptly raised dome, smooth and shining, with scattered small punctures. Propodeal spines straight (not gently arched as in worker), only the extreme tips slightly deflected ventrad. Sculpture, color and pilosity as in worker, except that punctures on dorsal surfaces of occipital lobes are more abundant and larger, more nearly foveoliform. The second female paratype has the propodeal spines very slightly arched as seen in side view, but still straighter than in any of the workers.

Wilson found the first workers (No. 839) foraging on bushes or small trees under 2 m. tall, at about noon on a sunny day, but in deep shade in rain forest. Careful search of the ground litter below the bushes turned up two dealate females and additional workers, indicating that the nest was inadvertently scattered. The workers are very slow and deliberate in their movements, and often stand still in one spot for long periods. One worker was seen walking with gaster recurved under the alitrunk. None was seen with prey, which could have been one of the numerous Collembola seen so commonly on stems and leaves of trees where the ants were taken. In a colony fragment returned to the United States alive, the female and four workers were exceedingly sluggish, and failed entirely to attack some entomobryid collembolans enclosed in a small nest with them in such a way that numerous contacts between springtails and ants were enforced. One egg was laid by the ants, but this disappeared within a few days. The colony appeared to be disorganized, and the adults spent much of their time resting on the glass cover forming the ceiling to their chamber. After two or three weeks, all adults had died.

A single worker labeled "Wisselmeren: Obano," collected at 1770 m. in Netherlands New Guinea by J. L. Gressitt, is slightly larger than the *szentivanyi* type series: TL 5.8, HL 1.44, HW 1.30 (CI 90), ML 0.83 (MI 58), WL 1.73 mm., but is similar in form. Its color is darker: head and alitrunk blackish-piceous; nodes and alitrunk orange or deep ferruginous yellow; legs and antennae ferruginous yellow, mandibles straw yellow. Punctation of head more distinct throughout, especially over the entire dorsal surfaces of occipital lobes, which are covered with spaced, umbilicate foveolae. Whether this specimen belongs to *szentivanyi* and is merely a geographical variant can only be decided by the study of more material.

Key to *Arnoldidris* species, based on workers

1. Each occipital lobe drawn out into a long, dorsally curved, tapered spine .... *horvathi* (Szabó)
Occipital lobes rounded or bluntly angulate, not drawn out into acute teeth or spines .... 2.

2. Propodeal spines and petiole long, but not extremely so, about 3/4 as long as the greatest width of the gaster; color (of type worker) yellow, with blackish alitrunk and nodes .... *chyzeri* (Emery)
Propodeal spines and petiole extremely long, about as long as the gaster is wide; color not as above, the head and alitrunk usually darker than the gaster ...... 3.

3. As seen from directly above (full-face view of head), the occipital lobes terminate each in a blunted angle .... 4.
As seen from directly above (full-face view of head), the occipital lobes each end in an evenly rounded full curve .... 5.

4. Head and alitrunk brownish-red, gaster yellow .... *biroi* (Szabó)
Head and alitrunk predominantly black or piceous, gaster brownish-yellow .... *longispinosus* (Donisthorpe)

5. Color of head and alitrunk rich medium brownish-red, gaster yellow; coarse punctures on occiput restricted to the immediate zone along the posterior excision .... *szentivanyi* Brown
Color of head and alitrunk predominantly black or piceous, gaster brownish-yellow; coarse punctures or foveolae widely distributed and conspicuous over occipital lobes .... The specimen from Wisselmeren, discussed under *A. szentivanyi.*

Orectognathus antennatus Fr. Smith

Specimens have been received from an additional Australian locality, the collection by Father C. Mercovich: Calga, New South Wales. These specimens average a little smaller than samples previously found: minimum HL 1.31 mm.; CI 75-76, MI 64-65.

Orectognathus sarasini Emery

In my *Orectognathus* revision of 1953, I followed Emery in recognizing *O. sarasini* as a distinct species, although it seemed from the original description that there was not much difference from *antennatus.* Wilson has now taken good series referable to *sarasini* in different localities in the southern half of New Caledonia. The material is divided between two distinct color forms, which, however, have the same measurements and the same general structure: TL 4.2-5.3, HL 1.07-1.26, HW 0.81-1.00 (CI 76-79), ML 0.64-0.71 (MI 59-60), WL 1.12-1.31 mm. (workers). A female from series No. 115 measures: TL 5.6, HL 1.24, HW 1.04 (CI 84), ML 0.69 (MI 56), WL 1.40. A male measures: TL 3.7, HL 0.69, HW 0.74, WL 1.26 mm. (Series No. 115).

This species is like *O. antennatus,* from which it differs only by the minor features cited in the key; the greater development of the humeral and anterior mesonotal protuberances is a relative character, difficult to appreciate without comparison direct of material of both forms. As Wheeler suggested, it is entirely possible that *antennatus* and *sarasini* are conspecific, but in the absence of objective criteria for their true relationship, it seems best to continue to distinguish them as arbitrary species, especially in view of the possible complications next discussed.

Emery described *O. sarasini* from Mt. Canala, New Caledonia. Wilson has seen type material, and affirms that it corresponds to a color form that he took, not at Canala, but at Mt. Mou and Le Chapeau Gendarme, which is concolorous clear ferruginous yellow, with only the legs lighter yellow (Mt. Mou: Nos. 115, 141; Le Chapeau Gendarme, No. 91 and Berlese samples). At and around Ciu, on the approaches to Mt. Canala, Wilson collected several series at about 300 m. altitude (Nos. 251, 289, observation colonies CC and EE, berlesates) in which the color of the workers is strikingly different: the color differs from that of *sarasini* in that the alitrunk and dorsum and sides of the head (except occipital lobes and sides of clypeus) are piceous, appearing black to the naked eye. The remaining parts are ferruginous yellow, although the gula and both nodes are slightly tinged with brownish. The female is colored much like the worker.

The male of *sarasini* is like the *antennatus* male, but is smaller and with proportionately narrower gaster; the surface of the gaster, while variable, tends to be much more smooth and shining; pubescence of gaster much reduced, less even than in *antennatus*.

The question arises as to whether the black-and-yellow form truly belongs to *sarasini,* or is a different species; this question can be answered only by a more intensive study of the distributions of the two types of color pattern. It is interesting to speculate that the original Canala concolorous population may have changed, in a period of four or five decades, to a bicolorous condition. Rapid changes of this type are not unknown in other animal groups (e. g., snails of the genus *Partula,* Crampton, 1917, 1932) that occur in insular situations.

Of the Mt. Mou collections of the concolorous yellow form, No. 115 was a small colony in a cavity about 3 cm. across under a small rock in wet soil by a stream, altitude between 180 and 400 m. The colony had a single queen and brood. No. 141 consisted of workers taken foraging on the trunks of two trees growing close together in dry forest; the collection was made during the first two hours of darkness and at a height of from 1-2 m. above the ground. The same spot was visited during daylight hours, but no further specimens were found. At Le Chapeau Gendarme, No. 91 was a nest in a rather dry dead branch, about 7 cm. in diameter, lying on the ground amid dry, thin leaf litter. This colony was observed for a short time in the artificial nest, but during that time it did not feed on any of the collembolans or other small arthropods that were provided. At this locality, stray workers were also taken in leaf litter berlesates.

At Ciu, No. 251 was a colony of about 30 workers, a single dealate female, 3 males, and 20-30 larvae and pupae gathered in a small circular cavity about 4 cm. wide in thin soil collected between two large rocks on the floor of rain forest. No. 289 was a colony taken under a rock in a drier, more open part of the forest. Other samples from Ciu came from soil cover berlesates.

Orectognathus phyllobates sp. nov.

(Figure 4)

Holotype worker: TL 4.5, HL 1.12, HW (disregarding compound eyes) 0.97 (CI 87), scape L 0.78, greatest diameter of eye 0.24, ML 0.64 (MI 57), WL 1.14 (occipital lobes overlap pronotum by about 0.12 mm., an amount subtracted from WL to obtain TL), petiole L in side view 0.47, postpetiole L 0.22, gaster L 1.00, propodeal spine L 0.28 mm.

Form as shown in Figure 4. Occipital lobes concave inside the bluntly carinate continuations of the frontal carinae; vertex convex, bituberculate centrally. Maximum depth of head about 2/3 HL. Anteocular teeth well developed, acute and sharply elevated. Mandibles strongly concave inside, even more so than in (*O. nigriventris*), the heavy preapical convexities correspondingly stronger. The three apical teeth subequal in length; upper tooth diverging from the lower pair as seen in end-on view of mandible.

Alitrunk in the typical *Orectognathus* plan; pronotum depressed and marginate, with a pair of strong, acute, anteriorly curved teeth, incrassate basally; rear of pronotum sloping through a gradual curve up to the mesonotum. Mesonotum raised in the usual manner; anterior tubercles low, blunt; posterior pair higher, more dentiform, though with extreme tips blunt. Propodeal spines strongly elevated, approximately straight in side view, diverging and slightly outcurved in dorsal view. Petiolar teeth strong, acute, curving posterodorsad, but with apices deflected. Postpetiole subtrapezoidal in dorsal view (Figure 4) ; in side view semiglobose in outline.

Body generally smooth and shining, with widely scattered inconspicuous punctulae in some areas. Sides of posterior alitrunk with some rather irregular rugosity; metanotal groove with short longitudinal costulae; costulae at base of gaster very short, almost obsolete, confined to the basal ring or groove. Funiculi and tarsi finely and densely punctulate, subopaque. Most dorsal surfaces of body, including humeral teeth, pronotum and sides of head, with a fairly abundant but short, fine and inconspicuous pilosity, mostly arched-subappressed, but becoming curved-erect on mesonotum. In Figure 4, only the pilosity of postpetiole and gaster is depicted; the gastric pilosity, in the form of a conspicuous whitish decumbent pubescence, is very even, evenly spaced, and quite distinctive. On legs and antennae, a dilute oblique pilosity becomes shorter and denser as a pubescence apicad.

Head, alitrunk and both nodes piceous brown (with a hint of reddish that may be due to fading), gaster deep piceous, nearly black. The general body color appears approximately black in life. Mandibles and antennae yellowish-brown, basal 2/3 of mandibles and middle of scape tending more toward light yellowish. Legs brown, with conspicuous broad bands of light straw color occupying the basal third of each of the six femora and the middle third of each of the two anterior tibiae.

The holotype [MCZ] and only known species of *O. phyllobates* was taken at the edge of the ravine which constitutes Joalah National Park, near the top of Tamborine Mt., southeastern Queensland. The ant was taken in late afternoon from the foliage of a glossy-leaved woody plant, a shrub or young tree, about three feet above the ground. The plant was growing in a very small opening in rain forest, the result of the falling of a medium-sized tree from the canopy. Intensive search was made of the ground cover near the plant, but no indication of the nest could be found.

O. phyllobates is most closely related to (*O. nigriventris*), but is easily distinguished by means of its broader postpetiole, by its smooth, shining, afoveolate sculpture, by its darker color, by its slightly stronger gastric pubescence, its more concave inner mandibular borders, and other minor details. *O. sexspinosus* Forel is lighter in color and is generally more slender, with much longer teeth or spines on the alitrunk, and it has no teeth on the petiolar node.

The discovery of *phyllobates* on foliage well above the ground, and Wilson's observations on *O. sarasini* climbing treetrunks at night, tend to show that *Orectognathus* may be more or less generally a nocturnal, arboreal or subarboreal forager. That *O. clarki* Brown may have similar habits seems likely, in view of the fact that this species is never seen foraging outside the nest during the daytime (so far as limited observations go).

Key to *Orectognathus* species, based on workers

1. Each occipital lobe drawn out as a stout, acute, dorsally curving tooth (n. Queensland) . . . . *satan* Brown
   Occipital lobes bluntly rounded posteriorly, without teeth . . . . 2.
2. Propodeal spines about 3 times as long as the distance between the centers of their bases; body and limbs with abundant, generally-distributed, fine, short, erect pilosity; petiolar node very slender, unarmed. (Queensland) . . . . *sexspinosus* Forel
   Propodeal spines markedly less than 3 times as long as the distance between the centers of their bases; either the body without generally-distributed pilosity, or else the petiolar node bidentate, or both . . . . 3.
3. Inner mandibular border just basad of apical teeth with a small tooth or dentiform angle, acute to subacute at tip . . . . 4.
   Inner mandibular border without an acute or subacute tooth or toothlike angle in the region just basad of the apical teeth, though some species have a rounded flange or thickening in this region . . . . 5.
4. Paired anteocular teeth, and a pair each on the vertex and petiolar summit, developed and acute; erect pilosity present and generally distributed over body (New Guinea) . . . . *csikii* Szabó
   Anteocular teeth and teeth of vertex obsolete, petiolar teeth nearly so; erect hairs confined to mandibles, under-mouthparts and gastric apex (Lord Howe I.) . . . . *howensis* Wheeler
5. Anteocular teeth lacking or represented only by an obtuse angle on each frontal carina; head narrower, CI normally 75-80 in the worker . . . . 6.

Anteocular teeth developed and normally strong, acute or at least rectangular; head averaging broader, CI 79-97, only rarely less than 81 .... 8.

6. Lamellate margin of inner mandibular border narrow throughout, not or scarcely expanded near the apical teeth (Queensland) .... *mjobergi* Forel
Lamellate margin of inner mandibular border with a distinct, rounded, subapical expansion or flange .. 7.

7. Size smaller, head length (HL) less than 1.30 mm.; pronotal teeth larger and blunter; anterior mesonotal tubercles well developed (New Caledonia) .... *sarasini* Emery
Size larger, head length (HL) 1.30 or more; pronotal teeth smaller and more acute; anterior mesonotal tubercles poorly developed (s. e. Australia; North I., N. Z.) .... *antennatus* Fr. Smith

8. Dorsal surface of head smooth and shining, with minute punctures or small, spaced foveolae; dorsal surface of gaster with a fine but distinct, more or less reclinate, pubescence-like pilosity .... 9.
Dorsal surface of head covered with coarse, crowded and often contiguous foveolae, the integument consequently subopaque to opaque; dorsal surface of gaster with only an extremely fine and dilute, appressed, pubescence-like pilosity (workers more or less polymorphic) .... 10.

9. Dorsal surface of head smooth and shining, with only the most minute and inconspicuous of punctulae; postpetiole at least 1½ times as broad as long, much broader anteriorly than behind (Figure 4) (s. Queensland) .... *phyllobates* Brown
Dorsal surface of head smooth and shining, but sown with numerous circular, umbilicate foveolae (Figure 3); postpetiole only slightly broader than long, with convex sides, not or scarcely broader in front than behind (e. New South Wales) .... (*nigriventris* Mercovich ms.)

10. Inner mandibular borders approximately straight along basal 2/3; polymorphism of workers extending

to a very large-headed, broad-jawed soldier form in addition to more "normal" workers (e. New South Wales, s.e. Queensland) ..... *versicolor* Donisthorpe

Inner mandibular borders shallowly but distinctly concave along basal 2/3; worker polymorphism not extending to the extreme large-headed, broad-jawed soldier form (Tasmania, s. Victoria to mts. of s.e. Queensland) .... *clarki* Brown

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REPRODUCTIVE ISOLATION IN THE HOUSE CRICKET (ORTHOPTERA: GRYLLIDAE)[1]

By A. S. K Ghouri[2] and J. E. McFarlane
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The existence of considerable geographic variation in the morphology of the field cricket, *Acheta assimilis* Fab., in North America has caused much confusion in its taxonomy, and although the variants are now commonly grouped into one species, the work of Fulton (1952) has shown that this solution is no longer acceptable. Fulton found that four "physiological races" of this insect which are reproductively isolated exist in North Carolina, and that although they show some average structural differences, intergradation between the races prevents the identification of specimens on morphological grounds.

The house cricket, *Acheta domesticus* (Linn.), is an insect with a cosmopolitan distribution but, surprisingly, has been the subject of very little work, although its availability and ease of rearing should have favoured its use as a laboratory animal. In the course of a study on the physiology of the development of this insect (Ghouri and McFarlane, in preparation), we have compared a strain obtained from Pakistan, where it lives in the field, with one obtained in Canada and have found rather large differences in their rates of development, among other characteristics, although morphologically they are quite similar. This report is concerned with the results of crossing ex-

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[1] This paper is based on a thesis submitted to McGill University by A. S. K. Ghouri in partial fulfillment of the requirements for the Ph.D. degree.

[2] Present address: Department of Plant Protection, Government of Pakistan, Karachi.

periments between the two strains which show that they are reproductively isolated.

METHODS

Eggs of the "Pakistani" strain were obtained from females collected near Usta Mohammad, West Pakistan, and sent to us by the Department of Plant Protection, Government of Pakistan, Karachi.[3] The "Canadian" strain was collected from the basements of Macdonald College. Dr. A. B. Gurney of the U.S. National Museum, Washington, D.C., very kindly confirmed the writers' identifications.

Virgin females were obtained by segregating the sexes as soon as the ovipositors could be detected in the hoppers. Single pairs were kept in two-pound ointment jars and groups of two or more pairs in one-gallon candy jars.

Crossing experiments were laid according to the plans shown in Tables I and II. Oviposition dishes containing moist sand were provided after 4 to 5 days and thereafter on alternate days until the female died. All eggs laid by each female were counted and incubated. The spermathecae of a number of females were examined for sperms at various intervals ranging up to two months after the experiments were begun.

OBSERVATIONS

The results of the crossing experiments are shown in Table I. The number of eggs laid in crosses within a strain, as shown in the table, does not represent the total egg production of the females, but only the number of eggs examined in order to establish that development was taking place.

The eggs laid in crosses between individuals of the same strain and in the stock cultures usually hatched, whereas eggs laid in crosses between the strains invariably failed to develop and died 4 to 6 days after incubation. The spermathecae of 9 females in the latter crosses, examined at different intervals during the active oviposition period of stock females of similar age, were devoid of sperms,

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[3] We are grateful to the Department of Plant Protection for supplying eggs of the Pakistani strain.

TABLE I — Crossing experiments with normal insects.

Code No.	Cross	No. Eggs Laid	No. Eggs Developing	No. Females Examined	Sperms Found (+) in Spermatheca, or Not Found (—)
X19	2 Pak. X 2 Can.	0	0		
X13	2 Pak. X 2 Can.	740	0	1	—
X18	3 Pak. X 2 Can.	few	0	1	—
X55	Pak. X Can.	0	0	1	—
X70	Pak. X Can.	25	0	1	—
X12	5 Can. X 3 Pak.	few	0	4	—
X22	2 Can. X 3 Pak.	3	0	1	—
X23	2 Can. X 2 Pak.	0	0		
X21	Can. X Pak.	0	0	1	—
X48	Can. X Pak.	2	0	1	—
X52	Can. X Pak.	0	0	1	—
X70	Can. X Pak.	99	0	1	—
Stock	Pak. X Pak.	Produced several		3	+
Stock	Can. X Can.	hundred offspring		4	+
X50	Can. X Can.	641	641		
X61	Can. X Can.	471	471		
X65	Can. X Can.	324	324		
X35	Pak. X Pak.	94	94		
X36	Pak. X Pak.	38	38		
X38	Pak. X Pak.	116	116		

whereas the spermathecae of females in the former crosses invariably contained sperms.

Although the ovaries of females in the crosses between the strains were apparently normal, containing large numbers of eggs, these females laid a smaller number of eggs than did the females mated with males of the same strain. A female of the Canadian strain generally withheld her eggs until the last days of her life. On the other hand, Pakistani strain females mated to Canadian strain males laid eggs comparatively earlier than the Pakistani females mated to Pakistani males.

Individuals of the two strains are not separable by any consistent structural differences (their morphology has, however, been far from adequately studied, and it is quite possible that obvious differences do exist) ; however, the strains may still be distinguished by average differences in appearance and behaviour. The average size of the body, ovipositor, the genital openings and spermatophores of the Canadian strain adults are larger than those of the Pakistani strain. The color of the Pakistani strain adults varies from light brown with distinct markings on the head to very dark brown with scarcely perceptible markings, whereas the adults of the Canadian strain are generally light brown and do not show as much variation (both light and dark Pakistani adults were used in the crosses). Individuals of the Canadian strain are docile and seldom take to wing; on the other hand, adults of the Pakistani strain are comparatively active, and have been observed to fly as many as 50 yards at a stretch.

In spite of the mating sounds and courtship of the males (as described by Khalifa, 1950), neither the Pakistani nor the Canadian strain females showed interest in the males of the other strain. In the crosses, females of the Canadian strain often devoured the smaller males of the Pakistani strain.

EFFECT OF REMOVAL OF TEGMINA OF MALES

The stridulation of the male cricket has commonly been considered to be important in attracting the females.

Species differences in the sounds made by the male are frequently detectable by the human ear, and Fulton (1952) has characterized one of his races of the field cricket on the basis of its song. It seemed possible that the mating sounds of the male were responsible for the unattractiveness of the males to the females of the other strain of *A. domesticus*, although no differences between the strains were apparent. The tegmina of the males of both strains were accordingly severed at the base, leaving the wings intact (the removal of the tegmina did not appear to affect the normal activities of the males), and crossing experiments were carried out as shown in Table II.

TABLE II—Crossing experiments after removal of the tegmina of the males at the base, wings left intact.

Code No.	Cross	Eggs Developed (+) or Failed to Develop (—)	Sperms Found (+) in Spermatheca or Not Found (—)
C1	Canadian X Canadian		+
C2	Canadian X Canadian	+	
C3	Canadian X Pakistani	—	
C4	Canadian X Pakistani		—
C5	Pakistani X Canadian	—	
C6	Pakistani X Canadian	—	
C7	Pakistani X Pakistani	+	

Females mated with males of the same strain laid fertilized eggs and the spermatheca of one female was found to contain sperms, whereas females mated with males of the other strain laid eggs which invariably failed to develop, and no sperms were found in the spermatheca of the one female examined. Thus the stridulation of the participating male is not necessary for copulation (or, more precisely, insemination), nor is it the sole discouragement to copulation in crosses between strains.

DISCUSSION

These crossing experiments have shown that the Pakistani and Canadian strains of *A. domesticus* are reproductively isolated, and therefore are actually separate species, as defined biologically (Mayr *et al.*, 1953).

In his crossing experiments with the races of *A. assimilis,* Fulton (1952) found that while insemination always took place, eggs laid by the females invariably failed to hatch. He concluded that hybrids were not produced either because the eggs were not fertilized or because the zygotes were not viable. With the two strains of *A. domesticus,* however, reproductive isolation consists in a failure of insemination to take place. It is possible that the strains of *A. domesticus* are not isolated at the genetic level or at the level of fertilization that separates the races of *A. assimilis;* however, attempts to achieve artificial insemination or fertilization have not been successful, due to technical difficulties.

Although there can be little doubt that geographic isolation has led to the differences between the Pakistani and Canadian strains, it would be of interest to discover the mechanism which is responsible for their isolation when brought together. Behavioural differences, in the broad sense, are obviously involved, and these may have to do with actions during courtship or perhaps with the odour of the male. In *A. assimilis,* Fulton (1952) has found that two "races" may occupy the same habitat, and the possibility that a more intensive study of both species groups will show that geographic isolation is not essential in speciation makes a study of the mechanism of isolation very much worthwhile.

The Pakistani and Canadian "strains" of *A. domesticus* are two distinct species, but, as has been pointed out by Gurney (1951) and Hubbell (1956) for *A. assimilis,* no practical purpose will be served, at the present stage of our knowledge of these crickets, by creating a new specific name. It will be desirable, however, to maintain a distinction between the species by giving each a geographic designation.

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TERTIARY FLIES FROM COLORADO AND THE BALTIC AMBER[1]

BY FRANK M. HULL

University of Mississippi

I wish to thank Dr. Frank M. Carpenter of Harvard University for the opportunity to study the following two species of most interesting fossil flies. The asilid from the Miocene shales of Colorado is particularly interesting because of the information that it affords as to the narrow extent of change in Recent related flies. The syrphid in Baltic amber represents the third species belonging to its genus and is unusually well preserved. Both are from the collections of the Museum of Comparative Zoology.

Senoprosopis romeri, new species

Plate 2

A slender asilid with elongate, attenuate abdomen, extending considerably beyond the wing, and belonging to the subfamily Asilinae. All of the femora are moderately stout without being swollen. Bristles on the legs prominent, short and stout. Length 25 mm.

Head: The head is well preserved, except for the antenna. Face quite short, more prominent below due to the recession of the eye. The whole face is very gently convex. Occiput prominent, no details of pile or bristles are present on the head. *Thorax*: The mesonotum is moderately high and arched, equally convex in front and behind. There are clear indications of scanty, scattered, moderately long, appressed, bristly setae which appear on the notopleuron area and with equally short elements on

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[1] Published with the aid of a grant from the Museum of Comparative Zoology at Harvard College.

the dorsocentral area behind the suture. Lateral elements are not clearly discerned. The whole thorax is relatively short and high, the height at least equal to the length. *Legs*: The femora are clearly preserved and are stout without being swollen. Posterior femur longer than the anterior pair and slightly narrowed at the base. Both the femora and tibia are densely covered with rather long, coarse, finely pointed, flat appressed setae on the dorsal, lateral and anterior surfaces. The tibiae similarly covered. Bristles are short but stout. The hind femur has 3 lateral bristles distributed along the middle. The apex is not preserved. The middle femur shows 2 or 3 anterior bristles, the hind femur bears 1 stout bristle medially near the base. Middle femur also with 3 prominent, ventral bristles distributed along the middle. Hind tibia stout and slightly wider toward the apex and of nearly the same length as the hind femur. It is comparatively well preserved with at least 2 prominent, dorsal bristles, 1 near the basal third, 1 near the apical fourth and the latter bristle with a matching ventrolateral bristle. Hind basitarsus stout. The middle tibia densely pilose but without bristles showing. The anterior femur shows no bristles but the corresponding tibia has 1 very stout, posterior, apical bristle, another quite long, arising from near the middle, besides, also 2 long, slender, bristly hairs on the basal third. Tarsal bristles stout but short. Claws sharp, bent chiefly at the apex, black with the base lighter colored. Pulvilli well developed. *Wings*: The wings are hyaline with the apical fourth darker, apparently due to villi. Marginal cell closed with a moderately long stalk; the second submarginal cell is comparatively narrow, developed almost entirely in front of the third vein and at the apex it is only moderately flared. The anterior branch of the third vein ends quite at the

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EXPLANATION OF PLATE 2

Photograph of *Senoprosopis romeri* n. sp. (Holotype, Florissant shales, Colorado, no. 5125, Museum of Comparative Zoology). Length of specimen 25 mm.

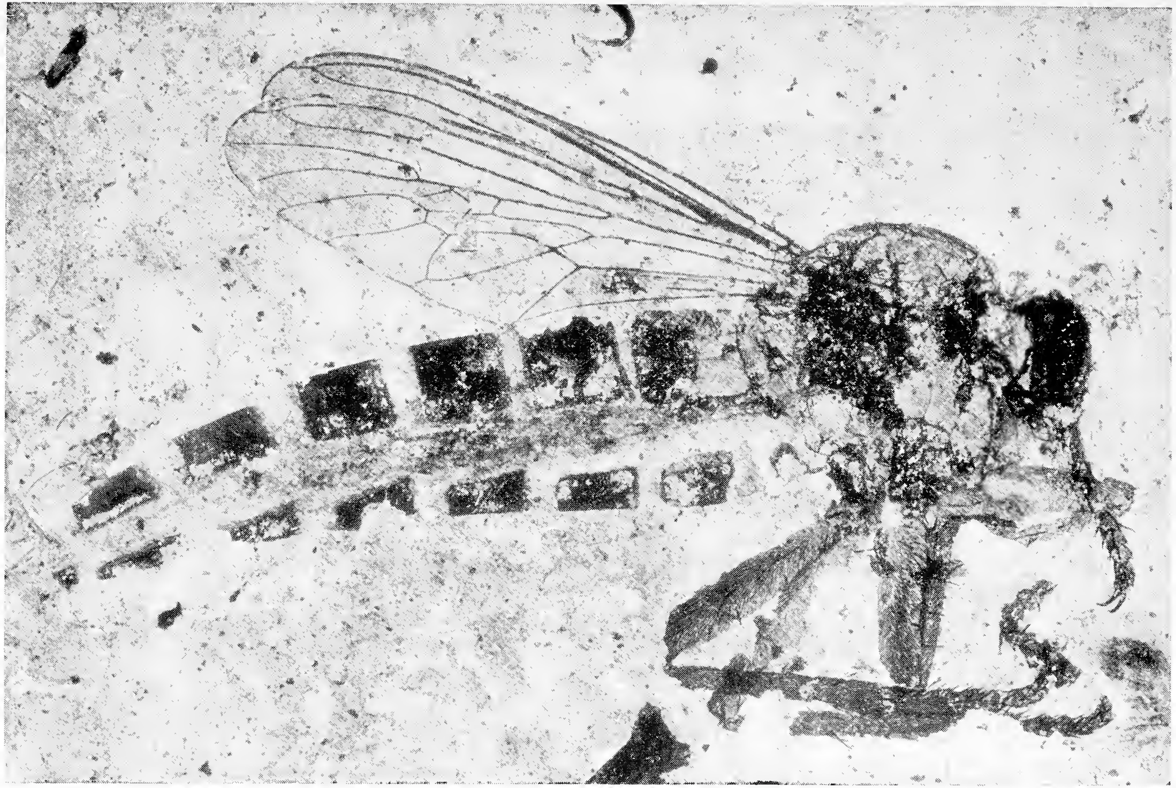

PLATE 2. HULL — SENOPROSOPIS ROMERI

apex of the wing, the posterior branch ends well behind the apex by a distance double the middle width of the second submarginal cell. The first, second and third posterior cells open maximally. Fourth closed with a moderately long stalk and the end vein of the fourth posterior cell outwardly convex. Also the upper vein of this cell also strongly convex, tending to occlude the discal cell. Anterior cross vein oblique, entering the discal cell a little beyond the middle. Posterior crossvein absent, upper anterior intercalary vein twice as long as the medial crossvein. Anal vein closed and stalked. *Abdomen*: The abdomen is elongate, considerably longer than the wing. It is well preserved and shows 7 tergites and 8 sternites. Apparently a female, the third to seventh tergites are of nearly equal length and while there is clear preservation of slender, postmarginal fringes of long, bristly hairs, rather widely separated, there is no evidence of distinct bristles. The sternites show clearly and are well preserved and their pile appears to have been extremely delicate. At only one point is there an indication of a sternal hair and certainly bristles were absent.

Type. Female; Miocene, Florissant, Colorado, no. 5125 in the Museum of Comparative Zoology. Named in honor of Director A. S. Romer.

This species is very close to the species *Senoprosopis antiquus* James, the wing of which was figured by James, 1939. It differs from it in the more extensive narrowing in the middle of the first posterior cell, which in *S. romeri* is clearly narrowed to less than half its maximal width, and also in the more straightened apical portion of the third vein.

I have examined the types of all Recent New World species placed in *Senoprosopis* Macquart; all differ to some extent from the clear profile drawing of the head shown by Macquart, of his type of genus, *Senoprosopis diardii*

Explanation of Plate 3

Photograph of *Pseudosphegina carpenteri* n. sp. (Holotype, Baltic amber, no. 5124, Museum of Comparative Zoology). Length of specimen 5.6 mm.

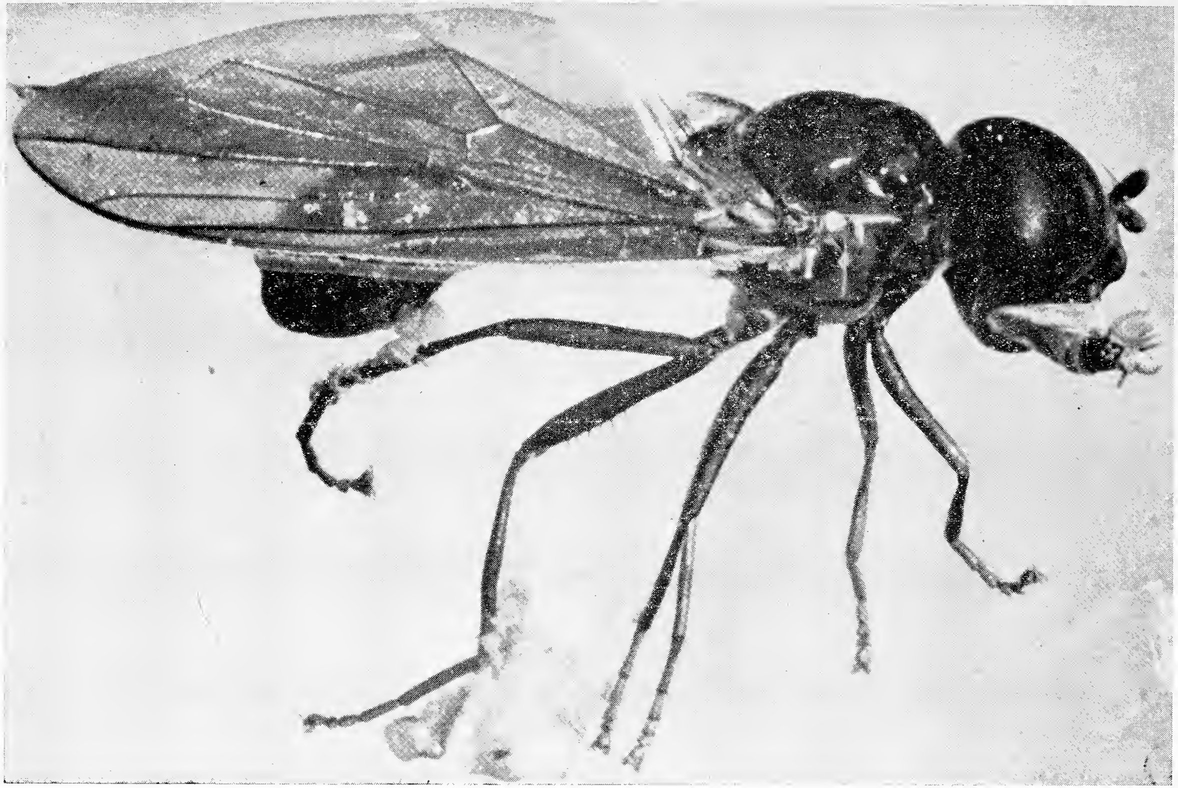

Plate 3. Hull — Pseudosphegina carpenteri

Macquart, which was from India, and which I have not seen. I therefore leave the New World species provisionally in *Senoprosopis;* all of these New World species have a distinct, rather long petiole at the base of the fourth posterior cell, in contrast to the two Florissant species and for this reason I propose the subgeneric name *Eosenoprosopis* for these two species with *S. romeri* as type of subgenus. As far as the second submarginal cell is concerned, the two fossil species agree better with *Opopotes* Hull, a Recent Costa Rican species, in which the anterior branch of the third vein ends clearly at the apex, and not a short distance above the apex as in the South American species of *Senoprosopis. Opopotes* is further characterized by the remarkably attenuate third antennal segment, 2 segmented, rather short styles; this may be the genus represented by the figure labelled *Senoprosopis* sp., in Curran's *The Families and Genera of North American Diptera,* 1934.

These two Florissant species give a very nice indication of the slight degree of change, at least as far as the wing is concerned, between Miocene and Recent species.

Pseudosphegina carpenteri, new species

Plates 3[2] and 4

Length 5.6 mm.

Male. *Head:* Eyes almost touching above the front, the ocelli form an isosceles triangle. Face with a well developed tubercle situated a little below the middle of the face. Antenna set a little above the middle of the head in profile, the first 2 segments quite short, each with

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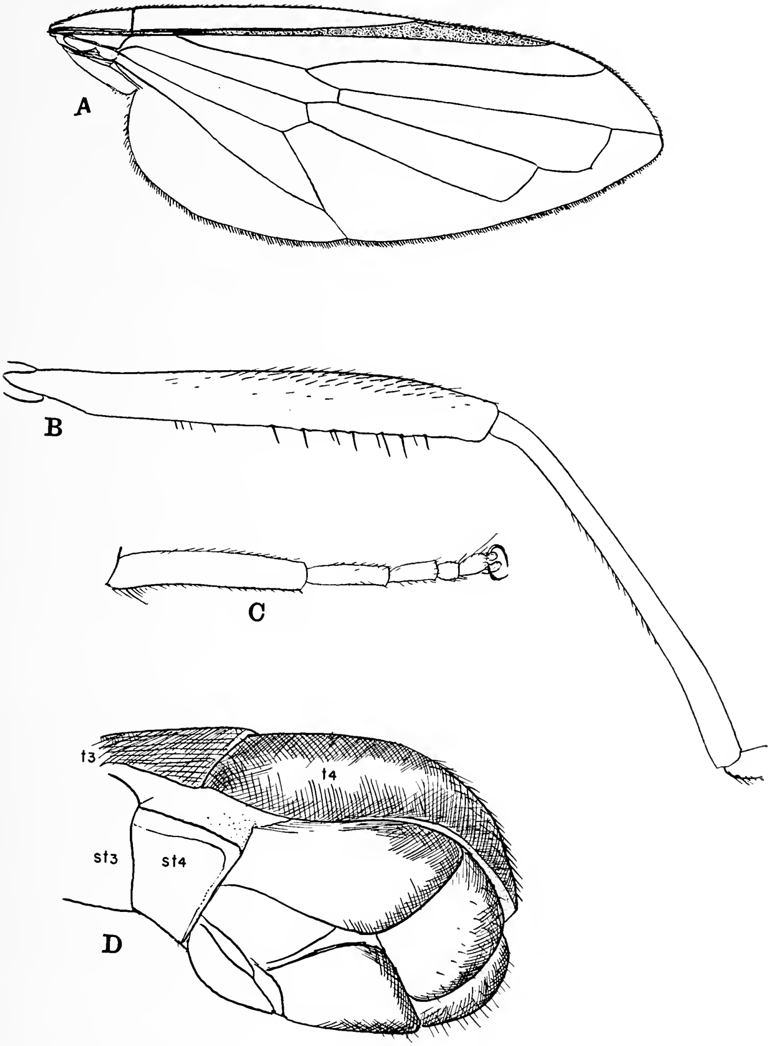
[2] For a colored photograph of this specimen, see cover of Scientific American, November, 1951.

EXPLANATION OF PLATE 4

Pseudosphegina carpenteri n. sp. (Holotype, Baltic amber, no. 5124, Museum of Comparative Zoology). A. wing. B. Proximal segments of metathoracic leg. C. Distal segments of metathoracic leg. D. Posterior part of abdomen: t3, t4, 3rd and 4th tergites; st3, st4, 3rd and 4th sternites.



HULL — PSEUDOSPHEGINA CARPENTERI

a prominent, ventral bristle, the second segment with a dorsal seta and the third segment short, oval with rather blunt apex. The arista is slender, basally thickened and one and a half times as long as the third segment. Front with scanty, fine, erect pile which is rather short. Face without pile. The occiput concave and sunken, the posterior margin of the eye prominent for a short distance behind the head. *Thorax*: The thorax is a little longer than wide and rather strongly convex. It is relatively bare with a few, scattered, suberect, stiff hairs on the anterior half in front of the suture and similar, still more scanty pile behind. Scutellum rather large, convex with a few fine, erect hairs of the disc and 2 pairs of rather prominent, comparatively long, moderately stout, marginal bristles. *Legs*: The legs are slender, the hind femur quite slender with 4 ventral setae on the basal half and a double row of quite sharp, erect, spinous, non-tuberculate bristles placed ventrolaterally and ventromedially on the outer half of this femur. The outer row contains 4 elements of about the same length and 3 smaller ones interspersed. The medial row contains 3 which are stout, and like the larger elements on the lateral portion. Hind tibia as long as the femur, quite slender with minute, fine, appressed, quite inconspicuous pile. Tarsi also slender, the basitarsus as long as the remaining segments, the second segment a little longer than the next 2, the third segment nearly twice as long as the fourth segment. Tarsal pile similar to that of the tibia, the ventral fringe quite short and also fine, and the apices with scarcely longer hairs, except on the ultimate segment, where there are 2 stiff, dorsal hairs side by side, which are nearly as long as this segment. Claws extremely fine, curved from the base and sharp, the pulvilli well developed. Middle femur with a posterior fringe of pile in which, however, the individual hairs are not very long. Apical bristles of the middle tibia are quite small and weak, middle basitarsus slightly longer than the next 2 segments, the other segments also progressively reduced. Anterior legs with extremely short, inconspicuous, fine, scanty pile, their basitarsus about as long as the next 2 segments and the whole tarsus shorter than the middle tarsus. *Wings*: The wings are pale brownish hyaline, a little darker in the costal cell. The stigma and whole subcostal cell much darker and light reddish brown. Marginal cell open by more than one and a half times the maximal width of this cell. Third vein perfectly straight. Anterior crossvein short, rectangular and situated quite close to the base of the discal cell. First posterior cell ends remotely from the wing apex by a distance equal to the subapical crossvein or end vein of first posterior cell. At the lower corner of the first posterior cell there is almost no trace of a spur vein and none whatever of the lower corner of the discal or second posterior cell. The fourth vein along the upper margin of the discal cell is almost entirely straight, barely curved apically. The apical petiole of the discal cell is fully as long as the subapical crossvein. Anal cell closed with quite a long stalk, whole wing villose, alula present but narrow. *Abdomen*: The abdomen is clavate, gradually and slightly narrowed towards the base, the hypopygium especially large. While well preserved, the abdomen is partly covered by wings. The first 3 sternites are light yellow, the fourth is dark reddish brown with lighter posterior margin, especially laterally; the first 3 sternites have a few, scattered, fine hairs; the fourth has numerous, stiff, subappressed hairs. Hypopygium apically with a few fine, erect, short hairs. Only the last tergite shows to advantage and it is much longer medially than laterally, tending to cover largely the long, bulbous, ventral hypopygium. It is dark, reddish brown in color with abundant, short, coarse, subappressed setae. Apparently the base of the third tergite is lighter in color.

Type. Male; Lower Oligocene, Baltic amber, no. 5124, in the Museum of Comparative Zoology. This interesting species is named in honor of Dr. Frank M. Carpenter.

THE ORGANIZATION OF A NUPTIAL FLIGHT OF THE ANT *PHEIDOLE SITARCHES* WHEELER

By E. O. Wilson

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Introduction. Most published information on the sexual behavior of ants relates solely to the inception of the nuptial flights, with very little being recorded of the behavior of the individual reproductive forms during the main part of the flights. The reason for this important gap in our knowledge is plain — in the great majority of ant species the reproductives scatter widely after leaving the nest, fly moderate to long distances, and finally mate in nuptial swarms far above the head of the human observer.

The nuptial flight is of more than ordinary interest to the student of social insects. It is here that the male ants exhibit, both in the formation and maintenance of the swarms and in subsequent copulatory movements, the greater part of their lifetime social behavior. Both sexes display fixed-action patterns, conceivably complex in nature, that appear only at this time and are apt to be among the most stereotyped and species-specific of the entire species' repertory. Judging from other animal groups in which the reproductive behavior is better known, the nuptial flight patterns of ants can be expected to have at least four essential adaptive features, which can be summarized as follows: synchronization and coordination of flight movements within the species, intraspecific sexual stimulation to copulatory levels, exclusion of other species from the final swarming and copulatory activity, and regulation of the species dispersal rate. Descriptions of nuptial flight behavior should include, among other things, information bearing on these topics.

Observations. During field work in New Mexico in the summer of 1952, the author had an unusual opportunity to observe a nuptial flight of the small myrmicine ant *Pheidole sitarches.* The flight occurred on August 9 near Datil, Catron Co., in an abandoned homesite surrounded by sparse juniper woods. The area, normally very dry, had received a moderate rain during the afternoon, so that the upper layers of soil were moistened, and in the late afternoon, when the flight was in progress, the sky was still overcast. The flight was in full swing when first encountered at about 5:00 p.m., and it persisted, with little or no decline, until nightfall, at about 7:30 p.m.

Three swarms developed in the homesite area. Each hovered over a conspicuously bare spot in the weed-grown yard, in particular a garbage pit, the corner of a collapsed stone wall, and a pile of rotting wood. Only the swarm above the garbage pit persisted throughout the observation period; the other two did not form until about 7:00 p.m. The swarms were roughly circular in shape and highly variable in size, containing at various times from approximately fifty individuals to none at all, and ranging in diameter up to about six feet. Their centers were usually located from five to six feet from the ground but occasionally shifted temporarily under the force of the wind to as low as a few inches from the ground surface or as high as ten feet from the ground. The attraction of the swarms to the bare spots mentioned was absolute. Occasional gusts of wind shifted the ants away or dispersed them altogether, but they quickly re-gathered in a swarm over the original spot.

Males made up the bulk of the swarms. These hovered more or less stationary and facing in an upwind direction when the wind was blowing, but flew zig-zag back and forth within the limits of the swarm when the air was relatively quiet. New individuals were constantly approaching from various directions out of the nearby juniper woods, while older members of the swarm were simultaneously being blown away downwind or dropping out as they successfully mated with queens, so that the membership of the swarm was always turning over. The origin of the males was not determined, but very likely they were emerging from nests in the near vicinity. Two nests of *sitarches,* containing mature males, were found in the juniper woods within forty feet of the swarms. The males of the garbage-pit swarm seemed to appear in four principal "waves" during the observation period.

Females flew in slow, even circles through the swarms of males. No more than five were seen in a single swarm at a given time. Each persisted only several minutes or less (in one case, five minutes) before being mounted by a male and dropping from the swarm. The complete act of mating was observed on six occasions. In each case the male seized the female from above, whereupon both ceased flying and spiralled to the ground together. Upon reaching the ground, and not before, the male inserted its genitalia, taking from several seconds to nearly a minute to complete the act. After attachment, the male remained perfectly immobile, while the female either remained immobile or (on two occasions) proceeded to walk slowly over the ground. The male remained attached for one to two minutes and was finally dislodged by the female, who doubled up and pushed the male away with her head or (in one case) pinched the male's abdomen gently until it released its hold.

On two other occasions the pair broke apart while falling from the swarm, thus thwarting copulation. In both cases the separated individuals immediately took flight again upon reaching the ground, or at least attempted to do so. It is interesting to note at this point that occasionally females would light on the observer's shirt when he stood too near the swarm. The males in the swarm made no attempt to approach them under these conditions, and it was clearly necessary for them to re-enter the swarm in order to be successfully mated.

Following successful copulation, the males did not attempt to fly again but walked about on the ground, soon to fall prey to the legions of *Conomyrma pyramica* workers that were foraging everywhere in the vicinity. Some of the females may have also succumbed to the attacks of the *Conomyrma* workers, but this was never observed. Immediately after copulation those that were followed by the observer proceeded to walk along at a steady but unhurried pace until they encountered a pebble or blade of grass under which they could conceal themselves. Dealation thereafter followed, the female drawing her hind legs, one at a time, forward against the wings until the latter broke off. After dealation, the females continued to run over the ground, evidently in search of a permanent nest site. One dealate queen was found lodged in a cavity under a small rock within the homesite area.

Discussion. Several principal conclusions can be drawn from the above observations:

(1) It is almost certain that the individuals comprising the swarms were drawn from multiple nests. Incoming males were seen to approach from many directions. Moreover, it does not seem possible that all of the males in the individual swarms, which were changing in membership constantly, could have been supplied by a single nest. *Pheidole sitarches* apparently does not form very large colonies; those near the nuptial flight area appeared to contain no more than two or three hundred workers and could not have supported many more males at maximum capacity. It is likely that the swarms were formed originally by individuals attracted to the open spots in the homesite area, and thereafter the swarms, oriented to these spots, served as the principal attractant foci for individuals flying in from the outside. Mixed swarms, of course, result in genetic outcrossing and increased population variability, processes that are generally of positive adaptive value.

(2) The *sitarches* flight is of such a highly specific and transitory nature as to seemingly insure that other *Pheidole* species occurring in the same area are excluded. Nearly all of the females reaching the swarm are quickly fertilized. Moreover, each female is fertilized by only one male, thus limiting the potential genetic diversity of single colonies.

(3) The nuptial behavior is also of such a nature as to limit greatly the dispersal power of the species. It is probably true that in some species of ants the fertilized queens continue flying after leaving the nuptial swarm, thereby increasing their dispersal potential, especially if they fly upward and are caught in upper air currents.

But in *Pheidole sitarches* the female is fecundated on the ground directly beneath the nuptial swarm and does not attempt to fly afterward. It is clear that in a single generation this species is able to increase its range only by that distance over which the males form swarms away from their home nests. This limiting phenomenon may be more common in the Formicidae than previously realized. It will be recalled that ants generally have effected little dispersal to isolated oceanic islands. Polynesia, for instance, contains an extremely sparse endemic fauna, while the sharp diminution of the endemic Melanesian fauna from New Guinea eastward suggests that ants in this part of the world have relatively limited dispersal powers. Another line of evidence is that some ant species in Melanesia with flightless, ergatoid queens (e.g., *Leptogenys diminuta, L. foreli*) have dispersed farther through the outer archipelagoes than most stocks with normal winged queens. Furthermore, some of the most widely distributed groups with winged queens (e.g., *Colobopsis, Turneria*) are arboricolous and could conceivably have been carried about as entire colonies in storm-blown twigs and branches. Further study may show that ants are generally limited in dispersal powers because of peculiarities in the organization of the nuptial flight similar to those described here for *Pheidole sitarches*.

A REVISION OF THE NEARCTIC SPECIES OF *TOMODERUS* (COLEOPTERA: ANTHICIDAE)

By F. G. Werner

University of Arizona, Tucson

The Nearctic species of *Tomoderus* are very similar to each other in general appearance and present a perplexing problem both taxonomically and nomenclatorially. When Say described the first species, *constrictus,* he mentioned that the elytra had "regular series of impressed punctures." La Ferté did not see any of Say's specimens but did have a series in which the elytra were "finement et irrégulièrement ponctuées." For this series he proposed the name *interruptus.* Casey segregated specimens in his series under the two names already in use on the basis of whether the punctures became "abruptly coarse and distinctly seriate in basal third or fourth" of the elytra or "very gradually coarse and confusedly subserial in arrangement toward base." In addition he described a third species, *impressulus,* on the basis of a series with a broader anterior lobe of the prothorax, a feeble median canaliculation on this lobe and other differences.

Subsequent students of the Anthicidae have used these three names and some have been able to identify three species by using Casey's key. I have been unable to use it except to segregate specimens of *impressulus.* The identified specimens I have seen of the other two are generally referred to *constrictus* if the elytra are markedly paler at the base and to *interruptus* if the pale area is more diffuse. Specimens with the elytra entirely pale do not fit either description very well but are most easily referred to *constrictus.*

My own investigations have convinced me that the distinction in the arrangement of the elytral punctures does not exist. The punctures appear larger and deeper in pale areas but are no different from those in other specimens in which the same area is dark. The more conspicuous they are, the easier it is to imagine that they are more nearly serially arranged. The distinction is, at best, a subtle one.

An examination of the genitalia of the males indicates that four, not three, very different species occur in the United States, of which *impressulus* alone is externally distinct. Even this last species is not always very obvious. Specimens of all four vary from pale, through dark with the base of the elytra pale, to all dark.

A nomenclatorial problem immediately presents itself. Both Say and La Ferté very obviously described species of *Tomoderus*. Say's type specimens have certainly been lost. La Ferté's type series of five specimens may still remain in his collection and he mentions a dozen more in the Dejean collection, sent by LeConte. There is every chance that these series are mixed and it would be necessary to dissect any males and decide on one as a lectotype. Both the La Ferté and the Dejean collection are under the care of the Paris Museum and such an examination is not possible without a visit there.

I have therefore decided to assign the names *constrictus* and *interruptus* to our two most abundant species, without formal designation of neotype and lectotype respectively. If there are any males in La Ferté's series, and the species here associated with the name is not represented, it will be within the province of a future investigator to reassign the name *interruptus*. The same might also be said of *bilobus*, a Dejean manuscript name mentioned by La Ferté as a color variety of *interruptus*. *Constrictus* was described without mention of type locality. Since Say spent more time in Indiana and Pennsylvania than in the South, and since he mentions the locality of other species described in the same paper as having been collected on special trips, the choice made here is consistent with the possible type locality. The species chosen is the abundant one in the Middle Atlantic States and the Midwest. *Interruptus* was described from specimens collected in Texas by Pilate. Very few specimens of *Tomoderus* have been seen from Texas and both *constrictus* and *interruptus* in the interpretation of the present author are represented. The one chosen to bear the name *interruptus* is by far the more abundant across the South.

The new species described here seems to be the least abundant of the three externally indistinguishable species. It is, of course, possible that it is the only one represented in La Ferté's series. In this event the name proposed here would become a junior synonym of *interruptus*. The species has not yet been taken in Texas but there is no good reason to suspect that it does not range that far since it is very widely distributed.

There is no area in the eastern United States where only one species of *Tomoderus* would be expected to occur. The apparent exceptions will doubtless disappear when more specimens are examined. At the present time only *inhabilis* sp. n. has been identified from New England. *Constrictus* must occur there as well. It has been taken as far north as northern Wisconsin. Therefore no identifications are possible without males, and the genitalia must be seen before even the males can be identified, except in the case of the more obvious specimens of *impressulus*. Fortunately, only the tip of the genitalia need be examined and the tip is often extruded. Otherwise, the specimen must be dissected. I have found dissection most easily performed by relaxing the specimen in hot water, removing the abdomen and pulling the genitalia anteriorly through the base of the abdomen with fine forceps. The genitalia need not be cleared for the purpose of identification. Males are easily distinguished in a series by the presence of a flattened, semicircular pygidium, which is completely absent in the females, as in all Anthicidae.

The genitalia are asymmetrical, as can be seen in the figures. They are remarkably constant in shape, and even in size, despite some variation in the size of the entire insect. Structurally, they are totally unlike those of any other Anthicidae examined, lacking a recognizable phallobase (basal piece) and possessing a twisted sclerotized structure internally, presumably associated with the internal sac. I have been unable to homologize any of the parts with those of other Anthicidae. The genitalic differences, coupled with the absence of tibial spurs and a very distinctive body form, set off our species of *Tomoderus* so strikingly that it is questionable whether they should be included in the Anthicidae.

There is little reason to expand the description of the genus given by Casey (1895, Ann. N.Y. Acad. Sci. 8:648). The following key to species is based entirely on the male genitalia, since they provide the only completely reliable features for distinguishing species.

1. Genitalia notched near the apex 2
   Genitalia not notched near the apex 3
2. Genitalia very unequally notched near the apex, formed into a hook . . . . *T. interruptus* Laf.
   Genitalia almost equally, and only feebly, notched near the apex . . . . *T. constrictus* (Say)
3. Genitalia slender, slightly expanded just before apex. . . . . *T. inhabilis* sp. n.
   Genitalia thick, tapered and slightly constricted just before apex . . . . *T. impressulus Say.*

Tomoderus interruptus La Ferté

Plate 5, Figs. 2, 6

Tomoderus interruptus La Ferté, 1848, Monographie des Anthicus et genres voisins . . .: 97. LeConte, 1852, Proc. Acad. Nat. Sci. Phila. **6**: 94. Casey, 1895, Ann. N.Y. Acad. Sci. **8**: 648.

Tomoderus interruptus var. γ (*bilobus* Dejean) La Ferté, 1848, *op. cit.*: 98.

Tomoderus abbreviatus Casey, 1895, *loc. cit.* (*lapsus calami* in the key to species).

As here interpreted this is the commonest species in Florida, ranging from there west to coastal Texas and

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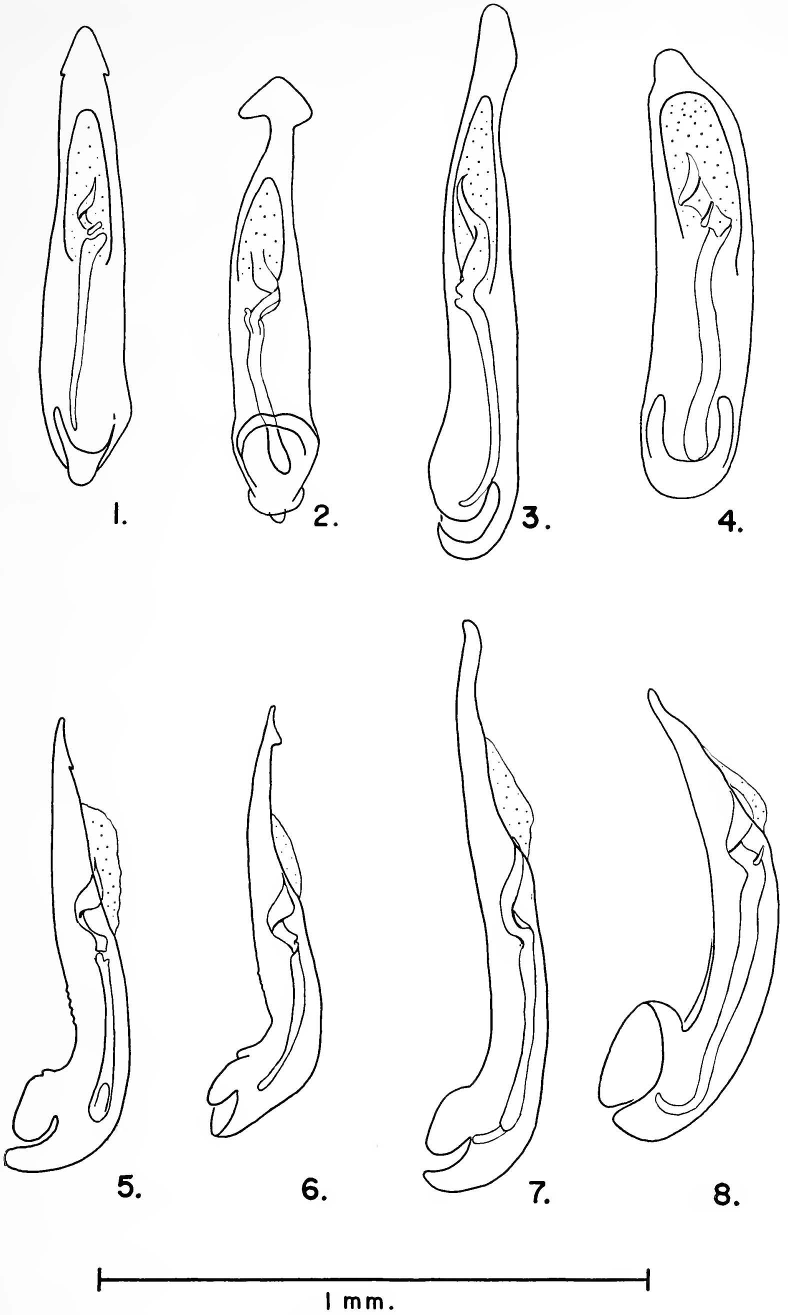
Explanation of Plate 5

Male genitalia of *Tomoderus,* Figs. 1-4 in dorsal view as they lie in the abdomen, Figs. 5-8 the same specimens in lateral view; all figures with the posterior end at the top. Fig. 1. *T. constrictus* (Say), Falls Church, Virginia. Fig. 2. *T. interruptus* Laf., Harahan, Louisiana. Fig. 3. *T. inhabilis* sp. n., Iowa City, Iowa. Fig. 4. *T. impressulus* Csy., Valley of the Black Mts., N. Carolina. Fig. 5. *T. constrictus.* Fig. 6. *T. interruptus.* Fig. 7. *T. inhabilis.* Fig. 8. *T. impressulus.*



WERNER — TOMODERUS

north in the Mississippi basin to Indiana. La Ferté mentions that the specimens in his collection were collected in Texas by Pilate and that the Dejean collection contained specimens sent by Leconte. Considering the date of the publication, it is most likely that the specimens were sent by the elder LeConte. In this event they most likely would have been collected in Georgia. Both eastern Texas and Georgia are within the range of the species as here understood, although no specimens collected in Georgia have been examined.

Specimens examined have come from the following localities: ALABAMA: Central Mills, Jan. 25, 1928, Woodruff. FLORIDA: Ch. Hbr.; DeLand; Jacksonville, July, 1943, G. S. Hensill; Lake Placid, Mar. and April; Lake Wambirg, Mar.; Orlando, Mar.; Ormond; Sand Pt., Feb.; Winter Park. INDIANA: Vermillion Co., Aug. 17, W. S. Blatchley. LOUISIANA: Harahan, Oct., Nov., 1944, at light, F. Werner; New Orleans, Oct. 23, H. Soltau. TENNESSEE: Memphis, July 3, 1899, Psota Coll. TEXAS: Richmond, Brazos R., June 22, 1917, J. C. Bradley.

Tomoderus constrictus (Say)

Plate 5, Figs. 1, 5

Anthicus constrictus Say, 1827, Journ. Acad. Nat. Sci. Phila. 5: 244.
Tomoderus constrictus, La Ferté, 1848, *op. cit.*: 101. LeConte, 1852, *op. cit.*: 94. Casey. 1895, *op. cit.*: 649.

This is the most abundant species from New Jersey to Virginia, west to Illinois and Arkansas. It ranges more widely than this, from New Jersey to Florida west to northern Wisconsin and coastal Texas. It has not yet been identified from New England.

Specimens examined have come from the following localities: ARKANSAS: Carlisle, Feb., 1891, Stromberg; Jasper, Newton Co., Aug. 21, 1948, at light, W. Nutting & F. Werner; 9 mi. E. Rogers, Benton Co., July 6, 1949, M. W. Sanderson and L. Stannard; Washington Co., Aug. 12, 1939, M. W. Sanderson. D.C. : Blanchard Coll. FLORIDA: Dunedin, Feb. 18, 1929, W. S. Blatchley. ILLINOIS: Galesburg; Oakwood, Oct., ground cover; Putnam

Co., Apr. 9, 1933; Volo, Oct. 7, 1933, Asterlund, moss in bog. INDIANA: Evansville, June 27, 1943, H. S. Dybas; Starke Co., Aug. 14, 1920, W. S. Blatchley. LOUISIANA: Tallulah, P. A. Glick. MARYLAND: Baltimore, Mar. 14. MISSOURI: St. Louis. NEW JERSEY: Arlington, E. L. Dickerson; Emerson, Feb. 3, 1918, Quirsfeld. NEW YORK: Staten Island, Feb. OHIO: Cincinnati; Holgate; Holmes Co., Feb., Mar., Everly; Holmesville, Mar. 24, 1928; Marietta, Nov. 10; Mendon, Mercer Co., Aug.; Salineville, Feb. 4, 1891. PENNSYLVANIA: Angora, June 15, G. M. Greene; Easton, May 4, 1937, J. W. Green. SOUTH CAROLINA: Sumter, Oct. 20, 1926. TEXAS: Lee Co., July, 1912, J. C. Warren. VIRGINIA: Falls Church, Sept. 28, Nov. 18, N. Banks. WISCONSIN: Bayfield Co., Liebeck Coll.

Tomoderus inhabilis sp. n.

Plate 5, Figs. 3, 7

This species is externally almost indistinguishable from *Tomoderus interruptus* and *T. constrictus* as interpreted in the present paper. The antennae tend to be slightly thicker toward the apex than in either of these two species. The following measurements, in 0.01 mm., length over maximum width, from basal to apical segments, show a comparison of the antennae of a male of each of the four species. It has not proven practical to segregate the species on this basis. *Interruptus*: 15/9, 10/6, 11/6, 10/6, 11/7, 10/8, 11/10, 11/10, 11/12, 10/12, 14/12. *Constrictus*: 13/9, 8/6, 9/6, 9/6, 10/7, 10/7, 11/8, 11/9, 10/10, 10/10, 13/10. *Inhabilis*: 15/8, 11/6, 11/6, 10/7, 12/9, 11/10, 11/11, 11/11, 11/12, 10/13, 16/12. *Impressulus*: 15/9, 10/7, 11/7, 10/8, 11/9, 10/9, 9/11, 9/12, 9/13, 9/13, 13/12. Segments VII to X are at least as broad as long in these specimens of *impressulus* and *inhabilis*, while only segments IX and X are as broad as long in the other two species. Even though these differences are not constant enough or striking enough for identification of species, they show up fairly well in a series after the specimens have been identified on the basis of the male genitalia. Except in the case of *impressulus*, where the thickness of the antennae can be associated with other external characters, antennal differences are probably not reliable enough for the identification of female specimens.

The male genitalia are distinctive, considerably more slender than in the other Nearctic species, and slightly expanded on one side near the apex, without any definite notches on the sides. Because they are dorso-ventrally flattened, they are more similar to those of *interruptus* and *constrictus* than they are to those of *impressulus*. The figures should be consulted for comparison.

Inhabilis ranges very widely east of the 100th Meridian, from Massachusetts to Florida, west to eastern Kansas and Arkansas. It has not yet been taken in coastal Texas. Despite the wide range, it has not been found to be abundant at any locality.

Type series: All the specimens designated as types are males in which the genitalia have been examined. Holotype: Homestead, Florida, June, 1929, P. J. Darlington (MCZ). Paratypes: ARKANSAS: 2 Washington Co., Oct. 11, 1939, M. W. Sanderson (INHS and author). CONNECTICUT: 1 So. Meriden, Apr. 9, 1939, H. L. Johnson (Conn. Ins. Surv.). FLORIDA: 2 Alachua Co., Apr. 24, 1948, I. J. Cantrall (U. Mich. and author). 1 Ch. Hbr., A. T. Slosson (AMNH). Enterprise, June 19, Bowditch Coll. (MCZ). 2 Homestead, eutopotypical (MCZ and author). Jacksonville, A. T. Slosson (AMNH). Titusville, Mar. 21/22, 1939, F. E. Lutz (AMNH). GEORGIA: 1 Spring Ck., Decatur Co. Jul. 16-29, 1912 (Cornell). INDIANA: 1 Vermillion Co., Aug. 17, 1921, W. S. Blatchley (Cornell). 1 Vigo Co., May 30, 1907, A. B. Wolcott (Chicago Nat. Hist. Mus.). IOWA: 2 Iowa City, Mar. 25, 1898, H. F. Wickham (MCZ and author). KANSAS: 1 Riley Co., Mar. 13, Popenoe (Kans. State). 2 Topeka, Popenoe (USNM and Kans. State). MASSACHUSETTS: 1 Tewksbury, Sept. 2, 1871, F. Blanchard (MCZ). MISSISSIPPI: 1 Lucedale, Dec. 4, 1930, H. B. Dietrich (Cornell). MISSOURI: 1 St. Louis, Liebeck Coll. (MCZ).

Tomoderus impressulus Casey
Plate 5, Figs. 4, 8

Tomoderus impressulus Casey, 1895, *op. cit.*: 649.

Samples of this species from the southern Appalachians are easily recognizable by their generally dark color, thickened antennae and slightly broader anterior lobe of the prothorax, this lobe having a fine median groove. Samples from other areas are not as obvious. The general color may be paler, the antennae not so obviously thickened and the anterior lobe of the pronotum not canaliculate. Specimens from other areas than the Appalachians are most easily identified by the form of the male genitalia, as shown in the key and figures.

This is apparently the common species in the southern Appalachians but it is apparently rather scarce elsewhere in its range. Specimens have been seen from coastal South Carolina, Virginia, Indiana, Illinois, eastern Kansas and a single specimen from the state of Washington. The combination of the southern Appalachians and Washington in its distribution suggests a relict distribution such as has been noted in some other groups of insects. No other species is known from west of the 100th Meridian in North America. The Washington specimen was taken by G. H. Nelson, an entomologist known for his attention to detail. There can be no question that the locality label is correct.

Specimens have been examined from the following localities: ILLINOIS: White Heath, Piatt Co., Apr. 1, July 20, Sept. 23, Oct. 12, Oct. 29, No. 7, in soil and humus, J. C. Dirks. INDIANA: Vermillion Co., Aug., W. S. Blatchley. KANSAS: Atchison, Apr. 25, H. Soltau; Topeka, Sept. 10, 1942, C. H. Seevers. NORTH CAROLINA: Asheville (type locality); L. Toxaway, A. T. Slosson; Valley of the Black Mountains, July, Sept. 24 and 30, 1900, Aug., Sept. 10-14, 1906, W. Beutenmuller. SOUTH CAROLINA: Florence, Jan. 18. VIRGINIA: Fairfax Co., Sept., Quirsfeld. WASHINGTON: Deep Lake, (Douglas Co.), May 5, 1949, G. H. Nelson.

THE NEST OF AN ANOMALOUS COLONY OF THE ARBOREAL ANT *CEPHALOTES ATRATUS*

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One of the distinctive elements of the neotropical ant fauna is the heavily armored and spinose genus *Cephalotes* of forested areas. The workers have powerful, short and convex mandibles that enable them to gnaw out cavities in the trees for nests. Kempf (1951) lists the species *atratus* (L.) from Honduras to Brazil and northern Argentina and summarizes the known biological records. He has also synonymized *quadridens* De Geer with *atratus*. As thus known, the worker is characterized as 8 to 14 mm and black in color and the female about 20 mm and black. The male length is up to 14 mm and with head, thorax and penduncle black, gaster and appendages testaceous to dark ferruginous. Other characters of the castes are fully described by him.

Under the name of *Cephalotes atratus quadridens* the present colony has been alluded to briefly (Weber, 1938, 1947; Wheeler, 1937; Whiting, 1938) and a figure of one of the anomalous workers has appeared (Wheeler, 1936). No account of its biology or nest has hitherto been published. Observations on the colony were initiated on December 11, 1934 and terminated on October 4, 1935, during tenure of a National Research Fellowship in Biology.

It is one of two known ant colonies that contained unprecedented numbers of anomalous individuals. Both were discovered and observed by the writer in Trinidad, B. W. I. and the other (*Acromyrmex octospinosus* Reich) was the subject of the book by Dr. Wheeler (1937). The *Acromyrmex* anomalies were considered by him to be mosaics or gynandromorphs but were later (Whiting, 1938) tentatively characterized as intersexes and intercastes. Dr. Whiting suggested that the *Cephalotes* anomalies, called gynandromorphs by Wheeler, may be female intersexes if not also intercastes. These colonies, which are in the author's collection, need to be restudied and the cause or causes of the anomalies remain obscure.

GENERAL ENVIRONMENT OF THE COLONY

The colony was taken on the savannah grounds (elevation 63 feet) of the Imperial College of Tropical Agriculture in a saman tree (*Samanea saman* ((Jacq.) Merrill) of the Family Mimoseae, a large, umbrella-shaped tree native to Central America. The daily temperature extremes were close to 21-30° C. and annual rainfall some 70 inches.

The tree was separated by 18 meters of well-cropped grassy lawn from the nearest tree, a *Cassia grandis,* to the southwest. The next nearest tree was 48 meters south and was a saman which housed a normal *Cephalotes atratus* colony in a large branch. Another tree, a saman, was 82 meters southwest from the first and lacked a colony of this species. Nine meters south of the latter tree was a saman tree with a normal *Cephalotes atratus* colony. There were no other suitable nesting sites in the area. It was the habit of the ants of all colonies to forage over the grass adjacent to their trees, where some were taken by the giant marine toad, long known as *Bufo marinus* (L.) (Weber, 1938).

THE NESTING TREE

The crown of the saman, fully 30 meters in diameter, had an estimated volume of the order of magnitude of 2000 cubic meters and branches on which the ants were found were up to 15 meters distant from the actual nest site. The leaves were bipinnate and large and closed just before sunset. Early in the dry season (January-May) the tree bloomed and late in February young fruiting pods appeared.

Branches of the tree touched those of the *Cassia* whose trunk was 18 meters from that of the saman. The branches met at a height of seven meters and served as a bridge for the ants. The *Cassia,* also with large, bipinnate leaves, was a young and vigorous tree with smooth bark and appeared with similar but smaller fruiting pods. There was no nesting site available here for the ants.

THE NEST

The original position of the nest was just within the trunk, at the place where a large branch had been sawed off on the north side some 12 years previously and at an elevation of three meters. In the drying of the cut surface an irregular crack had developed that was about 10 mm wide and a few centimeters long. Through this crack the ants gained entrance to an otherwise hard and sound trunk.

The ants gnawed a series of irregular tunnels and chambers in the tough wood, the chambers closest to the outside being some 2-3 cm in, the farthest about 30 cm. There was no regularity in the disposition or size of the tunnels and chambers, the latter being simply enlargements of the former. The nest resembled that of *Camponotus herculeanus* except that the alternating hard and soft layers of wood in northern trees were absent from this tropical wood and there were therefore no concentric excavations.

After the nest was excavated on March 3, April 27 and June 21 the surviving ants took refuge in the innermost tunnels. The wood here was so hard and tough that the ants eventually left it and for a month there was no indication of another site. Finally, on July 28, a worker was detected shortly before sunset crawling to an inconspicuous hole in a small branch at a point 10 meters distant from the trunk and three meters above the ground. The branch was 6 cm in diameter. A mass of ants of all castes was found in a cavity here that was about 20 x 2-4 cm. The opposite end of the cavity terminated in a small tunnel a few millimeters in diameter which was too small for a male or female ant but suitable for a small worker. The ants had either made this cavity or enlarged that of an *Azteca* colony.

During the next two months eleven more auxiliary nests were found. The size varied considerably and all were in dead stubs of branches or in live wood. The mandibles of the workers were small and much time was required to excavate. Some freshly excavated cavities contained scarcely a score of brood and with room only for a few workers. No auxiliary nests were formed in the *Cassia* tree.

AREA PATROLLED BY THE ANTS

The entire crown of the saman was available to the ants. They crawled over every main branch and were frequently found on the most remote smallest twigs and leaves. They occasionally foraged over the grass at the base of the tree but not more than 3-6 meters away from it. The *Cassia* tree was also used, the ants gaining access over the long bridge formed by the intermingled branches. To prove that the ants were from the saman colony, workers on the saman were marked with yellow paint on the thorax, those on the *Cassia* trunk were marked on the gaster. One from the latter site was recovered later on the saman at a point where it had to traverse a minimum distance of 32 meters, whether by the grass route at the base of the trees or by the aerial bridge. Another ant was recovered a similar distance away on the saman. Marked ants from the saman were later taken at the base of the *Cassia* tree and on the *Cassia* at the aerial bridge site. Other *Cassia* ants were recovered in saman nests.

The total volume of foliage used by the colony was thus well in excess of the 2000 cubic meters of the saman crown and approached the volume of soil used by a large *Atta* colony. The area patrolled was not computable on the same basis as that of a terrestrial ant but ants of the colony were taken some 50 meters distant from each other, an indication of the diameter of the area.

THE COLONY

A. THE FEMALE

The female was discovered on April 27 after hours of chiselling into the hard wood on March 3 and later. She was in a small cavity with eggs and minima larvae and was removed to an observation nest, together with a few media workers firmly clinging to her and some other workers and brood. Within two hours she laid nine eggs. The workers assisted with egg-laying. As an egg would slowly emerge a worker would grasp it and pull it away. She continued to lay eggs for two days; one laid on the 29th took 15 minutes to be completely extruded. On the 30th at 8:05 a.m. she was found to be lying on one side, with legs folded. The workers were licking her body and pulling her about. She showed no movements when she was isolated under the microscope, except of the terminal pair of gastric segments. These were rhythmically opening and closing the cloaca, an early cycle taking 20 seconds, later cycles taking longer. One lasted 25 seconds and consisted of 10 seconds of opening and 15 seconds of closing. The segments opened to a maximum of 0.7 mm which was easily equal to the length of one of her eggs. Twenty seven minutes after she was discovered in this condition the movements appeared to be in the nature of a retching and they later slowed down. Within three hours the cloaca was open more than it was closed and she was then returned to the observation nest. The workers immediately approached, explored her with their antennae, and licked her thoroughly as before. By 1 p.m. her terminal segments were still moving and an hour later she was preserved in 80% alcohol, where she floated despite an opening made in her gaster to allow the penetration of the fixative. Later sectioning showed that the ovary was normal and contained many eggs in all stages of growth. There was no sign of a double or binucleate egg.

All evidence pointed to the existence of the single female as the progenitor of this large colony. Her age probably dates from some time after the branch of the tree was cut off, 12 years earlier.

B. Brood

Eggs, larvae and worker pupae were found on the first occasion of opening the nest on March 3 and up to August 5. Soon after April 27 the ants largely abandoned the original nest site.

Media larvae were taken on September 15 and maxima to the 25th. Male pupae were taken on June 21 and were not again found until September 19 to 25. Adult males were taken June 21 — August 5 and two on September 25.

Alate females were found on July 28 and one on August 5. The September brood probably was the result of unfertilized eggs laid by the workers; some of these had fully developed ovaries containing eggs. The brood maturing through August 5 was probably from eggs laid by the queen up until her capture on April 27. The data suggest a maximum period of development from egg to worker of between 100 and 141 days and comparable periods for the sexual castes.

The first part of the worker pupa to take on the adult coloration was the eyes, as in *Cryptocerus varians,* then the tarsal claws and apices of the large spines and gaster. The head and thorax become black last. The pupa may move its legs and other appendages slightly when it is still a pale yellow in color. The pupa is aided from its white envelope by the adult workers licking and using the mandibles to pull at it. A callow worker, gray in color, could walk fairly fast when the nest was exposed in July.

Food of the Ants

The main source of food for the colony throughout the months of observation was the secretions of the membracid, *Adippe inconspicua* Fowler. From February through July these insects were on the fruiting pods of the saman and were being constantly tended by the ants. As the pods in most cases were many meters from the nest sites, much time must have been consumed by these slow-moving ants in travelling back and forth from the feeding areas. While the pods were young and succulent they bore large numbers of *Adippe* and their secretions at this time appeared to be particularly important as a source of ant food.

Workers that were foraging on the grass at the base of the tree gathered bird feces containing insect remains. Others dismembered a large, naked caterpillar lying freshly killed in the grass. The ants were often found to carry indeterminable bits of food but were at no time seen to carry recognizable plant remains.

Myrmecophiles and Predators

The entire absence of myrmecophiles in this large colony is noteworthy. Other common ants of the area that had a comparable colony size had a varied myrmecophilous fauna. Two phorid flies hovered over the nest while the brood collection of April 27 was being made and one apparently tried to ovoposit on a worker but both soon left. The integument was probably too dense for these parasites. On May 21 five workers were found in a motionless mass at the base of the tree under their nest. They were placed in a moist container to determine whether parasites would emerge but none did.

The marine toad, as noted before, fed on these ants and was the only predator observed. The stomachs of several ant-eaters (*Tamandua longicaudata* and *Cyclopes pygmaeus*), taken from nearby trees, did not contain remains of these ants.

General Behavior

The behavior of the workers underwent a marked change during the months of observation and collecting and seemingly as a result of this "persecution." At first they were aggressive, swarming over the hands and biting repeatedly. Their small mandibles could only pinch the human epidermis. Some workers fled but none freely dropped off the tree. Those which dropped off to the ladder or the clothes immediately climbed to where they could bite the exposed skin.

During July and early August they lost their aggressiveness to a large extent. By this time there were much fewer individuals and stimulation of one another would be reduced. Nevertheless, when a mass of workers would be encountered, as in exposing an auxiliary nest, the ants seldom attacked but fled.

By September the ants were so timid that, when one would be approached, it would instantly release its hold on the branch and drop to the ground from any height. It was noteworthy how often in their fall they might catch hold with their tarsal claws of a leaf, twig or hair on one's arm as they brushed by. The ants freely dropped off though one's fingers might be 15 cm. from them. Those that did not drop off ran quickly to the underside of the branch. When the nests were exposed the ants remained motionless, appressed to the branch, or fled.

On September 14, 3:30 p.m., several small groups of ants were resting quietly on main branches of the *Cassia*. Their mandibles were not moving and they were not feeding. Aggregates like this at this time of day were not seen when the colony was larger. On October 2 a cluster of 31 was on the sunny side of the *Cassia* trunk at 8 a.m. They were watched for half an hour and showed no tendency to leave or to feed. For the most part they remained motionless but occasionally one would change position. On both dates the ants instantly dropped off when they were approached with the fingers.

At all times of the year activity outside the nest ceased shortly before sunset, when the saman and *Cassia* bipinnate leaves folded and drooped down, and was resumed at dawn.

BEHAVIOR WITH BROOD AND MEMBRACIDS

When the brood was exposed during the first months many of the workers tried to carry it away. There was no division of labor on the basis of worker size or normal or anomalous morphology. An egg or small larva would be held by the middle, between the mandibles, and carried under the massive head. A larger larva or a pupa, however, would be grasped tightly towards one end and carried vertically in front of the worker or even inclined over the back. The workers assisted the callow from its pupal case by cutting this with their mandibles as noted earlier. When the brood was exposed in later and smaller auxiliary nests the same behavior was noted despite the change in aggressiveness.

The membracids were not defended nor taken away by the ants when attempts were made to collect both. At all times, when feeding membracids and ants were approached, the ants and the adult female membracids fled, the latter taking flight, while the nymphs were left unguarded.

BEHAVIOR OF ANOMALIES

The anomalous workers behaved as normal workers. They were aggressive when the rest of the colony was aggressive and fled when the others fled. Those most conspicuously anomalous were the maxima and these were nearly all collected in the first few months. They carried food to the nest, aided in dismembering a caterpillar and tended membracids. One with worker body and male genitalia stroked a membracid as would a normal worker; other anomalies were frequently on the pods. They carried brood, when the nest was disturbed, like normal workers. The anomalies also licked the female integument in the observation nest, a typical worker habit.

Anomalies with one or both of the curious ram's horn antennae (as in Wheeler, 1936, Fig. 1) were able to pursue a direct course and no clear asymmetry in motion was observed. The winged and apparently female anomalies behaved as did the workers and either bit quickly and repeatedly or fled.

The males, which were superficially normal, were uniformly timid, did not bite and either attempted flight or concealment.

Numbers in the Colony

Systematic collection of the colony was undertaken when the colony was discovered to be anomalous. By June 21 the totals were:

Apparently normal worker adults —	7284
” ” pupae	885
Anomalous worker adults	2919
” ” pupae	201
Adult males	94
Male pupae	48
Queen	1
	11432

The July and later collections added 19 alate females, including eight anomalies, and several hundred workers.

Summary

A nest of the arboreal ant, *Cephalotes atratus* (L.), contained over 10,000 adults during a 10-month period of collecting. The workers at first were aggressive and

attacked freely. Later, apparently as a result of the systematic search and collecting, the ants became timid, dropping from the tree or running to the opposite side of the branch when approached. Finally the remainder formed on another tree into temporarily immobile small clusters. These remnants of an aggressive colony lacked the stimuli of the queen, brood and other workers that might be necessary to maintain their normal behavior. The colony was also noteworthy in containing large numbers of anomalies whose cause remains obscure.

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SOME NEW SPECIES OF ROBBER FLIES (DIPTERA: ASILIDAE)

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Recent studies of Diptera have brought to light several undescribed species of Asilidae, which are here described.

Laphystia torpida, new species

A stout species of medium size. The abdominal pattern is superficially like that of *Laphystia annulata*, new species, but the femora and tibiae are chiefly black. Length 10 mm.

Female. *Head*: The head is black, the face is covered with dense, pale, yellowish grey, nearly white, fine micropubescence. Similar cover is found on the front, vertex and upper occiput. The pollen of the lower occiput is more nearly white and its pile fine, rather dense and whitish. There is a cluster of 6 or 7 weak, yellowish white bristles on the upper fourth of the occiput on each side. The low but wide ocellarium bears numerous, erect, stiff, yellowish hairs which are confined chiefly to the side slopes. Proboscis and antenna black, the former not quite extended as far as the face and robust, obtuse, with medial ridge, slightly swollen base and scattered, long, yellowish white hairs at the base below and a rather dense tuft of similar hairs at the apex. The black of antenna is covered by a pale, yellowish grey or nearly white pubescence of microscopic character and the first segment bears a slender, whitish bristle and abundant, whitish pile. *Thorax*: The thorax is black, upper pleuron and the lateral mesonotum are densely covered with pale, brownish yellow pollen, becoming more greyish white ventrally on the pleuron. There is much coarse, yellowish white, long, stiffened hairs on the posterior half and upper border of the mesopleuron and the anterior sternopleuron, besides more scanty pile on the pteropleuron and posterior hypopleuron. There is a broad, vertical band of slender, long, bristly, pale hairs on the metapleuron. Middle of mesonotum densely pollinose and slightly more brownish and still pale. Before and after the suture on each side there is a short, narrow, more or less bare stripe which may be natural or worn. Posterior margin of scutellum also bare and black. The disc densely pale pollinose with abundant, coarse, appressed, pale yellowish pile and similar pile in front of the scutellum. On the greater part of the mesonotum the pile is scanty, minute, flat appressed and golden. Down the middle anterior area is a slightly darker, greyish brown vitta, which is divided by a pale, narrow stripe. *Legs*: The legs are black, largely pale grey pollinose, the pile short, coarse, appressed, brassy and glittering. The bristles are weak, yellowish white and moderately numerous and short, except on the anterior and middle tibiae where they make long, spike-like, regularly spaced fringes. The extreme base of the anterior and middle femora and slightly more of the hind femoral base light reddish brown. All the tibiae narrowly and obscurely light brown at base. All the tarsi quite dark brown. Hind femur with 6 lateral bristles, 4 or 5 ventrolateral bristles and some ventromedial, bristly hairs and broadly covered ventrally with abundant, fine, short, erect, pale pile continued on to the ventral surface of the hind tibia. Hind tibia with moderately long bristles: 4 dorsolateral and 4 ventrolateral elements, their basitarsi robust. Middle femur with 1 long, anterior and 1 short anteroventral bristle, each close to the middle, 1 short, posterior bristle near the apex and 5 or 6 long, slender, basal and ventral bristles and numerous bristly hairs on the ventral surface. Middle tibia with 3 anteroventral bristles, 3 anterodorsal, 4 posterodorsal, 4 long, slender, posteroventral hairs and 4 conspicuous, long, evenly spaced, ventral bristles. Anterior femur with a slender, short bristle anterodorsally near the apex, the ventral compliment similar to the middle pair and no other bristles. Anterior tibia similar to the middle tibia and the conspicuous fringe in this case consists of 5 long, posteroventral bristles. Claws slender, uniformly and gently curved from the base, sharp. Pulvilli on all legs reduced to less than half the length of the claws. Empodium long and flattened. *Wings*: The wings are greyish hyaline. There is a minute stub near the base of the anterior branch of the third vein. First posterior cell a little narrowed, marginal cell widely open, fourth posterior cell and anal cell each closed with a long stalk. Alula well developed, ending at the apex of the anal cell. Alula large. *Abdomen*: The abdomen is black, dully shining, wider than the thorax, widest on the third segment, the posterior third of each tergite or a little less is densely clay colored pollinose and nearly the same shade as the mesonotum. The pollen extends completely and widely over all the lateral margins except for a narrow triangle at the base of the second segment. Pile scanty, flat appressed and brassy. Sides of first tergite with a patch of weak, yellow bristles and other pile. Middles of lateral margins of second tergite with a transverse row of 7 or 8 short and more stout, pale bristles. Third tergite with 5 such bristles; fourth with 4, fifth and sixth tergites with 2 such bristles. The minute ninth segment is dull black; seventh and eighth segments quite short.

Type. Female; Tracy, California, San Jouquin County, June 13, 1949, J. W. McSwain collector. Type in the collection of the University of California.

Laphystia annulata, new species

A small species which traces to *Laphystia confusa.* It is characterized by the dense, silvery grey pollen, the black antenna, the pale yellow femora and tibiae, the latter being quite narrowly black at the apex. Length 9 mm.

Male. *Head*: The head is black, everywhere silvery white pollinose with long, dense, silvery white, fine hairs on face, front, occiput, vertex and ocellarium. Upper corners of the vertex with 6 or 7 white bristles on each side. Proboscis shining black. Antenna black, its pile white. *Thorax*: The thorax is black, densely greyish pollinose on the pleuron, changing on the upper mesopleuron to a faint yellowish hue. Pollen of mesonotum faintly yellowish, the pile minute, appressed and pale brassy yellow, except for a collar of nearly erect, longer, white hairs anteriorly between the humeri. Bristles of lateral margins yellowish white and weak; 2 on notopleuron, 4 above wing, 2 on post callus and the scutellar margin with 4 pairs of slender hairs. *Legs*: The whole of the femora and all of tibiae except extreme apex and the extreme base of the basitarsi yellowish. Remaining tarsi blackish. Pile appressed and white or yellowish white. Bristles weak, short, except on the anterior and middle tibia, few in number and of the same color as the pile. Claws fine, sharp, black with the basal third yellowish. Pulvilli pale, thin, well developed. *Wings*: The wings are nearly hyaline, the second vein and the third vein on the basal part yellow, other veins light brown. Marginal cell open though narrowly. *Abdomen*: The abdomen is shining black. All of the first segment except the narrow posterior margins greyish white pollinose. Similar pollen covers approximately one-half of the second and third segments, being slightly decreased submedially and slightly increased in the middle and laterally widely covering the whole lateral margin. On the fourth and fifth and sixth segments a little less than half of the segments are covered by this band. Also the posterior margin of the second and fifth segments narrowly black except laterally. Pile appressed, setate, short and reddish yellow on the black portions, shining white on the pollinose portions. Terminalia short and black with white pile.

Female similar to the male.

Type. Male; near Navajo, Arizona, July 11, 1954, F. M. Hull collector. Allotype, female, 9 paratype males, 2 paratype females, all with the same data. In the collection of the author.

Laphystia annulata interrupta, new subspecies

Similar to *Laphystia annulata,* new species but with the grey bands on the abdomen distinctly interrupted, each half attenuate so that also more of the posterior margin is shining black.

Type. Female; near Navajo, Arizona, July 11, 1954, F. M. Hull collector. In the collection of the author.

Laphystia rubra, new species

A small species distinguished by the uniformly shining, dark red abdomen and the almost entirely brownish yellow femora. Length 8 mm.

Female. *Head*: The head is black. Face laterally with silvery, minute, appressed pubescence, brownish yellow in the middle on the upper half; the mystax consists of 2 or 3 rows of short, stout, brownish yellow bristles above the epistoma. There are a few fine, white hairs on the upper part of the face laterally which are not very long and appressed. First 2 segments of antenna black, the third brownish black, the first segment with 2 long and 1 short, stout, brownish yellow bristle below. Front in the middle with pale brownish yellow pollen, the sides more whitish. Upper front and medial part of the vertex adjacent to the eye with a few, short, stiff, brownish yellow setae. Occiput with fine pile except above, where there are 7 pairs of slender, reddish yellow bristles. *Thorax*: The thorax is black, pleuron thinly dusted with yellowish white pollen and a few long, yellowish hairs on the mesopleuron. Metapleuron with a vertical row of 12 quite slender, pale yellowish hairs and a few other short hairs. Mesonotum with abundant, minute, flat appressed yellow setae. Bristles brownish yellow, 2 on notopleuron, one of which is quite small, 2 above wing, 2 on post callus, 1 of them small, and scutellar margin with only a few minute, upturned setae. Scutellar disc likewise with a few appressed, brownish golden, minute setae directed outward. Knob of halteres yellow, the base reddish brown. *Legs*: The femora are brownish orange with an obscure, dark streak on the dorsal surface of the hind femur confined to the outer half. A smaller, distal, dorsal, obscure, dark patch on the anterior femur and a trace of such color distally on the middle femur. Apical fourth of all tibiae obscurely brownish black. All tarsi quite dark brown. Pile of legs minute, appressed, pale brownish yellow and setate. Bristles weak, pale and few in number. There is a whitish bristle ventrally near the base of the hind femur and sometimes a second smaller bristle a little beyond it. Each femur has near the apex a small posterior or medial bristle. Each femur has a still smaller yellow bristle laterally near the apex. Claws slender, black, with the base reddish. Pulvilli slender, long and whitish. *Wings*: The wings are nearly hyaline, the second vein and the basal part of the third vein pale brown, other veins light brown. Marginal cell open narrowly. *Abdomen*: The abdomen is more robust than in *Laphystia annulata*, new species. Tergites dark, shining, brownish red with the whole lateral margins only pale brownish yellow pollinose. This pollen extends narrowly along the posterior margin of the sixth tergite but leaves the middle interrupted and bare. The short seventh and eighth tergites entirely pollinose. Pile over the middles of the tergites minute, flat appressed and reddish yellow. Side margins of first segment with 4 stout, reddish bristles and the second and third segments with 4, the fourth segment with 3 and the fifth and sixth segments each with 2 similarly colored bristles.

Type. Female; near Navajo, Arizona, July 11, 1954. Paratype female, same data. F. M. Hull collector. In the collection of the author.

SYMPATRY OF THE ANTS CONOMYRMA BICOLOR (WHEELER) AND C. PYRAMICA (ROGER). — In his revision of the North American ant fauna Creighton (1950, Bull. Mus. Comp. Zool. Harvard, 104: 349) treats *C. bicolor* as a sympatric subspecies of *C. pyramica,* on the grounds that the two forms are separated ecologically where they occur in proximity. Kusnezov (1952, Acta Zool. Lilloana, 10: 430), on the basis of purely morphological criteria, raises *bicolor* to species rank, even placing it in a separate subgenus, *Biconomyrma.* A recent re-examination of the *pyramica* group has cast some doubt on Kusnezov's decision, however, since it has been found that *bicolor* does not possess the characters reputed to exist in the worker alitrunk of *Biconomyrma* species. It is therefore noteworthy that there is at least one locality where the two forms occur in intimate sympatry while remaining distinct with respect to characters in worker color and size. In Kingman, Mohave Co., Arizona, during July, 1952, the author found four places inside the town limits where *bicolor* and *pyramica* nests were located within several feet of each other. The *pyramica* nests were outnumbered by those of *bicolor* by a ratio of two or three to one and were restricted to the best watered and shaded spots. They could be distinguished easily by their smaller entrance holes and smaller, more regularly formed craters. No difference in periodicity of foraging was detected. In well shaded spots both species were active to some extent throughout the day, but were inactive and absent from the upper parts of the nests in exposed, sunny spots from about 11:00 a.m. to 3:30 p.m. These data suggest that *bicolor* and *pyramica* are distinct biological species. — E. O. WILSON, Biological Laboratories, Harvard University.

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sidered his genera as subgenera (*Cyphoda* and *Serroderus*) throughout, merely to avoid confusion. Three species had been previously recorded from Lebanon. In the present work two of these were re-discovered, and species previously recorded from Egypt and Palestine were found. Along with one new species, this brings the total known from the area to six species.

Cyphoderus genneserae Carpenter

Cyphoderus genneserae Carpenter, 1913, Jour. Proc. Asiat. Soc. Bengal 9:215

This species is fairly widespread throughout the southwestern Syrian Region. Handschin and Carpenter reported it from Palestine and the variation described by Handschin as "*aethiopica*" has been found in several regions in Central Africa. I have recovered the species from two localities: Litani River near the mouth on August 23, 1953 (Asfour and Salaymeh Coll.) and Antelias Stream Bank on November 9, 1952. Both of these localities are in the coastal plain of Lebanon and all of the specimens (about 25) agree with the descriptions and figures shown in Handschin, except in one startling respect: The presence of only two fringed scales in the inner row of dental scales. This characteristic places the species in the genus *Serroderus* of Delamare, although it lacks any hint of the gradation between scale and seta structure described as characteristic of the genus. The species of this genus which it most resembles is *S. sublimis* and this species also lacks the above mentioned characteristics. In spite of the difficulty of separating the specimens at hand from the last mentioned species I feel that the exact detail for detail identity of the present form with the described *genneserae* leaves little doubt that the existence of only a single pair of internal scales is a local variation. This, of course, points up the necessity of revising the limitations of the genus *Serroderus*, but this is beyond the scope of the present paper. The only other modification of Handschin's description is that in a few specimens the tenent hair can be seen to have a minutely clavate tip, visible only under the highest magnification. In both populations the *aethiopica* type of mucronal form was present in addition to the normal type.

Cyphoderus (*Cyphoda*) *grassei*
Cassagnau & Delamare-Deboutteville

Cyphoda grassei, Cassagnau & Delamare, 1951, Biospeologica 75: 384-385.

This species was described by Cassagnau and Delamare from a single specimen. The relative size of the mucro and dens (1-10) was taken as a characteristic of the species and upon this basis it was placed in the genus *Cyphoda*. I have several series of specimens which I have identified as this species. In one of these I have five specimens. The relative sizes of the mucro and dens varying as follows: 1-10, 1-9, 1-8.5, 1-7.5, 1-7. In a second series of three specimens the sizes are: 1-10, 1-6, and 1-5.5. In still a third series both specimens have a mucronal dentes ratio of 1-5.5. This presents a problem since the sole basis for separation of members of the genus *Cyphoda* is the relative mucronal length. Whatever the eventual decision concerning this genus, the species *grassei* can no longer be considered part of the genus.

In addition to this variation in mucro the species shows another peculiarity in that the tunica is absent in a few specimens, particularly young forms. In over 95% of the specimens seen, a clear tunica is present on the ungues. Perhaps the most unique characteristic of the group is the shape of the mucro. This is particularly noticeable upon specimens having a relatively large mucro, but can be seen upon all. The mucro has in addition to the apical hook, a very shallow anteapical tooth. This condition is always the same and places it directly on a line between the two groups bidenticulati and inermes.

Distribution: Hammana, Lebanon, August 28, 1952 and July 28, 1957. Vic. East Base Quornet es Sauda Lebanon, elev. 2200 meters, July 1, 1953; Vic. Turkish Border Latakia, Syria, August 2, 1953, lat. 35° 50″ long. 36° 01″; Dahr el Ain, Lebanon, October 10, 1951.

Cyphoderus (Serroderus) spinatus n. sp.
Plate 6, figures 9-11, Plate 7, figure 8

Body oval, head bluntly oval with well developed mouthparts. White without eyes or any indication of pigment. Antennae four-segmented with first and second segments subcylindrical, third segment short and swollen apically, and fourth segment fusiform. Clothing of fourth segment of numerous setae some curved acuminate and ciliate, others smooth blunt and sharply curved. Both varieties decrease in size apically. The remainder of antennal segments are similarly clothed except that ciliate setae become relatively larger and straighter, and the smooth setae are largely limited to the ventral surfaces. The third antennal sense organ of two blunt ovoid stalked knobs and a pair of small slender, sharply angled blunt setae.

The body well covered with fine scales. Large ciliate acuminate setae present on the ventral surface of the animal and posterior two segments. Body with scattered short to long slender bothriotrichia.

Legs with numerous short acuminate setae. Tenent hair stout and pointed on all legs. Unguis stout, sharply acuminate with paired basal prominent teeth, two small but definite median teeth. Apical-most tooth at about mid-level of unguis.

Manubrium with normal clothing, dens with acuminate ciliate setae, ciliate and smooth scales and spines (see Plate 6, fig. 10). Outer row of dorsal fringed scales six

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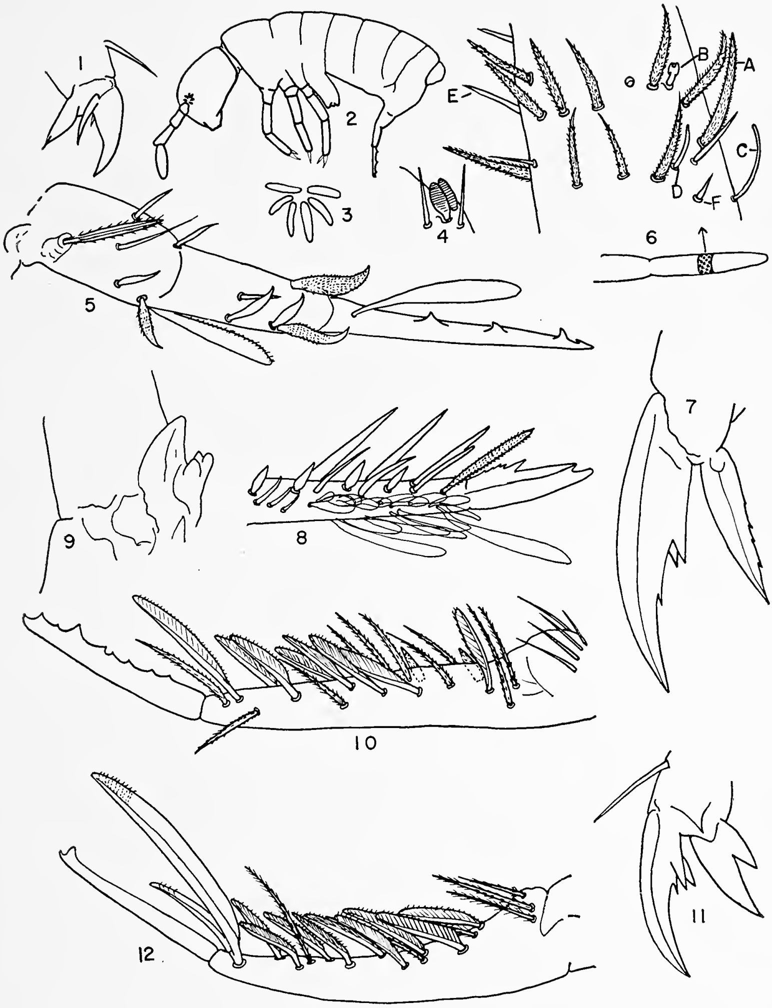
Explanation of Plate 6

Figures 1-5 *Oncopodura ambigua* n. sp. 1. Claw, paratype, approx. 1000 x. 2. Habitus, setae and scales omitted, holotype, approx. 100 x. 3. Left postantennal organ, paratype, approx. 1000 x. 4. Third antennal sense organ, paratype, approx. 2000 x. 5. Dens and mucro, holotype, approx. 2000 x. Figures 6-8 *Troglopedetes canis* n. sp. 6. Detail of clothing of antenna, with different types of setae mentioned in description labelled. Small lower diagram shows whole fourth segment with expanded part hatched, detail holotype, approx. 1000 x. 7. Front claw, holotype, approx. 1000 x. 8. End of dens and mucro, paratype, approx. 350 x. Figures 9-11 *Cyphoderus spinatus* n. sp. 9. Clasp organ at base of dens, paratype, approx. 1000 x. 10. Mucro and dens, holotype, approx. 400 x. 11. Hind foot, paratype, approx. 400 x. Figure 12. *Cyphoderus assimilis* Börner. Mucro and dens of specimen from Syria, approx. 400 x.



CHRISTIANSEN — CYPHODERUS

in number, distalmost strikingly larger than remainder. Inner row with two scales and in addition two short stout spines which appear to take the positions normally occupied by scales. If we consider the two pairs of spines as equivalent to scales, the group ends up as part of Delamare's "multidentati group" to which it shows a number of similarities. Taken from one locality; Jisr esh Chouer, Syria, September 21, 1953. In swamp, Berlese funnel sample, wet soil mixed with dead reeds and roots. Mucronal formula (after Delamare) aA1A5.

VARIATION

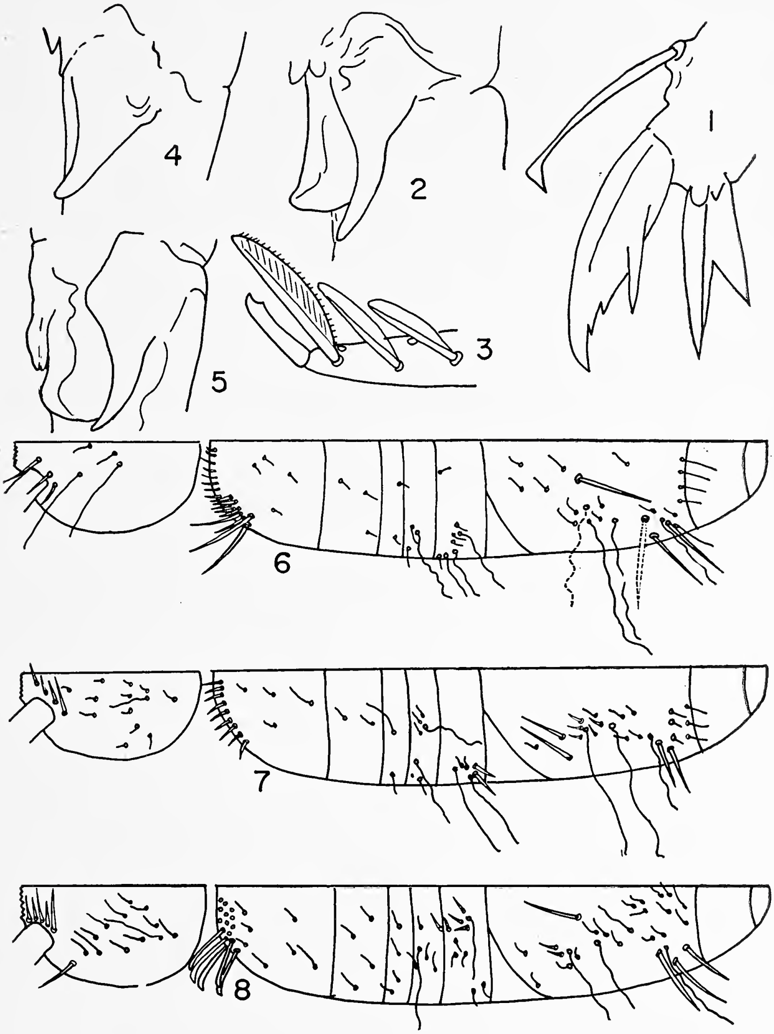
Only four specimens were seen and in this series little variation was noted. In one specimen the unpaired teeth were reduced to one extremely minute tooth on the first two pairs of legs. The external row of fringed scales were five in number on two specimens.

DISCUSSION

The presence of spines along with the fringed setae on the dens serves to separate this species readily from all previously described species of the genus. The presence of only two fringed scales on the internal row in this species would appear to place the species in Delamare's *Serroderus*. As is pointed out elsewhere the limits of this taxon need re-definition.

EXPLANATION OF PLATE 7

Fig. 1. *Cyphoderus assimilis* Börner. Claw, specimen from Syria, approx. 500 x. Fig. 2. *C. genneserae* Carpenter. Clasp organ at base of dens, specimen from Lebanon, approx. 1200 x. Fig. 3. *C.* (*Cyphoda*) *grassei* Cassagnau and Delamare. Mucro and tip of dens typical Lebanese specimen, approx. 600 x. Fig. 4. *C.* (*Cyphoda*) *grassei* Cassagnau and Delamare. Basal dental organ, approx. 1200 x. Fig. 5. *C. assimilis* Börner. Basal dental organ, specimen from Syria, approx. 1200 x. Fig. 6. *C.* (*Cyphoda*) *grassei* Cassagnau and Delamare. Semidiagrammatic representation of dorsal chaetotaxy. Fig. 7. *C. genneserae* Carpenter. As above, specimen from Lebanon. Fig. 8. *C. spinatus* n. sp. As above, paratype.



CHRISTIANSEN — CYPHODERUS

Cyphoderus assimilis Börner

Plate 6, figure 12, Plate 7, figures 1, 5

Cyphoderus assimilis Börner, 1906, Mitt. Naturhist. Mus. Hamburg 23:181.

The true identity of this species is a difficult problem to solve. The species *C. assimilis, C. similis, C. subsimilis,* and *C. simulans* all have in common: bidenticulate mucro, unguis without tunica and with two unpaired teeth, only a single well developed basal ungual tooth and a clavate tenent hair. Although the absence of the tunica, the unpaired median tooth, and clavate tenent appear to show some variation and much difference of interpretation, we have little choice other than to accept these as real characteristics. It would appear from Börner's description that his original diagnosis is a composite of two species. One of these is the species later described by Folsom as *C. similis.* The evidence for this is as follows: First Börner, 1906, described the species from two collections; one from Egypt, and one from orchids from the West Indies. Since the form Folsom described was from the West Indies, it seems quite probable that it is equivalent to the latter form seen by Börner. If this is accepted then a number of facts indicate that the description is composite, and the Egyptian form is another species. Börner says that the inner terminal scale is shorter to somewhat longer than the mucro. In the West Indian and Central American specimens it is never as long as the mucro. He says there is usually a small lamella upon the mucro; the West Indian and Central American material always have some lamella. This would mean that to account for his description the species seen by Börner were two: one an Egyptian form sharing the common characteristics of the group with a dental scale longer than mucro and without lamella on the mucro, and a second form later described by Folsom as *C. similis. C. subsimilis* of Delamare satisfies both requirements for the Egyptian species, but the figure of the unguis differs strikingly from that given by Börner in 1913. I have collections from Syria which satisfy all of the characteristics listed above. The one major disagreement between the species is the relative size of the mucrones. Since this, as most ratio distinctions, is very unstable it is not a serious objection. If this is accepted as the true *assimilis* then the following table can be used to separate the four species:

	assimilis ?	*similis*	*subsimilis*	*simulans*
dental formula	5/6	5/6	4/6	6/6
internal setae of tibiotarsus	"smooth"	1 row "smooth"	?	?
mucro	no lamella	with lamella	no lamella	no lamella
distal scale / mucro	longer	shorter	longer	shorter

Distribution: Bahr Atibe, east of Damascus, Syria, July 10, 1953.

Cyphoderus albinus (Nicolet)

Cyphoderus albinos (Nicolet), 1842, Nouv. Mem. Soc. Helv. Sci. Nat. 6:1-88.

Cassagnau and Delamare reported this from Dahr el Ain in Lebanon. I have two specimens taken from Latakia Syria, which appear to be this species. Unfortunately both were damaged in capture so that a certain identification is impossible.

Cyphoderus bidenticulatus (Parona)

Cyphoderus bidenticulatus (Parona), 1888, Ann. Mus. Civico Genova Ser. 6:83.

Reported from two caves in Lebanon by Cassagnau and Delamare.

Cyphoderus agnotus Börner

Cyphoderus agnotus Börner, 1906, *op. cit.*: 180-181.

Although this form has not been recorded from Lebanon or Syria its widespread occurrence throughout Palestine makes it quite probable that it does occur in the southern part of this area.

Genus *Troglopedetes*

Cassagnau and Delamare recorded two new species of this cavernicolous genus from Lebanon (*op. cit.*). This known species of the genus is largely circum-Mediterranean in distribution; but, the existence of Paleotropical and Neotropical members indicates the possibility of a tropicopolitan but still undiscovered distribution. One new species was discovered in this work bringing the known Syrian-Lebanese forms to three.

Troglopedetes orientalis Cassagnau & Delamare

Troglopedetes orientalis, Cassagnau & Delamare, 1951, *op. cit.*: 385-387.

These authors recorded this species from three localities in Lebanon. One record was non-cavernicolous.

Troglopedetes vandeli Cassagnau & Delamare

Troglopetes vandeli, Cassagnau & Delamare, 1951, *op. cit.*: 387-388.

Taken from one cave in Lebanon.

Trogopedetes canis n. sp.

Plate 6, figures 6-8

Facies characteristic for the genus. Antennae with basal three segments subcylindrical and fourth segment divided in middle and elongate fusiform in shape. Antennae covered with a variety of setae of different types (see Plate 6, figure 6). Setae of Type A decreasing in size apically and with the ciliations becoming more prominent. Setae of types F and B are limited to the fourth antennal segment while those of type C are most numerous here and upon a limited region on the inner margin of the apex of the second segment. Fourth segment with two scale-like knobs having a lateral axis, and a pair of small and oval blades projecting out from this. In addition nine smooth setae are present. Scales oval, with extremely short fine striations. Dorsum of first thoracic segment with an anterior lateral fringe of large acuminate finely ciliate setae. Because of the dense covering of large scales, the remainder of the body setae are difficult to perceive, but the situation appears to be quite similar to that found in *Cyphoderus*. Dense with a single row of twenty-one spines. Mucro with four very small and two large dorsal teeth.

Tibiotarsi with all setae uniformly ciliate. Tenent hair prominent and clavate. Unguis with basal teeth well developed, one definitely larger, two unpaired median teeth, the apical one being very minute. Median teeth more prominent upon the hind unguis. Unguiculus acuminate and sparsely serrate along its posterior margin.

Variation in dental spines: 22/19, 21/23, 22/21, 19/20, 19/23.

Known only from the type locality: Dog River Cave, Lebanon, July, 1951 on Debris 1 km. inside cave.

DISCUSSION

This species is similar in many respects to *T. orientalis* but differs from this species in the shape of the mucro, the number and disposition of the dental spines, possession of a clavate tenent hair, the type of setae upon the antennae (see below), and the structures of the ungues. In this last characteristic the present species ressembles *T. machadoi* Delamare, but it differs from this form in most respects, most strikingly in the relative length of the mucro.

The setae upon the antennae of these animals furnish an excellent series of characteristics. Unfortunately only three species were available for comparison but as the following table will illustrate, these indicated the value of further investigations of this characteristic.

In addition to this the so-called sense organ of the third antennal segment differs among the three forms (axis central in *ruffoi* and lateral in the other two).

seta type	*orientalis*	*ruffoi*
A	*	longer, ciliation more prominent
B	stalk longer than apical expansion	longer only slightly expanded apically
C	unilaterally finely ciliate	dense mass upon apex of third segment
D	*	straight
E	*	*
F	longer and definitely curved	longer

* signifies similar to that illustrated for *canis*

Oncopodura ambigua n. sp.

Plate 6, figures 1-5

Facies typical for genus. White, without trace of pigment or eyes. All antennal segments subovoid. Antennal segment four equipped with an apical conical projection and four blunt oval "sensory" setae. Remainder of setae of fourth segment slender smooth and acuminate. Third antennal segment with apical organ of two elliptical rods, with marked ladder-like striations, without clearly visible central axis. Remainder of antennae covered with a mixture of smooth setae (as in fourth antennal segment) and heavy conical finely striate setae. Postantennal organ of six lobes, the anterior pair lying at right angles to the long axis of the head, and the remainder radiating backward from this.

Tibiotarsus without any clearly spatulate setae. Unguis untoothed, with a definite "triangular lamella" and an opposing smaller but similar seta. Both structures are attached near the base of the unguis. Empodial appendage simple, external edge straight and equipped with a short apical filament.

Mucro slightly shorter than dens, equipped with an apical and three dorsal teeth. A single large scale is attached to the base of the mucro. Dens clearly subdivided into two portions. Inner dorsal margin of dens equipped with four apically curved heavy ciliate setae. A sixth seta is on the outer margin near the base of the dens. Remainder of dorsal surface with one large scale and five acuminate smooth setae.

DISCUSSION

In the series examined there was little variation outside of relative size. The large ciliate setae upon the inner margin may be five in number. Occasionally the basalmost of these setae is not curved at its apex.

The P.A.O. is often sunken into the head and it is very difficult to puzzle out the exact arrangement of the lobes. The presence of a definite triangular ungual lamella combined with the presence of a six-lobed P.A.O. immediately serves to distinguish this species from all those given in

Bonet (1943). In most characteristics this species would appear to be most closely allied to *O. crassicornis* Shoebotham and *O. cruciata* Bonet, but it may readily be distinguished from both of these by the presence of the ungual lamella.

This animal was extracted from a soil sample with a Berlese Funnel. Since only one locality is known, the range of the animal cannot be determined.

Known only from the type locality: Campus American University, Beirut, Lebanon, various dates, 1953.

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SOME FLIES OF THE FAMILY ASILIDAE (DIPTERA)

By Frank M. Hull
University of Mississippi

In this paper are descriptions of several species and genera of robber-flies.

Zabrops new genus

Type of genus: *Triclis tagax* Williston, 1884. Other American flies put in *Triclis* Loew probably belong here.

Small flies with short, appressed pile and comparatively robust form. From *Triclis* Loew they differ in the gibbous and prominent face, with numerous bristles below and little or no hairs in the upper part. Third antennal segment swollen. Female terminalia generally similar to others in the Laphystini. Length 11 mm.

Head: The face is prominent, short beneath the antenna but rising below into a gently rounded eminence, occupying at least three-fourths of the face. The occiput is prominent below due to the gradual anterior recession of the eye; its pile is dense and fine with 4 or 5 weak bristles on upper occiput. Proboscis short, robust, stout at base and not protruding beyond the face. Palpus minute, composed of 2 short segments. Antenna nearly as long as head; third segment swollen shortly beyond its base, and with style included, is about as long as first 2 segments combined. At its apex it bears a short, stout, spoon-shaped microsegment with enclosed spine. *Thorax*: The mesonotal pile is abundant, more or less appressed and undifferentiated. The lateral bristles are weak and consist of 2 notopleural, 3 or 4 supraalar, 2 or 3 postalar, and 4 to 6 pairs on the scutellum. Prosternum not or only slightly dissociated ventrolaterally. *Legs*: The legs are stout, the hind femur a little swollen distally and all legs with dense, appressed, setate pile. The hind femur bears 4 dorsolateral bristles, 2 lateral bristles and 3 dorsomedial bristles, which are near the apex; the ventral surface of both hind femur and tibia have a dense brush of fine, erect pile. Tibial bristles rather strong; no spine on anterior tibial apex. Claws sharp, pulvilli and empodium long. *Wings*: The marginal cell is widely open, the second vein not recurrent; first posterior cell closed and stalked and the fourth posterior cell also; anal cell closed and stalked. Alula small; ambient vein complete. *Abdomen*: The abdomen is comparatively robust, the first 2 tergites are at least as wide as the mesonotum; 6 tergites in males. The pile is dense, appressed and setate and there are 6 or 7 slender bristles on the sides of the first tergite, a patch of 6 to 8 or fewer on the sides of the second tergite and 1 or 2, or none on the third tergite and none beyond. Male terminalia partly rotate or wholly rotate. Epandrium undivided, uncleft, with short, blunt, posterolateral process; surstylus short, smaller, broad at base; hypandrium a mere lip-like extension.

Broticosia new genus

Type of genus: *Broticosia rapax* new species.

Small to medium size flies with laterally compressed abdomen and subcircular head and very narrow face. Bristly pile of face concentrated in a mane. Hypandrium drawn out as long, arched process which is curved downward. Length 13 mm.

Head: The face is very narrow and head nearly circular. The pile of the face is abundant and massed into a rather dense, vertical row of very long, slender bristles. Antenna elongate; the first 2 segments combined are about as long as the third segment, the microsegment excluded; this microsegment is long, held at a slight angle, is a little less than one-third as long as the third segment and is spoon-shaped at apex with long, dorsal, spinous bristle. Palpus of 2 segments. *Thorax*: The pile of the mesonotum consists of numerous, very long, fine bristles down the middle of the mesonotum with shorter bristles laterally; acrostical elements differentiated; dorsocentral bristles become extremely long and numerous opposite the wing. Scutellum with some stiff, bristly hairs projecting backward from margin. *Legs*: All femora and tibiae slender.

The hind femur bears 8 bristles, which includes 1 at apex and 2 weak, dorsomedial elements at apex; ventrally there is a moderately abundant fringe of long, fine, stiff hairs. Apex of anterior tibia without spine. Claws sharp; pulvilli well developed. *Wings*: The wings are hyaline and the marginal cell open. Fourth posterior cell narrowed to two-thirds its maximum width; anal cell widely open. Alula narrow and linear; ambient vein complete. *Abdomen*: The abdomen is slender and somewhat compressed. Seven tergites in the male with the eighth present only as a linear flap; all tergites without bristles. Male terminalia large, rotate; the hypandrium long, drawn out into a long process arched downward over the remainder of terminalia.

Broticosia rapax new species

Length 13 mm.

Female. *Head*: The head is black everywhere, including antennae. The pile on the lower third of the occiput is light brownish yellow, except for a fringe of fine, black hairs along the outer margin of the occiput. The pile on the base of the proboscis is yellow, except laterally where it is black. The predominantly black mystax has 3 or 4 yellow hairs in the middle or at the epistomal margin. All other pile and bristles of the face black. The upper part of occiput has long, abundant, very fine, stiff hairs, becoming very slightly stouter dorsally but nowhere becoming bristles. Ventral surface of first antennal segment and a narrow, medial band over the entire length of face and the gibbosity covered with quite long, numerous, slender, black, bristly hairs. Whole face with appressed, whitish pubescence continued on the cheeks. The antenna are quite slender, the third antennal segment is attenuate and bears a short, broad, oval, spoon-shaped microsegment containing a small spine. *Thorax*: The thorax is polished black, scantily covered over the sides of the mesonotum. Scutellar disc and pleuron with an exceptionally fine, whitish micropubescence, which on the anterior half of the thorax is more pollen-like and on the posterior half somewhat coarser. There are fine, long, acrostical, bristly hairs and equally long or longer dorsocentral hairs and 6 of the posterior, dorsocentral elements somewhat more stout but not conspicuous. There are 2 or 3 stout, long, notopleural bristles, 1 post supraalar, 2 on the post callus. The scutellar margin, however, bears only 3 or 4 pairs of long, slender, yellow, bristly hairs and a few white hairs on the disc. *Legs*: The legs are bright orange brown. The basal half of the hind femora, the extreme base of the other femora, apices of hind tibia, apex of hind basitarsus and the last 4 segments of all of the tarsi black. Bristles reddish orange. Most of the pile is composed of fine, black, appressed setae but the hind femur bears a ventral fringe of long, scattered, white hairs, others dorsally and medially on the basal half and the middle femur has a ventral and dorsal row of whitish pile, the ventral hairs long. Claws slender, black, reddish at the base; pulvilli long and rather slender. *Wings*: The wings are pale brownish hyaline with reddish brown villi densely on the apical and posterior margins widely. *Abdomen*: The abdomen is everywhere polished black with a strong, greenish, brassy reflection. The pile is scanty, fine and white for the most part, short, subappressed dorsally, becoming long and conspicuous though scanty on the sides of the tergites and sternites. Seventh and eighth tergites, especially the eighth, with black setae. On the whole posterior margin of the laterally compressed eighth tergite there is a conspicuous fringe of long, regularly spaced, slender, black bristles, the elements rather widely separated. The whole abdomen seems to be somewhat compressed laterally but this may not be natural.

Type: Female; National Park, Darling Range, West Australia, October 18, 1931, Harvard Australian Expedition. Collected by P. J. Darlington. Type in the Museum of Comparative Zoology.

Aplestobroma new species

Type of genus: *Aplestobroma avida* new species.

Medium size flies, characterized by cylindroid, narrow abdomen and subcircular, narrow face. Male with long, dorsally placed, protuberant, curved hypandrium. Female terminalia deeply recessed and without spines. Length 16 mm.

Head: The face is scarcely visible in profile on upper part and only moderately protuberant below; from anterior aspect the head is subcircular and the face quite narrow. Palpus of 2 segments. Proboscis short and stout. Antenna elongate, slender, longer than the head; first 2 segments subequal. Third segment slender with parallel sides to the middle and gently tapering beyond; it bears a short, stout microsegment with large, apical opening and short spine. *Thorax*: The pile is scanty and fine, composed of long, erect, or subappressed setae; it bears a single row of acrostical elements, a double row of dorsocentral elements which become long opposite the wing and beyond. Lateral bristles are well developed; scutellar margin with 1 pair of stout bristles or 2 to 8 pairs of slender, weak bristles. *Legs*: All the femora and tibiae are slightly elongate and rather slender. Bristles moderately well developed on the legs; the hind femur has as many as 20 bristles, of which the lateral row may contain as many as 9 or as few as 4; base ventrally with 3 and apex dorsally with 3 bristles. Apex of anterior tibia without spine. Claws sharp; pulvilli long and well developed. *Wings*: The marginal cell is widely open; the posterior branch of the third vein ends at or barely above the wing apex; the posterior branch ends well behind the apex. Fourth posterior cell closed and stalked. Anal cell widely open. Ambient vein complete. *Abdomen*: The abdomen is slender and subcylindroid; 7 tergites well developed in the male, the eighth a short flap. Eight well developed segments in females. Male terminalia fully rotate. Epandrium fully cleft; the superior forceps long, each half robust with long, conspicuous process; the hypandrium forms a long, medial, curved process arched downward over the other parts. Female terminalia deeply recessed and without spines on acanthophorites.

Aplestobroma avida new species

Length 16 mm.

Male. *Head*: The head is black. Ocellarium and most of the immediate post vertex bare and polished, although a narrow stripe of yellow pollen runs from the cervix to the back of the ocelli. Front with scanty, yellow pollen, somewhat more conspicuous on the upper half; side of front with 4 slender, black bristles on each side, face with dense, appressed, pale yellow pubescence continued on to the cheeks. Lateral occipital pubescence of the same color. The bristly pile of the lower occiput and its coarse hairs pale yellow. On the upper half there are only numerous, slender, black bristles in several rows, stouter above, but never very stout, the dorsal elements strongly proclinate. Ocellarium bristles black and very weak. Mystax of face composed of numerous, long, moderately stout, yellowish white bristles in a high, medial triangle on the lower fourth of face, which is barely produced. Upper face with 2 vertical rows of long, bristly, yellow hairs which become longer dorsally and curve downward. Proboscis and antenna black, bristles and hairs of the former yellow, of the latter black. Second antennal segment not as long as the first segment, third segment a little attenuate with short, cylindrical microsegment, which bears at its apex a small spine. *Thorax*: The thorax is black, opaque with well differentiated, fine, acrostical and dorsocentral rows of setae. The dorsocentral row posteriorly has 4 stout and 6 weak, long bristles. Humerus and whole lateral margins and a short, medial, prescutellar wedge-shaped stripe pale yellow micropubescent. Whole disc of the flat scutellum with similar, paler pubescence. Upper half of mesopleuron and whole pleuron except the greater part of the mesopleuron is yellowish micropubescent. Coxae and trochanters black. *Legs*: The legs are very pale, reddish brown; apices of all of the tibiae and femora narrowly blackish. Tarsi black, except the basal half of the basitarsus, all of which are reddish. Claws moderately sharp; pulvilli well developed. *Wings*: The wings are almost hyaline, but everywhere with sparse, greyish villi, except that much of the basal cells are bare. *Abdomen*: The abdomen is black to and including the base of the sixth tergite and sternite; beyond this point the abdomen is light brownish orange. Pile of the abdomen pale yellow, more reddish on the orange colored, apical segments and appearing dark in some lights on the black tergites. Base of the third to sixth tergite and middle of the second with a transverse band of sparse, greyish yellow pollen or micropubescence. These bands, however, do not extend down upon the sides of the segment. Male terminalia entirely light orange brown.

Female. The female is similar to the male, with the terminalia deeply recessed.

Type: a female; Mt. Lookout, New South Wales, collected Dec. 16th, 1952 and presented to the author by Dr. I. M. Makerras. Paratypes 3 males and 3 females from Tubrabucca, New South Wales, Jan. 10-23, 1948, R.R.M.P. and A.N.B., 1 pair in the author's collection, 2 pairs in the National Museum at Melbourne. 1 paratype male, Barrington Tops, Jan. 25, S.U. Zool. Exped., 1 paratype female, Mt. Gingern, Jan. 14, 1950, S.J. Paramonov, both in the C.S.I.R.O. collection, Canberra, A.C.T.

A NEW GENUS AND SPECIES OF ANTHICIDAE FROM WESTERN UNITED STATES

By Floyd G. Werner
University of Arizona, Tucson

The first specimen of the interesting beetle described here was taken by Dr. W. L. Nutting and the author under dried flakes of mud on an alkali flat in Nevada in 1950. A diligent search in this rigorous habitat resulted in our obtaining one specimen alive, another dead and broken up, a living and a dead specimen of *Tanarthrus salinus* Lec. and one or two living spiders. There was evidence of other insects, present mostly as fragments. Most of these seemed to belong to groups that would have blown in from surrounding areas. A second living specimen was taken by H. B. Leech in sand dunes near Stovepipe Wells, in Death Valley. The two collections indicate a rather extensive range for the species in the West, possibly confined to extreme desert areas.

Despite the shortened elytra, this insect is quite obviously an Anthicid. On first appearance it might be linked with such an insect as *Tanarthrus brevipennis* Csy., a species which also has abbreviated elytra. There are several striking points of difference. The present insect is much more slender than any known species of *Tanarthrus*. It has the last segment of the antennae entire and normal, without the groove that gives the illusion of dividing the last segment into two in *Tanarthrus*. There are major differences in the internal sac of the male genitalia. All the species of *Tanarthrus* except *T. salinus* have been examined and they have heavy spines on the internal sac and lack any specialized armature around the gonopore. The present insect lacks spines on the internal sac and has a peculiar structure associated with the gonopore, completely unlike any found elsewhere in the family, at least as it is represented in North America. The general shape of the genitalia is similar in the two genera. It seems best to designate this as a new genus and place it near *Tanarthrus,* but with some doubt as to its affinities.

Leptanthicus gen. nov.

Slender and flattened, with short elytra that leave the main part of the abdomen exposed. Metathoracic wings present but folded under the elytra in repose. Antennae normal and with the last segment not divided into two apparent segments by a groove. Mouth parts apparently normal, with the last segment of the maxillary palpi not expanded or otherwise modified. Pronotum rather slender, without any obvious modifications. Mesosternum not expanded laterally, the margins straight and ending near the outer edges of the mesocoxae. Legs not modified in the male, with two spurs on all the tibiae. Male genitalia without separate parameres, slender and pointed as in *Tanarthrus.* Internal sac without spines but with a complex and unique structure around the gonopore. Type of genus *Leptanthicus staphyliniformis* sp. nov.

Leptanthicus staphyliniformis sp. nov

Holotype ♂: almost uniformly brown in color, with darker abdomen and paler elytra, antennae, palpi, tibiae and tarsi. Surface generally finely punctured, with short and fine but moderately dense pubescence, not conspicuous except under some magnification and with longer, erect tactile setae scattered over the dorsal surface of the body. Length, to tip of elytra 1.97 mm., to tip of abdomen ca. 2.68 mm. Width: head 0.46 mm., pronotum 0.41 mm., and elytra ca. 0.56 mm.

Head narrowly quadrate, flattened, the disc almost flat, 0.51 mm. long to base of clypeus and 0.46 mm. wide. Surface subopaque because of moderately dense but fine microreticulation; pubescence short, about 0.02 mm. long, mostly subdecumbent and slightly curved, fine and directed toward the midline on the disc. Eyes small, 0.17 × 0.13 mm., placed well onto the sides and protruding only slightly from the sides of the head; with short, erect pubescence. Fronto-clypeal suture distinct though short. Bases of antennae separated by 0.18 mm. Clypeus fairly broad, 0.23

mm. wide, 0.08 mm. long, with a pair of obscure teeth on its anterior margin and a pair of slight angulations near the sides; setae longer, ca. 0.08 mm., slightly curved and projecting forward. Labrum largely concealed by the clypeus from above, evenly rounded. Mandibles projecting beyond labrum, pointed and bifid at the tip, the upper tooth the longer. Maxillary palpi fairly large, the last segment 0.13 × 0.08 mm., obliquely truncate. Labial palpi very small. Antennae submoniliform, 1.06 mm. long, with numerous erect setae. Measurements (in 0.01 mm., base to apex): 15/8, 10/6, 9/5, 8/5, 8/5, 8/5, 8/5, 8/5, 9/6, 8/6, 14/6. The second segment is relatively large, the last bluntly pointed.

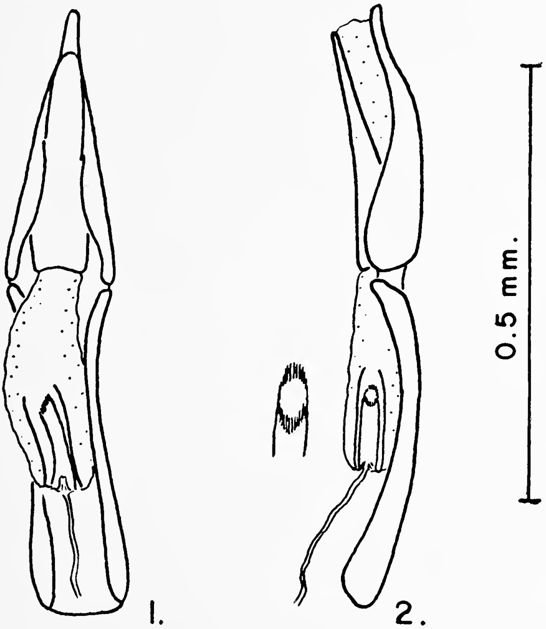


Figure 1. *Leptanthicus staphyliniformis* sp. n. Genitalia of holotype ♂. Fig. 1. Ventral view as the genitalia lie in the abdomen. Fig. 2. Lateral view and enlarged detail of apex of gonopore armature.

Pronotum 0.51 mm. long, 0.33 wide at base, 0.20 at collar and 0.44 at the widest point about 1/5 from the apex. Sides almost straight to the widest point, then rounding to collar. Disc flattened, with pubescence similar to that of head but surface more deeply microreticulate. Scutellum fairly small, rounded. Elytra subparallel, 0.95 mm. long, 0.46 mm. wide at humeri, ca. 0.56 at widest. Apices obliquely truncate, individually rounded at the suture. Surface smoother than head; pubescence moderately dense, suberect, slightly curved, fine. Three full segments of the abdomen are left exposed, plus the pygidium. These are well sclerotized and separate from each other. They have pubescence similar to that on the elytra but sparser. The first two exposed tergites are subquadrate and delimited on the sides by the exposed edges of the sternites; both have a pair of dense patches of decumbent, medially directed pale pubescence near the middle, the patches on the anterior segment much the larger. Third exposed segment reaching sides of body, with only a very narrow edge of the sternite visible, larger than the first two, somewhat arched and rounded behind. Pygidium barely visible, the edge rounded and slightly beaded.

Surface and pubescence below similar to that on dorsum of abdomen. Prosternum a flattened, hexagonal plate, with a point extended back between the procoxae. Mesosternum not expanded, forming a straight line with the medial edge of the mesepisternum, the lateral edge of which extends dorsally into a narrow lobe anterior to the base of the elytra, this lobe following the body contour and not provided with long setae on its free edge. Metasternum flattened but quite normal. Fifth visible abdominal sternite truncate apically, the edge very gently excavated. Legs apparently normal, moderately slender, paler than the body except for the femora, tips excluded. Pubescence on legs moderately dense, subdecumbent. Tibiae with two, apparently simple, slender apical spurs. Tarsal claws slender, simple. Tarsal segments simple, the penultimate indistinctly lobed beneath. Measurements of metathoracic leg in 0.01 mm.: femur 56 × 13, tibia 54 × 8, tarsus 33 × 5.

Paratype ♀: a larger and darker specimen, 2.35 mm. long to tip of elytra, ca. 3.12 to tip of abdomen. Head

0.59 mm. long, 0.49 wide; pronotum 0.61 mm. long, 0.42 wide; elytra 1.15 mm. long, 0.56 wide at humeri, ca. 0.77 at widest. Differences that are of a secondary sexual nature are: third exposed abdominal tergite not as arched; pygidium absent; fifth visible abdominal sternite large, the hind margin almost evenly rounded, slightly ogival. Other differences that may indicate individual or population variation are: hind margin of head slightly excavated at the middle; elytra and appendages almost as dark as rest of body and the pubescent patches on the abdominal tergites dark. The scattered, erect tactile setae are ca. 0.06 mm. long in the holotype, ca. 0.13 mm. in this specimen and therefore much more conspicuous. The labrum extends beyond the clypeus when viewed from above.

Holotype: ♂ — Mud flats next to alkali lake at Salt Wells, Churchill Co., Nevada, May 31, 1950, F. G. Werner and W. L. Nutting. Deposited in the M. C. Z. Paratype: 1 ♀ — Sand dunes near Stovepipe Wells, Death Valley, Inyo Co., California — April 2, H. B. Leech, in the Calif. Acad. Sci.

SPIDERS OF THE NEW GENUS *ARCTACHAEA* (ARANEAE, THERIDIIDAE)

By Herbert W. Levi

Museum of Comparative Zoology
Harvard University

The new spider genus *Arctachaea* is erected for two rare species from western North America, closely allied to *Theridion*. *Arctachaea* differs from the latter in abdomen shape and in structure of the genitalia. The rarity of the two species accounts for the belatedness of their description.

Dr. W. J. Gertsch of the American Museum of Natural History and Dr. R. V. Chamberlin of the University of Utah have made specimens available to me. I extend my sincere thanks for their cooperation.

Arctachaea, new genus

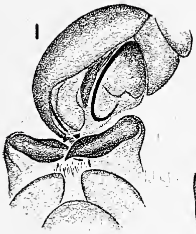
Arctachaea (fem.) has *Arctachaea pelyx* as type species.

Medium sized theridiid spiders. Carapace longer than wide, thoracic depression indistinct. Eyes subequal in size, anterior eye row procurved as seen from front, posterior row straight as viewed from above. Chelicerae lacking teeth. Sternum convex. First leg longest, fourth or second leg in males second in length, third shortest. Tarsal comb with few setae. Abdomen slightly longer than high with a distinct dorsal posterior hump. Colulus absent.

Epigynum a raised area. Palpus with median apophysis

Explanation of Plate 8

Figs. 1-2 *Arctachaea nordica* (Chamberlin and Ivie) Fig. 1. Ventral view of chelicerae and palpus. Fig. 2. Anterior view of left chelicera. Figs. 3-6. *A. pelyx* new species. Fig. 3. Left palpus, expanded (C, conductor; E, embolus; M, median apophysis; R, radix; Y, cymbium). Fig. 4. Female genitalia, dorsal view. Fig. 5. Epigynum. Fig. 6. Female. Figs. 7-11. *A. nordica* (Chamberlin and Ivie). 7. Female genitalia, dorsal view. 8. Epigynum. 9, 10. Female. 11. Left palpus. Figs. 12-13. *A. pelyx* new species. 12. Palpus (Utah). 13. Palpus (Oregon).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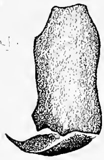
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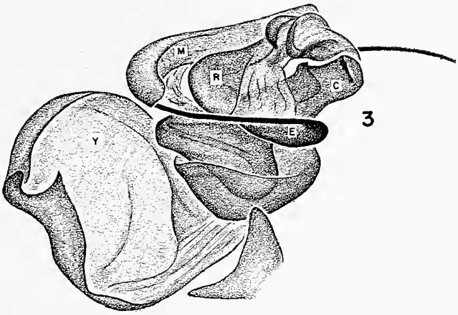
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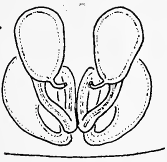
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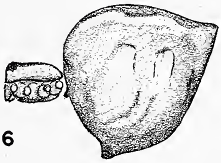
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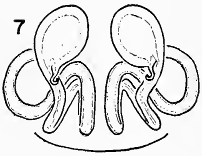
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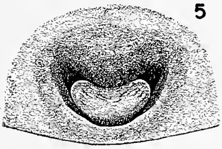
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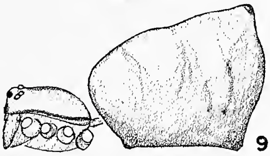
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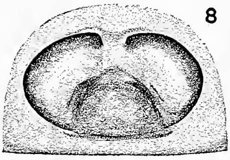
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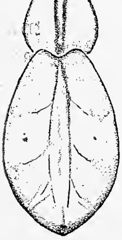
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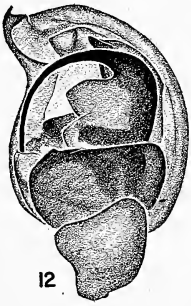
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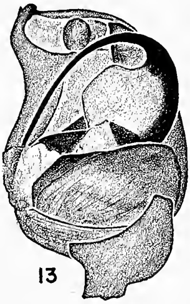
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Levi — Arctachaea

(M in Fig. 3), radix (R), conductor (C) and a long embolus (E). The cymbium (Y) is modified at its tip.

Arctachaea differs from *Theridion* by having a hump on the abdomen (Figs. 6, 9, 10), and in the shape and direction of the embolus. It differs from both *Theridion* and the closely allied *Chrysso* in having the tip of the male cymbium modified (Fig. 3). *Arctachaea* can be separated from *Achaearanea* which has a similar shaped abdomen in that the former has a radix in the male palpus while the latter genus does not.

Arctachaea pelyx new species
Plate 8, Figures 3-6, 12, 13; Map 1

Types. Male holotype from East Canyon, Salt Lake County, Utah, June 12, 1943 (W. Ivie) in the American Museum of Natural History.

Description. Carapace yellow-white with a median dusky band, narrowest posterior, enclosing eye region and continuing as a line across the clypeus; sides of carapace with a dusky line. Sternum with a black border on each side. Legs with some black spots. Abdomen (Fig. 6) yellow-white with a dusky median dorsal band bordered by white. Anterior median eyes separated by one and one-quarter diameters, one-quarter from laterals. Posterior eyes separated by one diameter. Abdomen with a tubercle (Fig. 6) that of male longer than high. Epigynum with a light swollen area illustrated by Figure 5, palpus by Figures 12, 13. Total length of female 3.2 mm. Carapace 1.02 mm. long, 0.92 mm. wide. First femur, 1.71 mm.; patella and tibia, 1.85 mm., metatarsus, 1.58 mm.; tarsus, 0.68 mm. Second patella and tibia, 1.11 mm.; third 0.78 mm.; fourth 1.24 mm. Total length of male 2.7 mm. Carapace 1.15 mm. long, 1-10 mm., wide. First femur 2.71 mm.; patella and tibia 3.05 mm.; metatarsus 2.72 mm.; tarsus, 0.91 mm. Second patella and tibia, 1.63 mm.; third, 1.05 mm.; fourth, 1.70 mm.

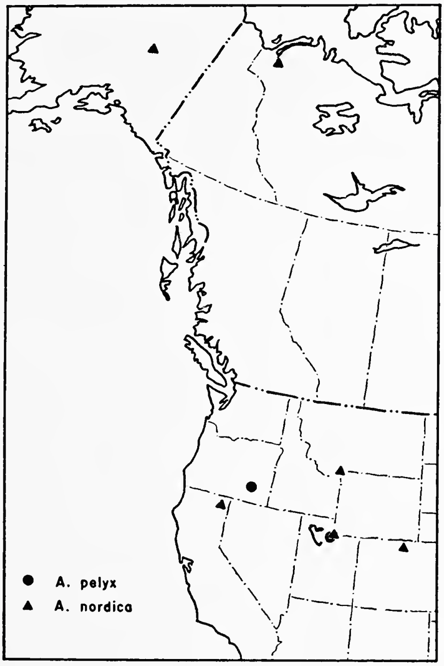
Records. Utah: Salt Lake Co.: East Canyon, June 14, 1942, ♀ paratypes; June 21, 1942 ♀ paratypes; June 12, 1943, ♀ allotype, ♀ ♂ paratypes (W. Ivie). Summit Co.: 3 mi. W. of Wanship, June 20, 1941, ♀ ♂ (W. Ivie). *Oregon.*

Harney Co.: above Fish Lake, Steens Mtn., 18 mi. E. of Frenchglen, 7000-8000 ft., July 14-16, 1953, ♂ (V. Roth).

Arctachaea nordica (Chamberlin and Ivie)
Plate 8, Figures 1-2, 7-11; Map 1

Achaea nordica Chamberlin and Ivie, 1947, Bull. Univ. Utah, biol. ser., vol. 37, p. 25. (Juvenile male holotype from College, Alaska, in the American Museum of Natural History).

Description. Carapace white, with a double median line and a dusky border. Sternum with a narrow dusky border. Legs white. Eyes on small black spots, anterior medians one and one-third diameter apart, one-half from laterals. Posterior medians separated by less than their diameter, by one from laterals. Abdomen white with a black spot



Map 1. Distribution of *Arctachaea nordica* (Chamberlin and Ivie) and *A. pelyx* new species.

on posterior tip (Figs. 9, 10). Epigynum with two anterior swollen areas, and a posterior median depression (Fig. 8). Palpus of male very large (Fig. 11), cymbium 0.65 mm. long, teeth of cymbium fitting against enlarged fang (bearing phlanges on each side) as illustrated by Figure 1. Total length of female from Montana 3.0 mm. Carapace, 1.12 mm. long, 0.97 mm. wide. First femur, 2.20 mm.; patella and tibia, 2.32 mm.; metarsus, 1.95 mm.; tarsus, 0.71 mm. Second patella and tibia, 1.35 mm.; third, 0.91 mm.; fourth 1.56 mm. Total length of male from Colorado 2.7 mm. Carapace, 1.24 mm. long, 0.98 mm. wide. First femur, 2.60 mm.; patella and tibia, 2.74 mm.; metatarsus, 2.40 mm.; tarsus, 0.85 mm. Second patella and tibia, 1.72 mm.; third, 0.92 mm.; fourth, 1.62 mm.

Records. Northwest Territories: Reindeer Depot, 68°42′: 134°06′, July 1-6, 1948, ♀; Aug. 1948, juv. ♀, juv. ♂ having enlarged fangs (J. R. Vockeroth). *Montana.* Gallatin Co.: Red Cliff Camp Ground, Gallatin Valley, meadow, Aug. 18, 1951, ♀ (H. and L. Levi). *Colorado.* Larimer Co.: Estes Park, 7800 ft., 1953, ♂ (H. and A. Jungster). *Utah.* Salt Lake Co.: East Canyon, June 12, 1943, ♀ (W. Ivie). *California.* Modoc Co.: 20 mi. N. of Canby, June 6, 1944, ♂ (W. M. Pearce).

EPICAUTA DUGESI A VALID SPECIES (COLEOPTERA: MELOIDAE)

By F. G. Werner
University of Arizona, Tucson

Some small samples of *Epicauta* from the states of Nayarit and Sinaloa in Mexico apparently represent the species described by Dugès from San Potosí as *E. vittata* and designated as *E. dugesi* by Beauregard. A single specimen, probably a female, remains from the Dugès series in the collection of the Instituto de Biología in Mexico City. Champion did not see any specimens from Mexico but decided that Dugès had *lemniscata* (Fab.) from his description. *Dugesi* has remained in synonymy with that species ever since.

The male of *dugesi* differs in several features from the species most closely related to it, *vittata* (Fab.), *lemniscata* (Fab.), *occidentalis* Werner and *vitticollis* (Haag). All of these have the pad of protarsal segment I of the male slightly heavier than in the female, covering the ventral surface of the segment and extending onto the ventral third to half of the posterior surface. In the male of *dugesi* the pad is highly developed, covering the ventral surface and extending over all of the posterior surface except for a very small area dorsally at the base, and is much different from the simple pad of the female. The succeeding protarsal segments reflect the condition of the first in all these species. Protarsal segment I is thicker, slightly broader and proportionately shorter in *dugesi* than it is in the other species; it differs radically from the first segment in *occidentalis* because that species has all the segments of the protarsi much more slender than they are in the others. A further difference is that the inner (anterior) protibial spur of the male of *dugesi* is definitely curved, while it is straight or nearly so in the others. Both sexes of *dugesi* have the head more deeply punctured than the other species, with less of an indication of a median smooth area on the front. The markings are little different from those of typical *lemniscata;* the outer two dark stripes on the elytra are perhaps a bit closer and more diffuse than would be normal for that species. The antennae are essentially as in *lemniscata.* These comparisons are based on 4 ♂♂, 1 ♀, Tepic, Nayarit, July 20, 1955; 1 ♀, Mazatlán, Sinaloa, July 21, 1955, and 2 ♂♂, 2 ♀♀, Los Mochis, Sinaloa, July 22, 1955, all collected at light by R. B. & J. M. Selander. The following synonymy for *dugesi* now applies:

Epicauta dugesi Beauregard

Epicauta vittata Dugès, 1886, Bull. Soc. Zool. France **11:** 582 (*nomen nudum*) ; 1889, An. Mus. Michoacano 2: 87. Not *Epicauta vittata* (Fab.), 1775.

Epicauta dugesi Beauregard, 1889, Bull. Soc. Ent. France **14:** ccxiii. (Substitute name for *vittata* Dugès nec Fabricius).

Epicauta lemniscata, Champion, 1892, Biol. Cent.-Am., Coleop. 4 (2) : 415, as applied to Mexican specimens. Not *Epicauta lemniscata* (Fab.), 1801.

Another male specimen collected at light by the Selanders, at Tehuantepec, Oaxaca, June 24, 1955, is quite similar to *dugesi* in form of protibial spurs and sculpture of head but has protarsal segment I dorso-ventrally flattened and broadened, with a broad pad on this segment confined to the ventral surface. It probably represents still another in this complex of species.

THE INDO-AUSTRALIAN SPECIES OF THE ANT GENUS *STRUMIGENYS* FR. SMITH: *S. DECOLLATA* MANN AND *S. ECLIPTACOCA* NEW SPECIES[1]

By William L. Brown, Jr.

Museum of Comparative Zoology, Harvard University

This paper is a further contribution in a series which, when complete, will cover the Indo-Australian portion of the world fauna of the dacetine ant genus *Strumigenys* Fr. Smith. Previous parts, the first two of which include explanations of the abbreviations used for citing measurements and indices, are in *Psyche* 60: 85-89 (1953), 60: 160-166 (1954), 61: 68-73 (1954) and 63: 113-118 (1957).

The purpose of this part is to furnish supplementary descriptive material on *S. decollata,* known only from the type material from the Solomon Islands, and to formally describe a new species, *S. ecliptacoca,* from wet mountain forest in Dutch New Guinea. These two species are peripheral members of the *godeffroyi* group, both aberrant in a number of respects. They have in common processes situated near the midlength of the inner mandibular borders — in *decollata* an acute denticle, in *ecliptacoca* a low welt or ridge — which are quite different from anything seen in other Indo-Australian *Strumigenys* species. Whether these two species are related to each other at all closely is problematical, but it is convenient to consider them together here. Figures of both species have been prepared, but are being saved for use in collective plates in connection with the eventual keys to all the Indo-Australian species of the genus.

Strumigenys decollata Mann

Strumigenys decollata Mann, 1919, Bull. Mus. Comp. Zool.,

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[1] Published with the aid of a grant from the Museum of Comparative Zoology at Harvard College.

63: 353 figs. 32, 33, worker, male. Type loc.: Fulakora, Santa Isabel I., Solomons Islands.

Lectotype worker (by present selection) in MCZ: TL 4.4, HL 1.11, ML 0.66, WL 1.05; CI 63, MI 59. Agreeing with Mann's figures, except that these show the posterior cephalic and anterior clypeal excisions as considerably deeper than they should be. Fig. 32 of Mann also portrays the scapes as too slender, and the small proximal preapical tooth of the mandible is shown as much lower and less acute than in the lectotype.

This species is easily recognized by the long, narrow, depressed head, long mandibles, elongate petiolar node, and by the partially smooth, shining state of most of the areas usually sculptured and opaque in species of this genus. An outstanding character is the presence of the small, triangular, but acute tooth in addition to the preapical tooth of most Indo-Australian *Strumigenys;* this extra preapical tooth is situated proximad of the preapical tooth near the midlength of the inner mandibular border.

Distal preapical tooth of mandible about 5/8 the length of the dorsal apical, situated very slightly distad of the apical third of ML. Teeth of apical fork subparallel, the ventral tooth 2/3 the length of the dorsal tooth; one small acute intercalary tooth.

Petiolar node a little less than (not "more than") twice as long as broad. Mann gives the color as reddish brown; the lectotype and another headless syntype are more yellowish, and may be teneral.

Male, from type series, MCZ: TL 3.2 mm. Color now is deep ferruginous; head deeply, alitrunk dorsum lightly, infuscated; legs and antennae sordid yellowish. Notauli complete and deep; parapsidal furrows present; no propodeal teeth. Nodes shaped as in worker, smooth and shining, but spongiform appendages and basigastric costulae obsolete. Mandibles not "bidentate," but with an expanded, convex inner margin basally and a single straight, acute apical tooth. Fore-wing venation much reduced, with only R + Sc to pterostigma, stigma itself and 2r defined, and these scarcely pigmented. Few other veins represented by indistinct colorless furrows. Both wings glassy and clear, with very few microtrichia, especially near bases; hindwing with 4 subapical hamuli.

Strumigenys ecliptacoca sp. nov.

Holotype worker: TL 2.8, HL 0.68, ML 0.35, WL 0.71; CI 65, MI 51. Antenna, scape L 0.47, funiculus L 0.62, apical segment 0.35. Head in facial view shaped much as in *S. mayri,* but rather narrow and with periocular areas more as in *godeffroyi,* i.e. without distinct preocular notches. Occipital lobes rather narrowly rounded behind, occipital excision broad and fairly deep, lateral borders of lobes broadly and evenly rounded. Dorsal surface of head evenly convex in both directions, without appreciable sulci or depressions in occipital area. Eyes rather large and convex, but not prospicient, the principal axis directed laterally. Preocular area only feebly concave; preocular laminae anterior to the concavity weakly convex in outline, as seen from dorsal view. Clypeus with anterior border medially impressed and strongly excised. Antennal scrobes indistinct, though not suddenly interrupted posteriorly; continuing above and behind the eyes to a distance equalling 2½ eye diameters, but traceable only with difficulty, if at all. Antennal scape very slender and curved so as to allow it to fit the curve of the side of the head when retracted, as in *szalayi* group. Funicular segment I slightly longer than II-III; II and III as broad as or slightly broader than long; IV longer and stouter than I, and nearly as thick apically as is the apical segment at midlength; apical segment longer than I-IV taken together, slender and fusiform.

Mandibles slender, depressed, feebly arcuate, their inner borders nearly straight from near base to preapical tooth, after which they curve evenly in to apical fork; extreme bases distinctly narrowed and bent slightly inward, their insertions separated and situated beneath the small lobes on each side of the clypeal excision. Shafts extremely slightly and gradually broadened from base toward preapical tooth, lying so as to diverge slightly from each other at full closure. Apical fork of two parallel slender spiniform teeth, the dorsal tooth (L ca. 0.12) about 1½ times as long as ventral tooth; a single small, acute intercalary denticle present. Preapical tooth slender, spiniform, extremely feebly curved, about as long as the ventral apical tooth, situated at or very near the apical quarter of the mandibular length; distant from the dorsal apical tooth by approximately its own length. Inner mandibular borders at midlength each with a small, very low, translucent, sublamelliform process or welt, rising gradually basad and continuing apicad only a short distance before terminating suddenly in more or less of an angle. This short ledge or welt is inconspicuous, and is best seen in silhouette by light reflected from a white surface held below the mandibles.

Alitrunk slender, formed much as in members of the *szalayi* group, with the promesonotum a bit more gently and evenly rounded above, but the mesonotum concave behind and the propodeal dorsum very feebly convex, yielding the same "sway-back" appearance. Propodeal declivity gently concave, the teeth reduced to minute, subacute tubercles or angles, chiefly responsible for the angularity of the propodeum seen from the side. Infradental lamellae completely obsolete. Petiole subclavate, node longer than broad, very low and gently rounded above, not very distinctly differentiated from, and slightly longer than, its anteriorly tapered peduncle. Spongiform posterior collar narrow, with small lateral lobes extending a short distance anteriorly along the sides of the node; midventral strip well developed. Postpetiole subquadratic seen from above, nearly as long as broad (W 0.15) and a little broader than the petiolar node; with well developed, areolate spongiform masses.

Gaster with a narrow transverse dorsal spongiform border. Basal costulae fanning from bilateral origins, on the sides extending up to 1/3 the length of the basal tergite; almost completely effaced in the middle, and much shorter. Remainder of gaster smooth and shining, as are also the postpetiole, propodeum, sides of alitrunk, posterior dorsum of petiolar node, fore coxae, clypeus and mandibles. Head and legs otherwise densely punctulate and opaque. Dorsum of pro- and mesonotum weakly punctulate, subopaque to feebly shining.

Dorsum of head with a scanty growth of very fine inconspicuous reclinate hairs and about 12 moderately long, fine erect hairs; clypeal border hairs fine, subspatulate, inconspicuous. Antennal scapes with short, fine subreclinate hairs, directed apicad. Alitrunk dorsum with pilosity like that of head, but considerably sparser; paired fine erect hairs on humeri and anterior mesonotum. Nodes and gastric dorsum with a very few fine hairs slanting caudad. Few short subflagellate hairs at gastric apex. Underside of head and legs with moderately dense, fine, short reclinate pilosity. Color rather uniform light ferruginous yellow.

Holotype a worker selected from a series of 41 workers and dealate females taken together with eggs, larvae and pupae in an "ant plant" at Camp of I/I/1939, Netherlands Indies-American New Guinea Expedition (Third Archbold Expedition) of 1938-1939, altitude 1800 M. (L. J. Toxopeus leg.). Deposited with paratypes in Zoologisch Museum en Laboratorium, Bogor, Indonesia. Some paratypes in MCZ and elsewhere. (See Archbold, Rand and Brass, 1942, Bull. Amer. Mus. Nat. Hist., 79: 246-250, and Toxopeus, 1940, Treubia, 17: 274, 278, for notes on type locality.

Paratypes, 40 workers from type nest: TL 2.6-2.9, HL 0.65-0.69, ML 0.33-0.35, WL 0.66-0.72; CI 63-65, MI 51. Varying slightly in shape and opposite-mandible symmetry of the welts on the inner mandibular borders. The propodeal teeth also vary slightly in distinctness and acuteness, but still remain minute and denticuliform at best.

Paratypes, 2 dealate females from type nest: TL 3.3-3.3, HL 0.73-0.74, ML 0.36-0.36, WL 0.85-0.86; CI 68-67, MI 49-49, respectively. Showing the usual caste differences for the genus. Propodeal teeth low, subtriangular, but definitely dentiform. Mesonotum evenly punctulate, with a few fine, erect hairs. Infradental lamellae present as fine lines or low carinae. Side sclerites of alitrunk largely smooth and shining, as is propodeal declivity; dorsum of alitrunk completely punctulate. Basal gastric costulae relatively stronger and longer than in worker. Color slightly darker and more brownish. (Male unknown.)

Pupae: Mandibles open at more than 180° angle, as in *szalayi* group.

This species appears to fall between the *szalayi* group and such *godeffroyi* group species as *esrossi*. It differs from all other Old World *Strumigenus* in lacking both propodeal teeth and their lamellae, and is also distinct in having the welt-like lamella on the inner mandibular border, which may represent a condition intermediate between the broad lamella of *guttulata* and toothed forms like *decollata*. *S. ecliptacoca* (from the Greek words meaning "deficient" and "point or edge") seems best placed arbitrarily in the *godeffroyi* group for the present.

PREDATION OF ARTHROPOD EGGS BY THE ANT GENERA PROCERATIUM AND DISCOTHYREA. — In my recently published revision of the genera of the ant tribe Ectatommini (Brown, 1958, Bull. Mus. Comp. Zool. 118: 246, 252-253, 336) I noted briefly observations indicating that North American species of *Proceratium* Roger (including *Sysphincta* auct.) normally feed on various arthropod eggs, and that such eggs are often stored in their nests in large numbers. One of the nests observed to contain eggs was collected by E. O. Wilson and myself at Ravenel, South Carolina, during June, 1957. This nest was packed with spherical eggs (and a few smaller fusiform ones); we assumed that they were eggs of geophilomorph centipedes or spiders, both of which were abundant in the leaf litter and rotting pine bark from which the ant nest was taken at the base of a large loblolly pine. This nest was maintained for one year in a glass-topped plaster ant-chamber, during which time it subsisted entirely or nearly entirely on eggs (more rarely on soft, hatching spiderlings) of various species of spiders gathered in eastern Massachusetts. Larvae of other ants, and parts of other insects, were ignored by the *Proceratium* so far as observations went. Spider eggs were stored in the brood chamber and in adjoining chambers. In feeding on the eggs, the workers and queen hold the egg against the floor with their forelegs and cut through the shell, immersing their mandibles in the egg contents. Partly deflated eggs are placed on the larvae, which feed directly.

My speculation that the similar genus *Discothyrea* might also feed on eggs of other arthropods now tends to be confirmed by an interesting find by Philip F. Darlington, who has collected four nests of *Discothyrea bidens* Clark (or near) in the Mt. Royal Range, near Barrington Tops, northeastern New South Wales, during October, 1957. Each nest contained numerous eggs of arthropods: spherical eggs (of spiders or Chilopoda?) from about 0.08 to 0.26 mm. in diameter, and fewer elliptical ones in two of the nests, averaging 0.17 × 0.08 mm. In the alcohol, none of the larvae is attached to eggs, but the circumstances leave little doubt that the eggs were being stored as food. — W. L. BROWN, JR., Museum of Comparative Zoology.

A PLIOCENE INSECT DEPOSIT IN TEXAS. — A few years ago numerous insects were found by Dr. Roy Reinhart of Miami University in a shale exposed along the Rita Blanca Creek near Channing, Texas. My attention was called to these fossils by Mr. Jack T. Hughes, Curator of Anthropology at the Panhandle-Plains Historical Museum in Canyon, Texas, who kindly sent some of the museum specimens to me for my examination.

In May of 1957, with Mr. Hughes, and Mr. James A. Corbitt and his sons of Dalhart, Texas, I spent a day collecting at the deposit. The insects occur in several beds of thin shales. which resemble closely those at Florissant, Colorado, and which were apparently formed of volcanic ash that had fallen into a small fresh-water lake. The insects are not nearly so numerous at the Channing deposit as they are at Florissant, however, and, in general, they are not nearly so well preserved. Small flies and beetles are the most numerous types of insects in the shales, but nymphs of dragonflies are not uncommon. Occasionally clusters of nymphs, comprising six or more specimens, can be found. The remains of other organisms, including small fish, also occur in the shale.

The deposit has been generally regarded as being of Late Pliocene age. Extensive collecting might result in enough good specimens to justify a systematic study of the insect fauna. It would certainly be interesting to make a detailed comparison between the fauna of this Pliocene Texas deposit and that of the Early Miocene (or Late Oligocene` Florissant deposit. — F. M. CARPENTER, Harvard University.

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THE PRESENCE OF A PERITROPHIC MEMBRANE IN SOME AQUATIC HEMIPTERA

By Margaret C. Parsons[1]

Harvard Biological Laboratories, Cambridge, Mass.

Although the peritrophic membrane was formerly believed to be absent in the order Hemiptera, Sutton (1951) has reported its presence in at least two species of Corixidae. It appears now that a peritrophic membrane is present in a second cryptocerate family, the Nepidae.

In a recent study on the digestive system of water bugs, the author made serial sections through the midguts of 29 adult specimens of *Ranatra fusca* P.B. Of these, four individuals showed evidence of what might be interpreted as a peritrophic membrane. In two of the four, the membranous material was found throughout the midgut; one of these is shown in Figure 1. In a third, it was limited to the anterior dilated portion of the midgut, while in the fourth specimen it was present only in the narrow posterior region of the mesenteron.

The membrane appeared to be of the type which is secreted by the midgut epithelium in general (the Type I of Wigglesworth, 1950) rather than by a limited group of cells. In most sections it seemed to be formed by the condensation, in the lumen of the gut, of a network of fine strands of cuticula, secreted by the midgut cells. In some areas, however, the membrane, which varied in width from one to approximately four micra, appeared to be delaminated directly from the surface of the epithelium.

In the two individuals which showed this structure throughout the midgut, it was not a continuous membrane.

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[1] This project was carried out partly during the tenure of a National Science Foundation Predoctoral Fellowship and partly under the Ellen C. Sabin Fellowship, awarded by the American Association of University Women.

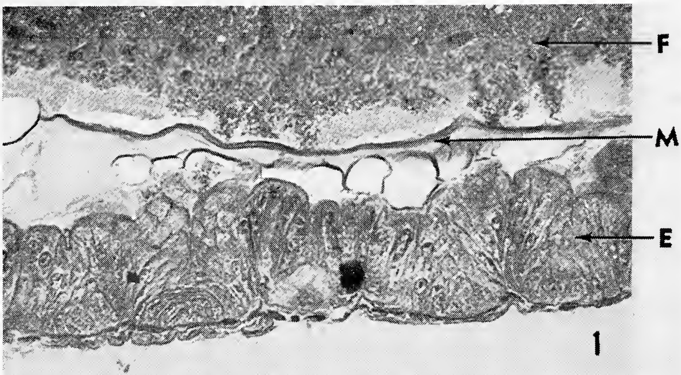
Its presence in a region seemed, in general, to be correlated with the presence of food in that region, and not all the midgut cells appeared to be secreting it. This gave it a fragmentary appearance in most sections.

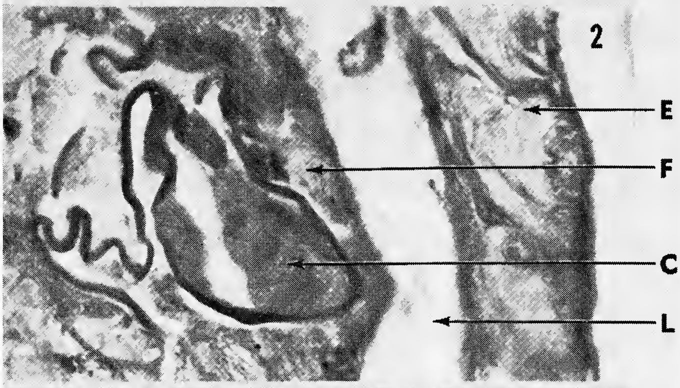
In order to ascertain whether the membrane contained chitin, and could be called a peritrophic membrane, eight midguts of *Ranatra* which had been fed fifteen hours before were subjected to the chitosan test, as described by Richards (1951, pp. 32 and 33). Solid food was never observed in the *Ranatra* midgut, and thus use of this test seemed to be justified. The technique of Sutton (personal communication) was employed; each individual was dissected in Ringer's solution, the gut removed, and the midgut cut off just posterior to the esophageal valve and anterior to the point of entrance of the Malpighian tubules. The midgut was then placed in about 5 cc. of concentrated potassium hydroxide solution in a Bunsen tube and heated in a glycerine bath to 160 degrees C. for 20 minutes. If, after this treatment, any residue remained in the tube, it was tested with Lugol solution, zinc chloride, 1% sulfuric acid, and 3% acetic acid, following the methods prescribed by Richards (1951). In three of the eight individuals, positive reactions were obtained by this method; the small and very delicate strands of material which remained after the potassium hydroxide treatment in these three appeared, therefore, to be chitinous in nature, and to represent fragments of a peritrophic membrane.

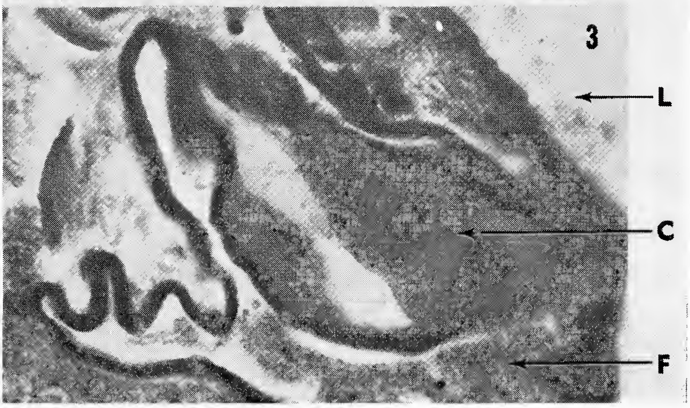
EXPLANATION OF PLATE 9

Figures 1-3. Fig. 1. Longitudinal section through part of the anterior, dilated portion of the midgut of *Ranatra fusca,* showing the secretion of a peritrophic membrane by the epithelial cells. Fixed in alcoholic Bouin's; Mallory's triple connective tissue stain. 240 X. Fig. 2. Longitudinal section through the posterior part of the midgut of *Hesperocorixa interrupta.* Note the large fragment, presumably an ingested piece of arthropod exoskeleton, within the food mass. Fixed in aqueous Bouin's; Mallory's triple connective tissue stain. 440 X. Fig. 3. Detail of the fragment shown in Figure 2. Note the sculpturing on the surface of the fragment. 720 X.

ABBREVIATIONS USED IN FIGURES. C-Fragment of exoskeleton within food mass. E-Midgut epithelium. F-Food material in gut. L-Lumen of gut. M-Peritrophic membrane.







Parsons — Peritrophic Membrane of Hemiptera

The peritrophic membrane of *Ranatra* bears some resemblances to that of *Sigara falleni* and *Corixa punctata* as described by Sutton (1951). Both were of Wigglesworth's Type I, fragmentary in nature, and seemed to be secreted in response to the presence of food; both were present in only a few of the individuals examined. Sutton found the peritrophic membrane only in the posterior part of the midgut, however, whereas that of *Ranatra* may occur throughout the mesenteron.

The author has examined several species of North American corixids, representing the genera *Hesperocorixa*, *Sigara,* and *Trichocorixa,* to determine whether any of these possessed a peritrophic membrane. Histological sections through the midguts of ninety corixids showed no evidence of a membrane. The midguts of ninety-nine others, all of which contained food, were removed and examined in a dish of Ringer's solution under a stereoscopic microscope; they were carefully turned inside out, beginning at the posterior end, with fine forceps. Since the epithelium tended to curl outwards when peeled back in this way, its inner surface and the surface of the midgut's contents could be easily examined for traces of a membrane. However, none of the midguts so examined showed anything of this sort. The two species of which the most individuals were examined were *Hesperocorixa interrupta* (113) and *Sigara signata* (22); the present study has shown, therefore, that a peritrophic membrane is absent, or at least extremely rare, in these species.

Sutton applied the Schulze and chitosan tests to whole midguts, using the technique which was described earlier in this paper. She considers the chitosan test to be the most reliable, and describes her method as follows: "I did not dissect out the membrane. Instead I dissected out the hind part of the mid gut taking great care that no trace of the oesophageal valve was present (to avoid any invalidation of the results of the tests to be applied, by the chitinous 'entonnoir'.) The chitosan and Schulze tests were then applied to the freshly dissected mid guts. I did not apply any test for chitin to preserved material" (Sutton, personal communication).

It is unfortunate that the chitosan test cannot be applied to sectioned material. However, Sutton's technique is open to criticism. The corixids, unlike *Ranatra,* are able to ingest particulate food, and histological sections through their midguts often show sizeable fragments of exoskeleton from small Crustacea and other arthropods within the food mass (Pl. 9, Figs. 2 and 3). The presence of setae or surface sculpturing on these fragments indicates that they are of foreign origin rather than secretions of the midgut epithelium. The chitin in these pieces could withstand potassium hydroxide treatment as well as could a peritrophic membrane, and it seems unlikely that the former could be distinguished from the latter, using Sutton's technique.

To test this hypothesis, the chitosan method was applied to the midguts of eighteen *Hesperocorixa interrupta,* using Sutton's technique. In one of these, a positive result was obtained. A small piece of material, approximately 0.5 mm. square, withstood the potassium hydroxide treatment and reacted positively to the subsequent tests. Examination of this fragment under the compound microscope showed it to be rolled up like a scroll, its surface covered with small hairs. It bore much resemblance to the pieces seen in histological sections through the food mass in corixids.

In the author's opinion, the chitinous nature of the "membranelles" described by Sutton in the midguts of two species of corixids has not been sufficiently proven. Some test must be devised which can distinguish between secreted and ingested chitin before this point can be settled. However, the discovery of a peritrophic membrane in *Ranatra,* in which ingested particles have never been observed, supports Sutton's conclusion that this structure is not absent in the Hemiptera. It may be, as she has suggested, that the Type I membrane is a primitive feature which has been inherited from the ancestral hemipteran. It seems quite possible that further study will reveal its presence in other species of the Hemiptera.

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THE FOOD PUMP OF *PELOCORIS* AND COMPARATIVE STUDIES ON OTHER AQUATIC HEMIPTERA

By Edwin P. Marks

Washburn University, Topeka, Kansas

Introduction

In earlier studies it has been found that in the Corixidae (Griffith 1945, Sutton 1951, Benwitz 1956, Marks 1958) and in the Notonectidae (Marks 1958) the buccopharyngeal pumps contain rather complicated armatures apparently derived from the remnants of the hypopharyngeal suspensorium. When the opportunity was provided to study this closely related form, therefore, it was quickly accepted. Twelve specimens of *Pelocoris femoratus* P.B. from ponds in the Cambridge, Mass. area were obtained. Several were killed in chloroform and dissected immediately. Three were cleared in caustic, lightly stained in acid fuchsin, and placed in glycerin. The last makes an excellent medium for dissection of both cleared and uncleared specimens because of both its property of rendering the material transparent, and its viscosity, which holds the specimen in place for drawing or photographing. The dissections were photographed by Dr. Thomas S. Parsons and then drawn by the author for the purpose of illustration.

Thanks are due to Dr. and Mrs. Parsons for their hospitality and their help with many technical details, and to Prof. Frank M. Carpenter and the Department of Biology of Harvard University for the facilities which made this study possible.

Description

When the ventral wall of the head is removed, the muscles of the stylets are exposed. These muscles and the attached stylets can be removed by gently withdrawing them from their attachments and sliding them out of the beak. This exposes the salivary pump, which is firmly embraced by the ventral arms of the hypopharynx (Plate 11, Fig. 1). The latter hold it in place and enclose the short duct leading to the stylets. The pump itself closely resembles that of *Belostoma* (Marks 1958). It is rather large and heavily constructed, which is somewhat surprising in so small a bug. The pump is operated by two powerful muscles which insert on the forked apodeme of the plunger of the pump and originate on the wings of the hypopharynx, one on either side of the food pump.

The food pump itself is found dorsal to the salivary pump, partially obscured by the latter and by the arms of the hypopharynx. Both of these can be removed by gently pulling them away. This exposes the ventral wall of the food pump for its entire length. From the ventral aspect it is somewhat triangular in shape (Plate 11, Fig. 1). It begins at the anterior end as a sheath around the food channel and widens gradually into the anterior or cibarial portion of the pump. This region extends approximately one half of the length of the pump. At this point it flares laterally to form the heavily scerotized pharyngeal portion of the pump. There is a dark, heavily sclerotized bar in this region which is visible through the floor of the pump. It arises from the dorso-lateral edges, and arches ventrally crossing the pump just in front of its widest point. This

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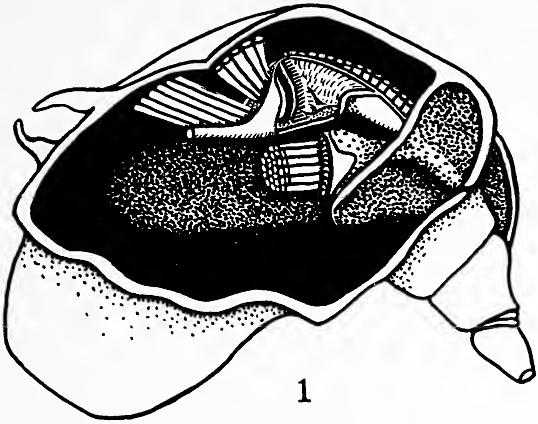
Explanation of Plate 10.

The head of *Pelocoris femoratus* P.B. Figure 1. Composite stereogram showing structure of pump and relationship with the rest of the head. Figure 2. Parasagittal section showing the lateral aspects of the food and salivary pumps. Figure 3. Sagittal section slightly lateral to the midline, showing the internal structure of the food and salivary pumps.

Abbreviations Used in Plates: AB — anterior sclerotized bar; AH — arms of hypopharynx; AP — apodeme of salivary pump; BP — bristle pouch; CM — cibarium; ES — esophagus; FG — frontal ganglion; FP — food pump; FR — floor of pump; G.1 — muscle group 1; G.2 — muscle group 2; G.3 — muscle group 3; HX — hypopharynx; LF — lateral fold; PB — posterior sclerotized bar; PX — pharynx; SB — sclerotized bar; SP — salivary pump; ST — setae-like teeth; TF — transverse fold; T.I — first toothed fold; T.2 — second toothed fold; WH — wing of the hypopharynx.



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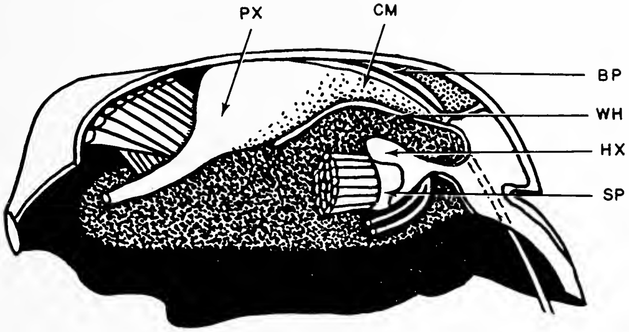

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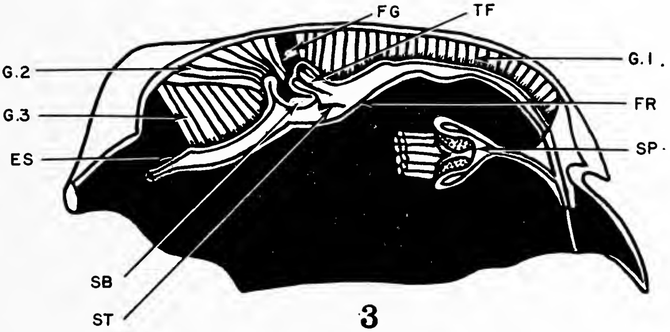

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Marks — Pelocoris femoratus P. B.

bar, however, belongs properly to the roof of the pump and will be described in detail later on. From this point the walls of the pump taper sharply, converging to form the entrance of the esophagus.

From a lateral view (Plate 10, Fig. 2) the pump is obscured at its juncture with the cranium, by the presence of the bristle pouches, which must be cut away to permit adequate inspection of the structures. The cibarial portion of the pump expands gradually for approximately half of the entire length. Then it bends ventrally, forming the enlarged pharyngeal portion in which the sclerotized bar is again plainly visible through the wall. Directly behind the bar, the dorsal edge of the ventral wall detaches from the cranium and descends to form the entrance to the esophagus. The large pharyngeal dilator muscles emerge below the esophagus at this point and attach to the posterior wall of the cranium.

If a head is placed on a block of paraffin with the dorsal side up and sectioned free hand along the midsagittal line with a very sharp blade, the two halves can be separated and examined under a stereoscopic microscope. If one half is placed in glycerin for a few hours, the tissues will partially clear showing the sclerotized structures in sharp relief. The other half preserved in alcohol will be better for the study of the muscles themselvs. Specimens fixed for a few hours in alcoholic Bouin's solution were used in studying the frontal ganglion as the picric acid in this fixative stains the muscles darker than it does the nervous tissue. The structures as seen in such a dissection are shown in Plate 10, fig. 3.

There are three discrete groups of muscles which operate the food pump. The first group, which is distinctly cibarial in origin, operates the delicate anterior portion of the pump. These muscles arise on the striated inner surface of the cranium and insert by means of slender sclerotized apodemes on the midline of the roof of the pump. The action of these muscles is obvious and direct. They raise the roof of the food channel and thus draw food from the stylets into the pump. This group of muscles, which will be referred to as "Group 1", consists of the dilators of the cibarium, and they extend approximately one half of the length of the pump. The second group of muscles is both longer and heavier than the first. It arises on the posterior angle of the cranium and inserts on a large apodeme, which attaches in turn to the sclerotized bar in the dorsal wall of the pump. This group of muscles lies behind the frontal ganglion and thus must represent the anterior dilators of the pharynx. These muscles will be referred to as "Group 2". They occupy approximately one-fourth of the length of the pump. The action of these muscles appears from micromanipulation to result in a rocking motion of the sclerotized bar so that the attached teeth sweep the floor of the pump. The third group of muscles is somewhat smaller than the others. These muscles, like the first group, insert on the midline of the roof of the pump by means of slender sclerotized apodemes. The muscles are somewhat longer and more slender than Group 1. They originate on the posterior angle of the vertex and make up the final one-fourth of the length of the pump. They serve to dilate the posterior pulsatile area, which carries food into the esophagus, and represent the posterior pharyngeal dilators. They will be referred to as "Group 3".

The membrane which makes up the roof of the pump varies in structure in the three portions of the pump. In the anterior portion, which is operated by the muscles of Group 1, the roof is a delicate membrane which is V-shaped in cross section. The dorsolateral edges are attached at the lateral margins of the pump and the dilator muscles are attached at the midline. This membrane is otherwise uncomplicated for the first one-third of its length. At this point an oblique fold appears in the lateral walls (Plate 11, Fig. 4) and extends dorsally and posteriorly nearly to the lateral edges. The walls of this fold are more heavily sclerotized than the surrounding area and are yellow-brown in color. The folds form a distinct landmark in the membrane. They possess no musculature, and will be called the lateral folds of the cibarium.

Posterior to these folds, the membrane curves dorsally, forming a deep transverse fold (Plate 11, Fig. 4). This fold contains in its cavity a series of secondary folds which are provided with toothed armatures (Plate 11, Fig. 3). The setae-like teeth are borne on lightly sclerotized ridges, which cross the membrane. There are three such ridges, the first of which is incomplete, extending only part way down the sides of the pump. The second ridge extends downward to the midline. These two ridges are completely enclosed in the transverse fold, and show only in a sagittal section, or when this fold is pulled open for inspection. The third ridge is the heaviest of all and occurs on the posteroventral edge of the fold where it is visible in the ventral or lateral view. This ridge is closely attached by a membrane to the heavily sclerotized transverse bar which lies immediately behind it. This bar is perhaps the most prominent structure in the dorsal wall. It consists of a heavily pigmented and sclerotized thickening in the dorsal membrane. It is comma-shaped in sagittal section with the tail of the comma extending dorsally and anteriorly. The toothed fold is attached by a membrane to this forward edge. At the posterior edge of the bar is found a second, less heavily sclerotized bar which is, in turn, attached to the one in front by a thin membrane. This second bar is provided with a large hollow apodeme on which muscle Group 2 inserts. Posterior to this apodeme, the roof of the pump becomes membranous again, closely resembling the structure found in the cibarial portion. It is V-shaped in cross section and the muscles attach along the midline by means of slender sclerotized apodemes. This region narrows sharply to form the entrance to the esophagus.

The floor of the pump is relatively simple. It is heavily and uniformly sclerotized along its entire length. As can

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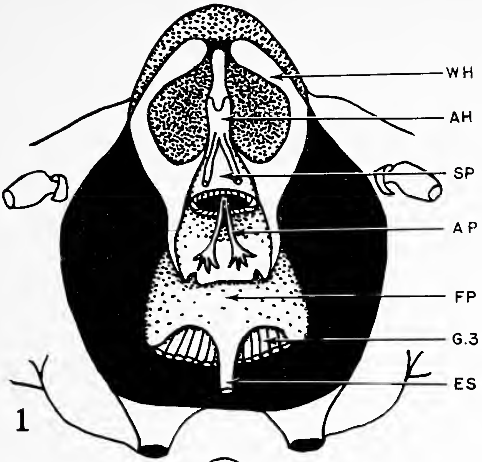
EXPLANATION OF PLATE 11.

Figure 1. Ventral view of the food and salivary pumps of *Pelocoris*. Figure 2. Lateral view of the food pump of *Notonecta* with the lateral wall of the floor of the pump cut away. Figure 3. Ventral aspect of the roof of the food pump of *Pelocoris* showing the transverse fold and the teeth. Figure 4. Lateral view of the food pump of *Pelocoris* with the lateral wall of the pump cut away. Figure 5. Ventral view of the roof of the pump of *Pelocoris* showing the armature and the lateral fold. Figure 6. Dorsal aspect of the roof of the pump of *Notonecta*. Figure 7. Dorsal aspect of the roof of the pump of *Hesperocorixa*.



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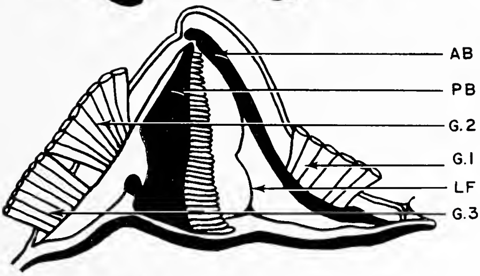

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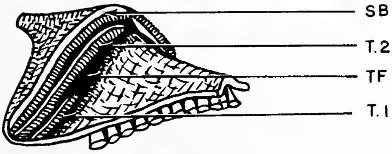

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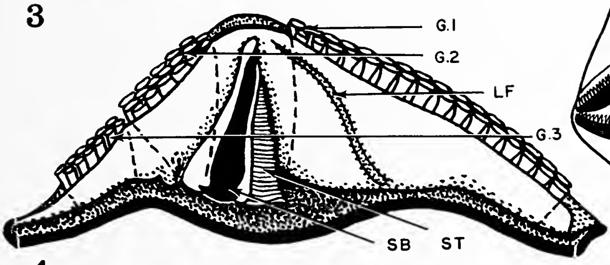

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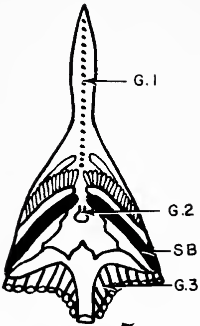

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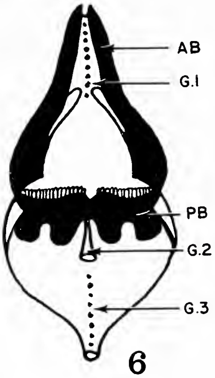

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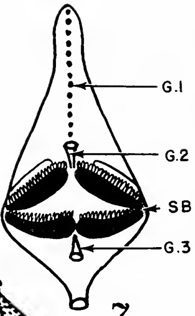

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MARKS — HEMIPTERAN FOOD PUMP

be seen in Plate 10, Fig. 2, it forms the rigid framework which permits an effective pumping action. With patience and care the floor of the pump can be loosened at the edges and gently lifted off. This exposes the ventral aspect of the roof of the pump, not otherwise visible. The structures exposed are shown in Plate 11, Fig. 5. Here one can see the relationships of the hard parts to the membrane and open up the transverse fold to expose the first and second toothed ridges, as shown in Plate 11, Fig. 3. Plate 11, Fig. 4, shows a lateral view with the side of the floor of the pump cut away. Here the setae-like teeth are seen in detail. They are strikingly like those found in *Notonecta,* which are shown in Plate 11, Fig. 2. Note that, in *Pelocoris,* the teeth associated with this bar are not directly connected to it as in *Notonecta,* but are instead attached to it by means of a membrane. The sclerotized bar does not articulate with the floor at the lateral margins, but instead ends in a membranous connection. There is no dorsal bar in the cibarial region as there is in *Notonecta.*

The purpose of this pharyngeal armature is not fully understood. It is not clear from the action of the parts exactly what role they play in the ingestion of the food. It may be supposed that the teeth serve some sort of straining function and perhaps act to break up clots in the food material. When the apodeme is worked back and forth the second set of teeth appears to rub over the third set much as one might clean a comb with a brush. Such action might be supposed to prevent the clogging of the teeth with food material during feeding. The action of the first set of teeth, which extends only part way down the sides, has not been determined. Plate 10, Fig. 1, shows a composite stereogram of the entire structure with the lateral wall of the pump cut away. It will help the reader to orient the various structures in relationship one with another and with the head as a whole.

Discussion

A detailed comparison of the pumps of *Notonecta, Pelocoris,* and *Hesperocorixa* is necessary before any assumptions can be made concerning the relationships between them. The reader is referred to the beautifully illustrated work of Benwitz (1956), and to the papers of Griffith (1945), Rawat (1939), Sutton (1951) and Marks (1958) for further information on these three groups. Since the subject of this paper is *Pelocoris,* it will serve as a point of reference and the other forms will be compared with it.

The cibarial portion of the food pump of *Pelocoris* is elongated as it is in the Corixidae, both groups having an elongated clypeal region. Correspondingly, in both groups the musculature of the cibarial region is highly developed and this region has assumed the largest part of the pumping function. In *Notonecta,* however, the clypeal region is relatively much shorter, and these muscles are only weakly developed. The pumping action is shared approximately evenly with the posterior pharyngeal pump. In all three insects there is a lateral oblique fold (Plate 11, Figs. 5, 6, and 7). This fold is figured by Rawat (1939) in *Naucoris* but is not mentionened in the text. It is not provided with muscles and appears to be a stiffening device enabling the entire membrane to respond to the pull of the muscles as a unit. Unfortunately Rawat's otherwise fine paper does not cover the pump of *Naucoris* in any detail.

The sclerotized armature is found posterior to this fold. In *Notonecta* the sclerotized, toothed bar is activated by a set of muscles which are apparently located anterior to the frontal ganglion (Griffith 1945). The position of this ganglion has been confirmed in this study. These muscles presumably represent the posterior cibarial dilators. In *Pelocoris* there is a strikingly similar toothed bar. The muscles which operate this latter bar, however, are behind the frontal ganglion and thus presumably represent the anterior pharyngeal dilators, raising some doubt that these two bars are actually homologous. In *Hesperocorixa* where there are two sets of bars (Plate 11, Fig. 7), the anterior bars are activated by the posterior cibarial dilators while the posterior set is activated by the anterior pharyngeal dilators, the frontal ganglion being located between the two apodemes· Sutton (1951) reports finding two types of food pumps in *Naucoris.* She describes the first type as follows: "Buccopharyngeal teeth are present, so similar in appearance to those of the Corixidae that from the sections through the buccopharyngeal regions it would be almost impossible to tell which genus was being examined" (page 489). The second type she characterized by "the presence of a small number of uniform teeth in the buccopharyngeal region". From the figures (fig. 5, page 474, and fig. 6, page 475) it is obvious that *Pelocoris* most closely resembles the second type. In all twelve specimens examined, the pumping apparatus was identical, there being apparently only one variety of this species in this area. In no case were specimens found which might be confused with corixids.

In the three insects examined there is a second pulsatile area which lies posterior to the armature. This area reaches its greatest development in *Notonecta* where it is as well developed as the cibarial pump. In *Pelocoris* it attains a modest development, but is not nearly as prominent as in *Notonecta.* In *Hesperocorixa,* muscle Group 3 is reduced to a few strands at the entrance to the esophagus. In all cases these muscles are well behind the frontal ganglion and thus represent the posterior pharyngeal dilators. The action of this area is apparently to pass food on from the pharyngeal region into the esophagus.

It is difficult to establish homologies between the parts of the sclerotized armatures of the three insects. At first appearance, when the preparations are studied from a ventral view (Plate 11, Figs, 5, 6, and 7), the homologies would appear to be as follows:

a. The anterior lateral bars of *Notonecta* are unique and do not appear in the other groups.

b. The posterior transverse bar of *Notonecta* appears homologous with the anterior transverse bar of *Hesperocorixa.* Both are activated by the posterior cibarial dilators. Both possess similar teeth. Both are posterior to the lateral constriction and the lateral fold.

c. The sclerotized bar of *Pelocoris* appears to be homologous to the posterior transverse bar of *Hesperocorixa.* Both are activated by the anterior pharyngeal dilators. Both occur at the point of greatest width of the pump. In both cases the apodeme is attached to an area behind the bar rather than to the bar itself.

If, however, one compares the lateral views of the armatures (Plate 11, Figs. 2 and 4) of *Notonecta* and *Pelocoris,* one is forcefully struck by the similarity of the transverse bars in these two groups. So striking is this similarity that the author carefully rechecked the positions of the muscles in relationshp to the frontal ganglion. The question then arises as to whether, in spite of the diffierence in the origin of the muscles attached to these bars, they are not actually homologous. It is possible that the present musculature of this bar in *Notonecta* may be a secondary condition due to a posterior shifting of a group of the cibarial dilators. This would account for the position of the frontal ganglion as well as the reduction of the pharyngeal dilators to their present condition. If this were the case, then the transverse bar of *Notonecta* would be homologous with the posterior transverse bar of *Hesperocorixa* and the transverse bar of *Pelocoris.* All three of the bars would be pharyngeal in origin. The anterior transverse bar of *Hesperocorixa* would then be homologous with the second tooth-bearing fold found in the transverse fold of *Pelocoris,* both being definitely cibarial in origin. At the present time there is not sufficient evidence available to uphold or eliminate either of these hypotheses.

Certain of these relationships do, however, appear to be significant. Certainly the appearance of such similar structures in closely related groups can scarcely be coincidental. These structures then should be of some significance in ascertaining the relationships between groups. From the very slender evidence available at this time, it would appear that *Pelocoris* shows features pertaining to both the notonectids and corixids. It is like *Notonecta* in such features as the single, heavy, toothed bar, and the well developed pharyngeal pulsatile area, while it is more like *Hesperocorixa* in the presence of secondary toothed folds and the highly developed cibarial pulsatile region.

This evidence, inconclusive as it is, tends to bear out the suggestion of China (1955) that the Naucoridae occupy a place in the phylogeny of the Hemiptera which gives them fairly recent common ancestry with the Notonectidae and the Corixidae, these two latter groups then pursuing diverging lines of specialization. Investigation of the pumps of various genera within these three families should provide valuable information concerning these relationships.

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THE ESOPHAGEAL VALVE OF SOME AQUATIC HEMIPTERA

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Only two previous comparative studies have been made on the esophageal valves of the aquatic Hemiptera. Sutton (1951) described this region in *Sigara falleni* Fieb. and *Corixa punctata* Ullig, and compared it briefly with the valves of naucorids and notonectids. More recently, Marks (1958) compared the esophageal valves of four species of aquatic Hemiptera, representing four different families; *Notonecta undulata* Say (Notonectidae), *Ranatra fusca* P.B. (Nepidae), *Belostoma flumineum* Say (Belostomatidae), and *Hesperocorixa escheri* (Heer) (Corixidae).

In the present investigation, the valves of the first three species of Marks were studied. The Corixidae used were *Sigara ornata* (Abbt.) and *Hesperocorixa interrupta* (Say); *Pelocoris femoratus* P.B., representing the family Naucoridae, was also examined. Both transverse and longitudinal serial sections through the valve were employed, the digestive tracts being fixed in aqueous Bouin's, alcoholic Bouin's, Held's, and Zenker's fluids and sectioned by the paraffin method. The stains most commonly used were Mallory's triple connective tissue stain, Mallory's phosphotungstic acid hematoxylin, and Delafield's hematoxylin and eosin.

The purposes of the present paper are (1) to compare the esophageal valve of *Pelocoris* with that of the other aquatic Cryptocerata, and (2) to offer a few comments on the works of Sutton (1951) and Marks (1958).

I wish to thank Mr. Edwin P. Marks and my husband, Dr. Thomas S. Parsons, for their valuable suggestions in connection with this problem. The research was carried out partly during the tenure of a National Science Foundation Predoctoral Fellowship and partly under the Ellen C. Sabin Fellowship, awarded by the American Association of University Women.

THE ESOPHAGEAL VALVE OF PELOCORIS FEMATORUS P.B.

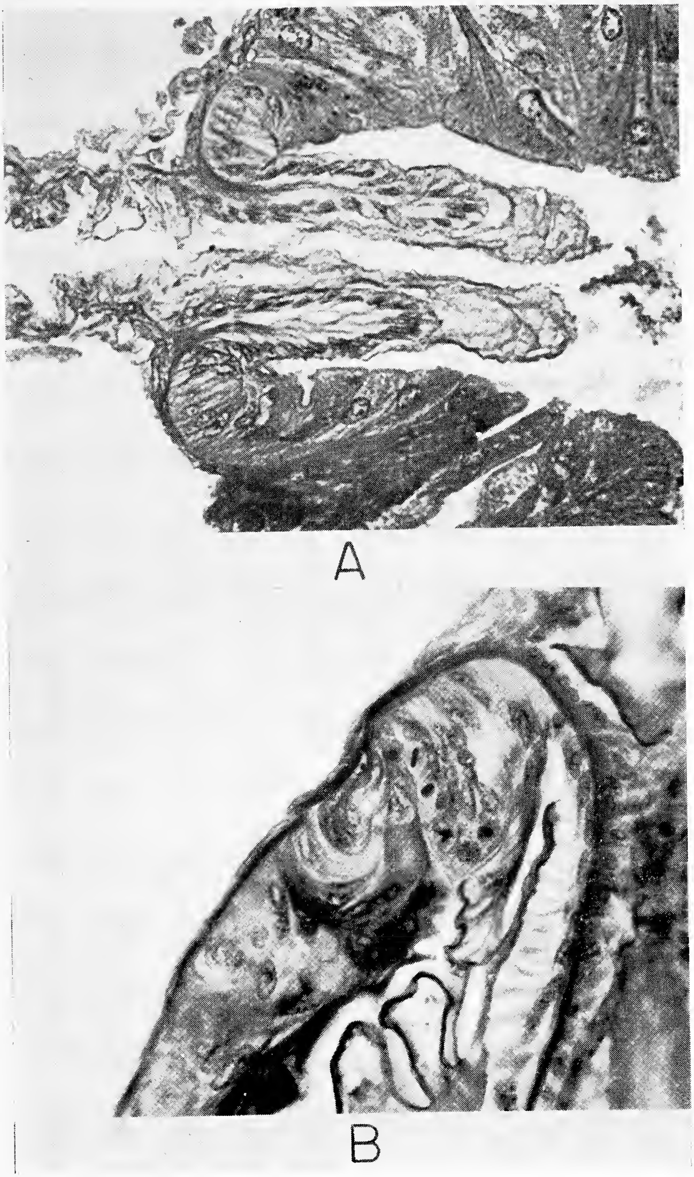
Figure A and Text-figure 2 show the general structure of the *Pelocoris* esophageal valve. The invagination consists of two layers of foregut epithelium, an inner and an outer one, which are continous with each other. The cells of the outer layer are somewhat taller than those of the inner one. In most of the specimens examined, the two layers are contiguous, but a few individuals show a small intravalvular space between them. Such intravalvular spaces contain fine connective tissue fibrils, but never muscle.

The cells of the outer cell layer become taller at the anterior limit of the invagination, where they gradually merge with the annular cells, a ring of tall cells encircling the foregut-midgut junction. This corresponds to the "terminal pad" of cells described by Marks in other water bugs, and will be discussed later. The annular cells, like those of the invagination, have basally located nuclei, and are covered by a cuticular intima which is continuous with that of the esophagus. The intima adheres closely to the annular cells, but is pulled away from the epithelium of the invagination to form a definite "entonnoir" (Aubertot, 1934), similar to, although not as pronounced as, that of the Corixidae. The entonnoir and the cells of the invagination are usually connected by fine strands of cuticula which run from the entonnoir to the spaces between the cells.

The cells at the posterior tip of the invagination usually contain, at their apical ends, large vacuoles. Such vacuoles occur less frequently in the more anteriorly located cells of the inner and outer cell layers or in the annular cells. Their presence appears to be connected with the secretion of the intima, since in many cases they seem to be passing from the cells into the space between the epithelium and the entonnoir.

EXPLANATION OF PLATE 12

Figure A. Photomicrograph of the esophageal invagination of *Pelocoris femoratus*. See Text - figure 2 for explantion. Held's, Delafield's hematoxylin and Eosin Y. 225 X. Figure B. Photomicrograph of the annular cell region of *Sigara ornata*. See Text - figure 3 for orientation. Aqueous Bouin's, Delafield's hematoxylin and Eosin Y. 600 X.



Parsons — Esophageal Valve of Hemiptera

Vacuoles similar to these may be seen in the cells at the tip of the invagination in *Hesperocorixa* and *Sigara*, but they are rarely found in *Belostoma, Notonecta,* or *Ranatra.* This suggests that they may be associated with the pulling away of the cuticula to form the entonnoir, a phenomenon found in corixids and in *Pelocoris* but not in the other three bugs. Vacuolated cells have been described in the esophageal valves of *Ptychoptera contaminata* (van Gehuchten, 1890), and in two species of aphids (Weber, 1928, and Miller, 1932), all of these having a cuticula which is somewhat separated from the cells of the invagination.

Sutton, after examining *Naucoris cimicoides*, concluded that there are two "varieties" of that species. The first of these, she stated, has a "long oesophageal valve" (Sutton, 1951, p. 489; she did not say how long), with a shorter entonnoir than that found in corixids, and possesses a definite corixid-like "proventriculus". The latter term is misleading, since it has been used by some authors to designate the "gizzard" of the foregut; in the present study, the "proventriculus" of Sutton, which is part of the midgut, will be called the "perivalvular region". In corixids it surrounds the esophageal invagination (Text-fig. 3), and is narrower in diameter than the more posterior part of the midgut, from which it is separated by a constriction. No such perivalvular region was found in any of the naucorids examined in this study.

Sutton found a second "variety" of *Naucoris cimicoides* in which there is no distinct perivalvular region and the esophageal valve is reduced to a vestige. In *Pelocoris,* all the esophageal invaginations appeared to be equally prominent. Whether *Pelocoris* is more similar to the first "variety" or the second "variety" of *N. cimicoides* cannot be definitely determined, since Sutton did not include illustrations of the valves of both of these; the lack of a differentiated perivalvular region in *Pelocoris*, however, suggests that it more closely resembles the second "variety". This theory is supported by the conclusion of Marks (in press) that the food pump of *Pelocoris* bears more similarity to the second "variety" of *N. cimicoides* than to the first.

NOTES ON THE ESOPHAGEAL VALVE OF OTHER AQUATIC HEMIPTERA

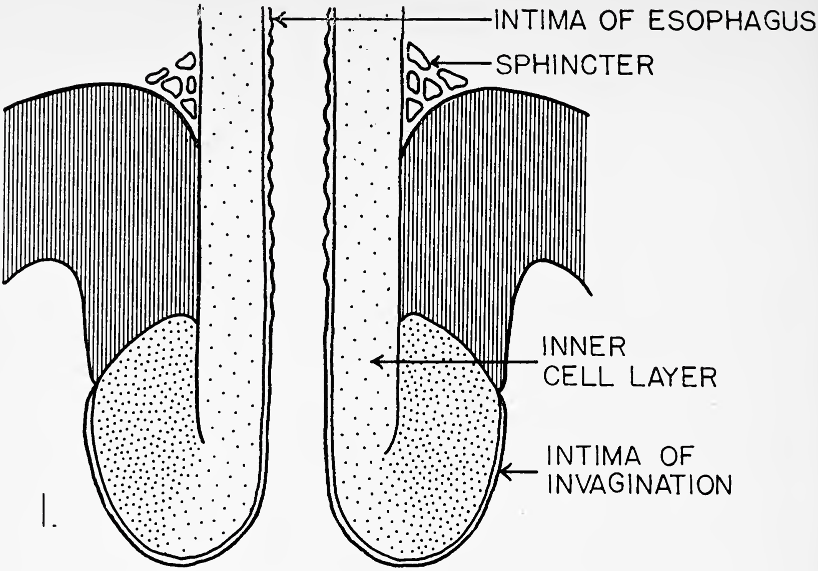
A. ESOPHAGUS

Since Marks' description of the histology of the cryptocerate esophagus was brief, a few additional observations may be mentioned here. The epithelium consists, as that author has stated, of a single layer of cuboidal cells, with an inner cuticular intima. It is surrounded by an inner circular and an outer longitudinal layer of muscle.

The present investigation has shown that the histology of the corixid esophagus differs somewhat from that of *Belostoma, Ranatra,* and *Notonecta.* The intima in the latter three adheres fairly closely to the esophageal cells; it generally has a scalloped appearance in section, the scallops more or less corresponding to the individual cells which secrete it. In these three bugs, the esophageal epithelium is usually quite folded, the folds projecting into the lumen. In *Sigara* and *Hesperocorixa,* on the other hand, the epithelium is less folded and the intima is pulled away from the cells, lying free and much folded in the lumen of the esophagus. In many preparations, the cells appear to be secreting additional layers of intima beneath the ones which fill much of the lumen.

It has been shown by other authors (Hungerford, 1917; Griffith, 1945; Sutton, 1951) that the corixids ingest particulate matter. In this respect they differ from the other Hemiptera, which, as far as has been demonstrated, take in only fluids. It may be that the pulling away of the esophageal cuticula and the secretion of additional layers beneath it is a protective phenomenon, shielding the epithelium from abrasion by particles.

The histology of the esophagus of *Pelocoris* resembles that of the fluid-feeding water bugs rather than that of the corixids. Although Sutton found that *Naucoris cimicoides* was able to ingest solid food, no particulate matter was observed in any of the *Pelocoris* guts in the present study.



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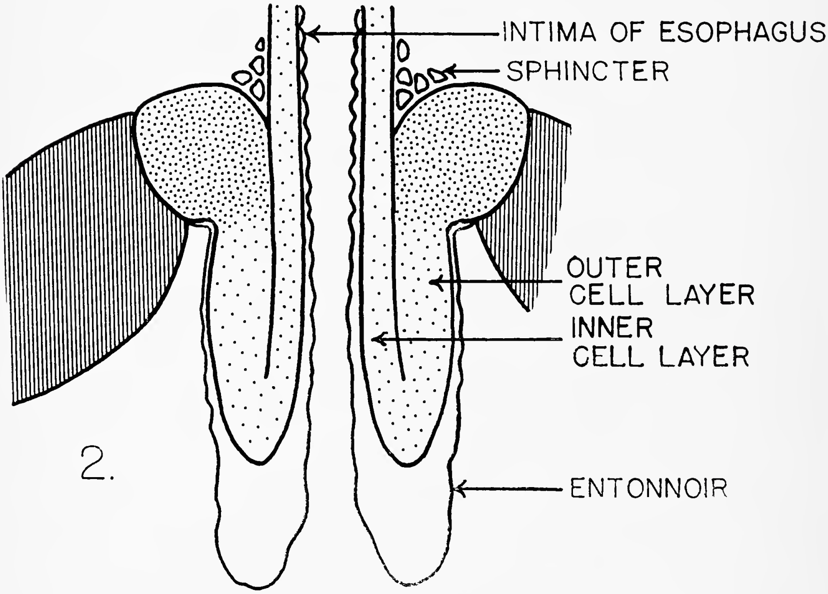

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Fig. 1. Diagram of the esophageal invagination of *Belostoma flumineum*. Heavy stippling indicates annular cell region; light stippling indicates rest of foregut epithelium; shading indicates midgut epithelium. Muscle is omitted except for that of the sphincter. 300X.

Fig. 2. Diagram of the esophageal invagination of *Pelocoris femoratus*. Legend same as for Text - figure 1. 375X.

B. ESOPHAGEAL VALVE

1. *Location of the Muscle*

In their studies of the esophageal valve of corixids, both Sutton and Marks described circular muscle strands within the intravalvular space of the invagination. In the present study, muscle was absent in this area in all 36 corixids examined. The muscle is limited to a strongly developed sphincter at the point where the esophagus enters the midgut (Text-fig. 3) and a less well developed longitudinal layer overlying this sphincter.

It is the author's belief that the "muscle strands" of Sutton and Marks were only fine connective tissue fibers; these are very common in the subepithelial tissue of the gut, and appear to run between the basement membrane of the epithelium and the sarcolemma of the muscle. Such fibers have been described in the connective tissue surrounding the gut of other insects (Rengel, 1896; Nazari, 1899; Leger and Duboscq, 1902). In the corixids, these connective tissue fibers, along with small tracheoles, penetrate the intravalvular space of the esophageal invagination, and may quite easily be mistaken for muscle strands (Mr. Marks has examined my material, and agrees with this conclusion).

2. *The Annular Cells*

In all five bugs, the junction of the foregut and midgut is encircled by a ring of tall foregut cells. These correspond to the "terminal pad" of Marks, who showed them in his figures of *Hesperocorixa, Belostoma, Ranatra,* and *Notonecta.* Sutton apparently mistook them for midgut cells, as Marks has pointed out.

Text-figure 3 shows the location of the annular cells in *Sigara* and *Hesperocorixa.* The annular cell region in corixids is more extensive than Marks' figures (1958, his plate VII, figures 1, 3, and 4) would indicate; the author has examined Marks' slides, and found that this region showed some distortion in his material, which probably accounts for this difference.

The most outstanding feature of the annular cells, which was overlooked by both Sutton and Marks, is their high mitotic rate. This is particularly evident in the corixids; one specimen of *Sigara ornata* showed 181 mitoses in the annular cell region. Figure B shows a detail of the annular cells in this specimen. Mitoses are not nearly as frequent in the annular cells of representatives of the other four families, although Table 1 (below) shows that some amount of cell division is always present.

TABLE 1

	A	B	C
Notonecta undulata	28	5	3
Ranatra fusca	17	3	8
Pelocoris femoratus	21	4	6
Belostoma flumineum	24	11	14
Hesperocorixa interrupta and *Sigara ornata*	36	28	181

Frequency of mitotic figures observed in the annular cell region. Column A, number of valves examined; Column B, number of valves showing mitoses in annular cell region; Column C, maximum number of mitoses seen in any one valve.

It is difficult to account for this high mitotic rate in corixids. Verson (1897) reported that in the silkworm, cell division in this region adds to the cells of the esophageal valve. However, degenerating cells are rarely observed within the esophagus or the esophageal invagination of corixids, and there appears to be no real need for such frequent cell addition. The location of the annular cells corresponds to that of the imaginal disc which regenerates the foregut of nymphs after a moult; it may be that the annular cells are remnants of this highly active nymphal region, which retain their high mitotic rates.

3. *Comparative Aspects*

In his study of the esophageal valves of four species of water bugs, Marks described a sequence of increasing complexity in the following order: *Notonecta, Ranatra, Belostoma,* and *Hesperocorixa*. In general, the present study supports this conclusion.

The valvular action in *Notonecta* and *Ranatra* is derived from the circular muscle sphincter which, when it contracts, draws together the tall annular cells. There is no real invagination in either of these bugs. The valves of *Notonecta* and *Ranatra* appear, to the author, to be equally simple, although Marks considered the latter to be somewhat more developed than the former.

The form of the valve in *Belostoma* is more complex (see Text-fig. 1). Here a shallow invagination is present, which may offer resistance to the passage of material from the midgut into the foregut. Although an inner cell layer is present, there is nothing corresponding to the outer cell layer of *Hesperocorixa* or *Pelocoris;* instead, the annular cells occupy the posterior and outer surfaces of the invagination.

The *Pelocoris* valve is more complicated than that of *Belostoma,* but less so than that of *Hesperocorixa* and *Sigara.* In its degree of complexity, therefore, it appears to be an intermediate between these two groups. The invagination is deeper than that of *Belostoma* but shallower than the invagination of corixids. The presence of an entonnoir indicates another advancement in complexity. In *Pelocoris* an outer cell layer is present, but the annular cell region appears to extend part way into the invaginated area, gradually merging with the tall cells of the outer cell layer (Text-fig. 2).

The increased length of the invagination, the prominence of the entonnoir, and the placement of the annular cells in the corixid valve make it the most complex of the five. Sutton's assertion that the entonnoir may extend as much as two-thirds of the length of the midgut was not borne out in the present study. The cuticula does extend farther into the midgut than in the other four bugs, but it was never observed to penetrate more than one-tenth the length of the mesenteron in the material used in the present study. In corixids, the annular cell region never extends into the invagination, as it does in *Belostoma* and *Pelocoris.* It is, instead, sharply set off from the outer cell layer, forming a distinct region which encircles the area between the termination of the invagination and the beginning of the midgut (see Text-fig. 3).

The conclusion of Sutton that the corixid esophageal invagination is long when the midgut contains small amounts of food, and either extended or retracted with large quantities, was not supported in the present study. In the four corixids with the shortest invaginations, the midgut was empty. Sutton's claim that the intravalvular space contains a blood sinus may be true, but there is no evidence from the present study to support her theory that the valve takes an active part in moving the food posteriorly into the midgut.

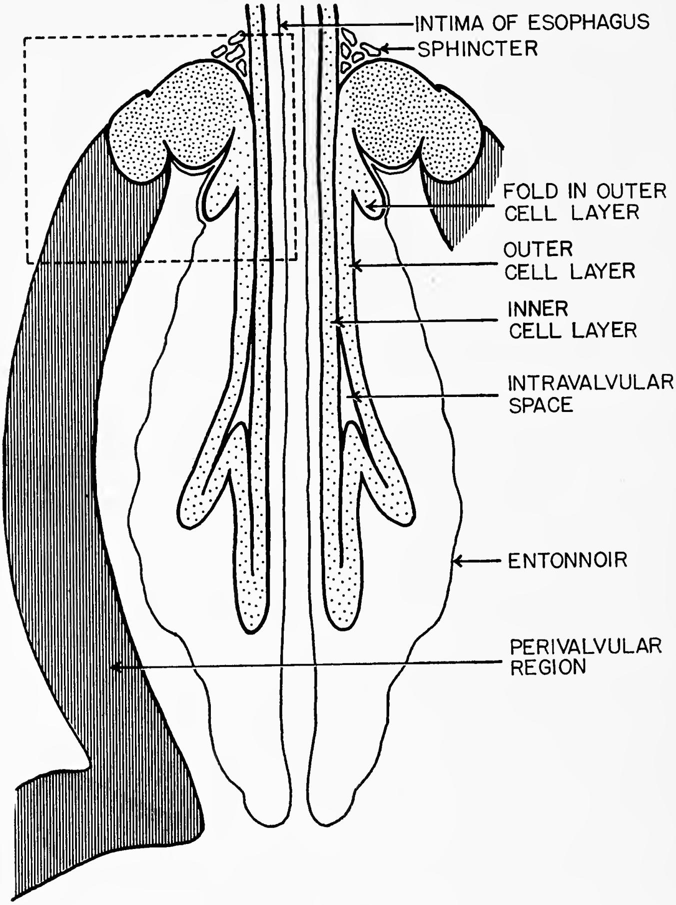

Fig. 3. Diagram of the esophageal invagination of *Sigara ornata* or *Hesperocorixa interrupta*. Legend same as for Text - figure 1. Dotted lines indicate region from which Figure B (Plate 12) was taken. 330X.

Although the increasing complexity of the valve, from *Notonecta* and *Ranatra* to the corixids, represents a morphological sequence, I, like Marks, will not here attempt to draw any phylogenetic conclusions. In terrestrial Heteroptera, both simple and complex esophageal valves are represented; in *Oncopeltus fasciatus,* the valve resembles that of *Notonecta* (Hood, 1937), while the esophageal invagination of the cacao capsid bug (Goodchild, 1952) is similar to that of corixids.

4. *Sutton's Interpretation of the Significance of the Corixid Esophageal Valve*

Sutton proposed that the complex valve of corixids is a primitive feature. This theory was based primarily on her belief that the primitive corixids secreted two kinds of peritrophic membranes, one from the cells of the posterior midgut (the Type I of Wigglesworth, 1950) and a second from the anteriormost midgut cells of the perivalvular region (Wigglesworth's Type II). Sutton's hypothesis was that modern corixids have lost the second type of membrane, but have retained the first type. The latter theory is to be the subject of another paper (Parsons, in press); the proposal that corixids once secreted a Type II membrane will be discussed here, however, since part of Sutton's evidence for this hypothesis is based upon an apparently incorrect interpretation of the nature of the annular cells.

When the ancestral corixid secreted a Type II peritrophic membrane, according to Sutton, a long esophageal invagination was present; this helped to mould the membrane and to move it posteriorly by alternate extension and retraction. The membrane was secreted by the anterior cells of the perivalvular region. In the course of evolution, the latter region has lost its ability to secrete chitin, but it has not yet acquired a digestive function. If any food were to get into this non-functional region, it would only decompose; to prevent this, Sutton claimed, the long esophageal invagination has been retained in modern corixids.

Sutton cited the work of Aubertot (1934), who, in his study of the peritrophic membrane in many orders of insects, distinguished a groove or "sillon" which marks the boundary between foregut and midgut. It is from the midgut cells directly posterior to this groove that the Type II peritrophic membrane is secreted, and the sillon marks its anteriormost point of insertion. This secretory group of midgut cells, the "massif des cellules-mères de la péritrophique" of Aubertot, is histologically distinct from the rest of the midgut in some insects.

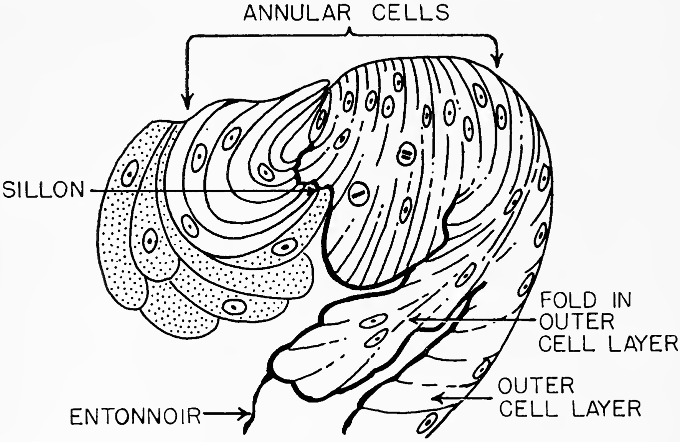

Fig. 4. Detail of the annular cell region in *Sigara ornata*. Heavy line indicates the cuticular intima of the foregut, with which the entonnoir is continuous. Orientation same as that of Figure B (Plate 12); the esophagus and inner cell layer are not shown. The midgut epithelium is stippled. 850 X.

It appears, however, that Sutton has mistaken the annular cells, which are definitely of foregut origin, for midgut epithelium, perhaps believing them to represent a "massif". In so doing, she has taken the groove between the annular cells and the esophageal invagination to be the sillon; this appears to be the case in her figure 10. In the present study, however, the intima was seen to cover the annular cells and to end at a point more posteriorly located than the sillon of Sutton's diagram. This area is quite complicated in corixids, since the annular cells which are closest to the migut bend inwards, towards the lumen, forming a whorl. The true sillon lies at the apices of these curved annular cells, and the terminal part of the intima therefore extends up into the whorl (see Text-fig. 4). There is rarely a distinct groove here, and the sillon is obscured by the close approximation of the whorl of annular cells with the anteriormost midgut cells.

The evidence cited by Sutton to support her theory of a Type II peritrophic membrane in the corixid ancestor appears to be two-fold: the presence of a distinct sillon in about half of her specimens, and the existence of a non-secretory perivalvular region in all of them. The present study casts considerable doubt upon her first piece of evidence, since the true sillon of corixids is not a distinct groove. Her observation of a non-secretory perivalvular region in corixids was correct, however, and will be discussed in a later paper. Whether or not this is sufficient evidence to support the idea that the corixids once secreted a Type II peritrophic membrane is difficult to say; it may be that the lack of a secretory function in this area is due to other causes. Certainly her theory that the long esophageal invagination is a device for keeping food out of this region is open to question; long valves are present in *Anasa tristis* (Breakey, 1936) and the cacao capsid bug (Goodchild, 1952), neither of which has a non-secretory perivalvular region.

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